Exelon Generation.

Order No. EA-12-049

RS-16-202
RA-16-087

December 6, 2016

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

Oyster Creek Nuclear Generating Station
Renewed Facility Operating License No. DPR-16
NRC Docket No. 50-219

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 1, dated January 22, 2016
3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 2, dated December 2015
4. Exelon Generation Company, LLC's Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated October 25, 2012
5. Exelon Generation Company, LLC Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2013 (RS-13-023)
6. Exelon Generation Company, LLC First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2013 (RS-13-125)
7. Exelon Generation Company, LLC Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2014 (RS-14-013)

8. Exelon Generation Company, LLC Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2014 (RS-14-211)
9. Exelon Generation Company, LLC Fourth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 27, 2015 (RS-15-022)
10. Exelon Generation Company, LLC Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2015 (RS-15-213)
11. Exelon Generation Company, LLC Sixth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 26, 2016 (RS-16-025)
12. Exelon Generation Company, LLC Seventh Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 26, 2016 (RS-16-148)
13. NRC letter to Exelon Generation Company, LLC, Oyster Creek Nuclear Generating Station – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049, (Mitigation Strategies) (TAC No. MF0824), dated February 19, 2014
14. 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
15. Exelon Generation Company, LLC letter to USNRC, Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness – Staffing, Requested Information Items 1, 2, and 6 - Phase 2 Staffing Assessment, dated May 11, 2016 (RS-16-098)
16. NRC letter to Exelon Generation Company, LLC, Oyster Creek Nuclear Generating Station – 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. MF0824), dated August 29, 2016

On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events," (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directed EGC to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event. Specific requirements are outlined in Attachment 2 of Reference 1.

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

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. References 6, 7, 8, 9, 10, 11, and 12 provided the first, second, third, fourth, fifth, sixth, and seventh six-month status reports, respectively, pursuant to Section IV, Condition C.2, of Reference 1 for Oyster Creek Nuclear Generating Station.

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 Oyster Creek Nuclear Generating Station.

Oyster Creek Nuclear Generating Station 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 Oyster Creek Nuclear Generating Station with Reference 1.

OIP open items have been addressed and closed as documented in References 6, 7, 8, 9, 10, 11, 12, and below, and are considered complete pending NRC closure. EGC's response to the NRC Interim Staff Evaluation (ISE) confirmatory items identified in Reference 13 have been addressed and closed as documented in References 7, 8, 9, 10, 11, 12, and 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 Reference 16, and below, and are considered complete pending NRC closure. The following tables provide completion references for each OIP open item, NRC ISE confirmatory item, and NRC Audit Report open item.

Overall Integrated Plan Open Items

Sequence of events (p. 10-12)	The times to complete actions in the Events Timeline are based on operating judgment, conceptual designs, and current supporting analyses. The final timeline will be time validated once detailed designs are completed and procedures developed.	Reference 12 and updated with this submittal as provided below.
Sequence of events (p. 11-12)	Initial evaluations were used to determine the fuel pool timelines. Formal calculations will be performed to validate this information during development of the spent fuel pool cooling strategy detailed design.	Reference 12
Identify how strategies will be deployed in all	1. Transportation routes will be developed from the equipment storage area to the FLEX staging areas.	Reference 12 and updated with this submittal as

modes (p. 13)	2. Identification of storage areas is an open item. 3. An administrative program will be developed to ensure pathways remain clear. Compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation.	provided below.
Identify how the programmatic controls will be met (p. 14)	An administrative program for FLEX to establish responsibilities, and testing and maintenance requirements will be implemented.	Reference 12 and updated with this submittal as provided below.
Maintain Spent Fuel Pool Cooling (p. 36)	Complete an evaluation of the spent fuel pool area for steam and condensation.	Reference 12 and updated with this submittal as provided below.
Safety Functions Support (p. 44)	Evaluate the habitability conditions for the Main Control Room and develop a strategy to maintain habitability.	Reference 12 and updated with this submittal as provided below.
Safety Functions Support (p. 44)	Develop a procedure to prop open battery room doors upon energizing the battery chargers to prevent a buildup of hydrogen in the battery rooms.	Reference 12
Sequence of events (p. 10)	Issuance of BWROG document NEDC-33771P, "GEH Evaluation of FLEX Implementation Guidelines," on 01/31/2013 did not allow sufficient time to perform the analysis of the deviations between Exelon's engineering analyses and the analyses contained in the BWROG document prior to commencing regulatory reviews of the Integrated Plan.	Reference 6
Baseline coping capability (p. 27)	In response to NRC Order EA-12-049 and implementation of EPG/SAG Rev 3, containment venting is not required for FLEX. Modifications and capabilities of the Hardened Vent System will be in accordance with OC extension request for EA-13-109.	Reference 12

Interim Staff Evaluation Confirmatory Items

Item No. 3.1.1.3.A	Reference 12
Item No. 3.1.1.4.A	Reference 12
Item No. 3.1.2.2.A	Reference 9
Item No. 3.1.3.1.A	Reference 12
Item No. 3.1.3.1.B	Reference 12 and updated with this submittal as provided below
Item No. 3.1.3.2.A	Reference 12
Item No. 3.2.1.1.A	Reference 9
Item No. 3.2.1.1.B	Reference 9
Item No. 3.2.1.1.C	Reference 9
Item No. 3.2.1.1.D	Reference 9
Item No. 3.2.1.1.E	Reference 9
Item No. 3.2.1.3.A	Updated with this submittal as provided below
Item No. 3.2.4.2.A	Reference 12 and updated with this submittal as provided below
Item No. 3.2.4.4.A	Reference 12 and updated with this submittal as provided below
Item No. 3.2.4.8.A (1)	Reference 12
Item No. 3.2.4.8.A (2)	Reference 12
Item No. 3.2.4.8.B	Reference 12
Item No. 3.2.4.10.A	Reference 12
Item No. 3.4.A	Reference 12

NRC Audit Report Open Items

Audit Open Item	Completion Response Reference
ISE CI 3.2.4.2.A	Reference 12 and updated with this submittal as provided below
ISE CI 3.2.4.8.B	Reference 12
AQ 18	Updated with this submittal as provided below
AQ 19	Updated with this submittal as provided below
AQ 39	Updated with this submittal as provided below
AQ 41	Updated with this submittal as provided below
SE 5	Updated with this submittal as provided below
SE 9	Updated with this submittal as provided below

The following table provides completion information for the remaining open items listed above. As previously stated, EGC considers these items to be complete for Oyster Creek Nuclear Generating Station.

Item	Description	Reference
OIP Open Item: Sequence of events (p. 10-12) The times to complete actions in the Events Timeline are based on operating judgment, conceptual designs, and current supporting analyses. The final timeline will be time validated once detailed designs are completed and procedures developed.	Detailed designs are completed, and procedures have been developed. The time validation process was completed and documented in OP-OC-118-1001, "Oyster Creek FLEX VALIDATION Plan", on September 30, 2016. Performance of the required tasks in response to the adverse conditions in a BDBEE has been validated and demonstrated that personnel are able to respond and perform successfully. This is due to the numerous performance attributes considered, including evaluations of the environmental factors (seismic, flooding, extreme heat, extreme cold and wind) in accordance with NEI 12-06. Validation of the tasks using multiple and diverse personnel provides additional confirmation of human action feasibility. Use of standardized mechanical connections, standardized and color coded electrical connections, use of placards, enhanced labeling, and specific procedures or guidelines which will, as appropriate, include diagrams/pictorial references provides additional assurance of successful implementation. The straightforward nature of the tasks will require no new skills to be acquired and would be considered normal journeyman knowledge. Plant personnel typically use Personal Protection Equipment (PPE) on a daily basis and there would be no introduction of a new variable in carrying out these tasks. Emergency Operating Procedures/Abnormal Operating Procedures (EOP/AOP) provide	Complete

	the decision making guidance for initiation of the FLEX guidelines. Operations personnel are well versed in maneuvering through EOP/AOP procedure steps. Indications for the diagnosis are readily available in the control room. OP-OC-118-1001 (Oyster Creek FLEX VALIDATION Plan) has been posted on the ePortal.	
OIP Open Item: Identify how strategies will be deployed in all modes (p. 13) 1. Transportation routes will be developed from the equipment storage area to the FLEX staging areas. 2. Identification of storage areas is an open item. 3. An administrative program will be developed to ensure pathways remain clear. Compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation.	1. Complete: Four transportation routes have been defined from two FLEX storage pad locations inside the Protected Area. Two transportation routes from each storage pad location have been established to support 360 degree deployment capability. Transportation routes have been defined in FSG-05, "FLEX Equipment Deployment and Debris Removal." FSG-05 has been posted on the ePortal. 2. Complete: Two storage pads locations have been identified within the protected area: 1) SE location, and 2) NW location. Identification of storage areas have been defined in FSG-05 (Debris Removal and FLEX Equipment Deployment). 3. Complete: ATI 1672697-24 was completed on 9/16/16 to ensure pathways remain clear or compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation. Administrative program control information relative to ensuring pathways remain clear or the implementation of compensatory actions is contained in OCGS program document: CC-OC-118. The deployment of FLEX equipment is governed under FSG-05, "FLEX Equipment Deployment and Debris	<u>Complete</u>

	Removal." Evaluations of FLEX equipment travel paths relative to different conditions/hazards are detailed in FSG-05 Attachment FSG-05-05 "Evaluation of Potential Travel Path Debris with each Hazzard." A contingency exists where SE Storage pad FLEX equipment is staged in the TBTB (Turbine Building Truck Bay) which is seismically robust, and the NW Storage pad FLEX equipment is staged in LLRW (Low Level Radwaste Building) upon warning of a potential hurricane event. This action will be governed using OP-OC-108-109-1001, "Severe Weather Preparation T&RM For Oyster Creek." Procedures CC-OC-118, FSG-05, and OP-OC-108-109-1001, are posted on the ePortal.	
OIP Open Item: Identify how the programmatic controls will be met (p. 14) An administrative program for FLEX to establish responsibilities, and testing and maintenance requirements will be implemented.	OCGS FLEX equipment will be tested to ensure it performs its functions prior to accepting the equipment. After acceptance testing, the equipment will be maintained and tested per PMs created using Exelon PM program templates. Exelon's PM program templates were created based on EPRI template recommendations and vendor recommendations. Shelf life of spare parts will be handled by the preventive maintenance program as laid out in the FLEX Program Document. ATI #1672697-50 completed on 9/14/16 to establish the replacement frequency of all spare parts based on shelf life duration. Evaluation A2326264 E14 was completed 9/16/16 for development of the OC Program Document CC-OC-118. Procedure CC-OC-118 is the administrative document that controls FLEX implementation at OCGS. Procedure CC-OC-118 is posted on the ePortal.	<u>Complete</u>

OIP Open Item: Maintain Spent Fuel Pool Cooling (p. 36) Complete an evaluation of the spent fuel pool area for steam and condensation.	The OCGS strategy is to run hoses and perform any actions for SFP makeup prior to the boiling of the SFP. These actions are to be performed within 6 hours of the onset of the event. OCGS has created a FLEX Support Guideline FSG-18,"Lower Reactor Building Temperature – Post BDBEE" to provide a vent pathway for the steam/condensate from the boiling of the SFP (119' elevation). The flow path includes the hatch on the 119' elevation which is open to the 23' elevation. On the 23' elevation, doors will be propped open (to atmosphere). On the roof of the 119' elevation, there is a roof hatch door (to the atmosphere) that will be opened, which will create the chimney effect. Evaluation A2392457 E16 for spent fuel area stay times for the temperature and condition expected during an ELAP event, completed on 8/17/16. FSG-18, "Lower Reactor Building Temperature – Post BDBEE," and Evaluation A2392457 E16 have been posted on the ePortal.	Complete
OIP Open Item: Safety Functions Support (p. 44) Evaluate the habitability conditions for the Main Control Room and develop a strategy to maintain habitability.	GOTHIC calculation EXOC049-CALC-001, Control Room Flex Heat Up to evaluate the heat-up rate for the Main Control Room was completed per evaluation 2656138-11 on August 15, 2016. Per the GOTHIC calculation, Main Control Room ventilation will be established prior to exceeding 30 hours. Strategies relative to the evaluation have been incorporated into the FSG-15, "Establishing MCR and Battery Room Ventilation." GOTHIC calculation EXOC049-CALC-001 and FSG-15 have been posted on the ePortal.	Complete
ISE CI 3.1.3.1.B Confirm qualified storage locations for the hurricane and extreme snow and icing	ATI 02656138-07 documented the OCGS FLEX Protection Matrix. Section 8.3.1 of the Protection Matrix states the FLEX equipment will be relocated to the Turbine Building and the N+1 set located in the Low Level	Complete

hazards are identified.	Radwaste Building truck bay. PCRA 1672697-36 was completed to revise OP-OC-108-109-1001, Severe Weather Preparation, to move the equipment as needed. ATI 02656138-09 completed to provide a vehicle (Kubota Front End Loader) that provides the same debris removal and deployment capability as the F750. Aditional the ATI ensure that the other functions of the F750 were evaluated. An additional portable Fuel Storage tank for the NW pad was purchased to be able to match all the capabilities of the F750. ATI 2656138-07, OCGS FLEX Protection Matrix, is posted on the ePortal.	
ISE CI 3.2.1.3.A The SOE final timeline will be time validated once detailed designs are completed and procedures are developed. The licensee should provide the results for NRC staff review.	Detailed designs have been completed. FSGs (FLEX Support Guidelines) were established to implement all FLEX actions on September 1, 2016. SOE final timeline validation process completed September 30, 2016, and the results were incorporated into OP-OC-118-1001, "OC FLEX Validation Plan." OP-OC-118-1001 is posted on the ePortal.	<u>Complete</u>
ISE CI 3.2.4.2.A The licensee stated that battery room ventilation to address high/low temperatures and prevention of hydrogen buildup will be addressed through procedure changes and that the proposed methods of ventilation, open doors and fans, will be confirmed during the detailed design process.	GOTHIC calculations EXOC049-CALC-002, (A/B Battery Room Flex Heat Up), and EXOC049-CALC-004, (4160V and Battery Room C Heat Up for BDBEE with Extended Loss of AC Power) were completed August 5, 2016 under ATIs 2656138-12 and 2656138-13 to address High/ Low temperature limits in the battery rooms. Per the GOTHIC calculations, A/B Battery Room ventilation will be established prior to exceeding 86 hours. Strategies relative to the evaluation have been incorporated into FSG-15, "Establishing MCR and Battery Room Ventilation." Per calculation C-1302-735-E320-050, C Battery Room ventilation will be established prior to exceeding 30 hours. Strategies relative to the evaluation have been	<u>Complete</u>

	incorporated into the FSG-15, "Establishing MCR and Battery Room Ventilation". Per Caculation C-1302-735-E320-050, Rev 0 "Oyster Creek Batteries A, B, and C Hydrogen Calculation" the limits for Hydrogen Buildup are as follow: Battery Room A/B – reach 1% Hydrogen without ventilation: 77F – 218.5 hours 100F – 87.4 hours Battery Room C – reach 1% Hydrogen without ventilation: 77F – 78.0 hours 100F – 31.2 hours All actions contained in FSG-15, "Establishing MCR and Battery Room Ventilation," will prevent Hydrogen Buildup for indefinet coping. The following were posted on the ePortal GOTHIC Calc EXOC049-CALC-002, GOTHIC Calc EXOC049-CALC-004 FSG-15 C-1302-735-E320-050, Rev. 0	
ISE CI 3.2.4.4.A The NRC staff has reviewed the licensee communications assessment (ADAMS Accession Nos. ML12306A199 and ML13056A135) in response to the March 12, 2012 50.54(f) request for information letter for OCNGS and, as documented in the staff analysis (ADAMS Accession No. ML13114A067) 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	Satellite phones have been purchased for offsite communications. On site, the sound powered phones have been staged in appropriate locations and the radio repeater located in the Upper Cable Spreading Room is powered from a generator located on or near the Heater Bay roof. ATI 1672697-34 was completed on September 23, 2016 to verify all communications upgrades have been implemented using FSG-21, "FLEX Communications." This procedure incorporates all the actions required to utilize FLEX communication equipment. FSG-21, "FLEX Communications" has been posted on the ePortal.	<u>Complete</u>

maintained. Verification of required upgrades has been identified as a confirmatory item.		
AQ 18 - The Integrated Plan does not contain sufficient analytical results to support the conclusions that the predictions of the code(s) used are consistent with expected plant behavior and that core cooling would be maintained by performing the identified actions within their time constraints. Provide, on the portal, the relevant calculations that demonstrate adequate core cooling for NRC staff review (e.g., reactor pressure vesselwater level, pressure and temperature, etc.)	MAAP #7 in OC-MISC-010 R1 (MAAP Analysis to Support FLEX Initial Strategy) contains sufficient analytical results. Conservative evaluations within MAAP #7 have concluded that Primary Containment temperature and pressure will remain below containment design limits and that key parameter instruments subject to the containment environment will remain functional for a minimum of 7 days. Critical inputs to the analysis are as follows: • Both Isolation Condensers (ICs) are credited for 1.5 hours • 50°F/hour cooldown rate, alternating ICs • IC shell side makeup begins at 1.5 hours • Reactor vessel injection begins at 3.3 hours @ 100 gpm • The reactor coolant leakage ≤35 gpm at normal operating conditions Per MAAP #7 (Case 7), peak suppression pool temperature is 98°F, peak Torus airspace temperature is 106°F, peak Torus airspace pressure is 28.2 psia, peak Torus level is 12.4 feet, peak Drywell airspace temperature is 261°F, and peak Drywell pressure is 29.8 psia. Therefore, at no time in the MAAP analysis are the HCTL, PSP, DW temperature or Torus Load Limit exceeded. Additionally, primary containment venting is not required. OC-MISC-010 R1 is posted on the ePortal.	Complete
AQ 19 - The licensee identified that four out of five recirculation pumps will be isolated at 3 hours post ELAP and the	The reactor water level and the primary containment analysis assumes a reactor coolant leak of 35 gpm per MAAP #7 in OC-MISC-010 R1 (MAAP Analysis to Support	Complete

electromagnetic relief valves are not used when the isolation condensers are utilized. The licensee did not identify what the assumed recirculation pump seal leakage was or the basis of the assumption.	FLEX Initial Strategy). Because OCGS uses the same CAN2A seals, the seal performance evaluation is the same as NMP1. The OCGS reactor recirculation pump CAN2A seals are assumed to leak a total of 20 gpm (gallons per minute) for all five recirculation pumps (NMP1 recirculation pump seal performance evaluation was completed that supports the assumed leakage rate). Taking this RCP (Recirculation Pump) seal leak rate of 20 gpm, and adding normal site operating drywell leak rates for identified leakage (approximately 4 gpm) and unidentified leakage (approximately 1 gpm), the total reactor coolant leak rate would be approximately 25 gpm. Therefore, using 35 gpm per the MAAP #7 analysis is a conservative value.	
AQ 39 - Because the strategy and associated support analyses have not been completed, there is insufficient information to conclude that the habitability limits of the control room will be maintained in all Phases of an ELAP. The staff needs to review postulated outside air temperature, the heat loads from personnel in the control room, and qualification of equipment used in mitigation. Licensee to demonstrate through analysis that the heat-up rate for the Main Control Room during an ELAP will be maintained habitable to support operator actions. If procedures are used to document personnel actions, a description of what actions are taken should also be provided.	GOTHIC calculation EXOC049-CALC-001, "Control Room Flex Heat Up," to evaluate the heat-up rate for the Main Control Room was completed per evaluation 2656138-11 on August 15, 2016. Per the GOTHIC calculation, Main Control Room ventilation will be established prior to exceeding 30 hours. Strategies relative to the evaluation have been incorporated into the FSG-15, "Establishing MCR and Battery Room Ventilation". This FSG gives operators guidance on how to restore Main Control Ventilation during a FLEX event prior to exceeding the 30 hours. GOTHIC calculation EXOC049-CALC-001 and FSG-15 have been posted on the ePortal.	Complete
AQ 41 - Provide information on the adequacy of the ventilation	GOTHIC calculations EXOC049-CALC-002, "A/B Battery Room Flex Heat Up," and	Complete

provided in the battery room to protect the batteries from the effects of extreme high and low temperatures. Licensee to provide an analysis to evaluate the temperature changes in the battery rooms during an ELAP, and any procedures that direct action to be taken.	EXOC049-CALC-004, (4160V and Battery Room C Heat Up for BDBEE with Extended Loss of AC Power) were completed August 5, 2016 under ATIs 2656138-12 and 2656138-13. Results of the GOTHIC calculations have been incorporated into FLEX Support Guidelines. Per the GOTHIC calculations, A/B Battery Room ventilation will be established prior to exceeding 86 hours. Strategies relative to the evaluation have been incorporated into procedure FSG-15: "Establishing MCR and Battery Room Ventilation." Per calculation C-1302-735-E320-050, C Battery Room ventilation will be established prior to exceeding 30 hours. Strategies relative to the evaluation have been incorporated into procedure FSG-15, "Establishing MCR and Battery Room Ventilation." The following were posted on the ePortal: GOTHIC Calc EXOC049-CALC-002 "A/B Battery Room FLEX Heat", GOTHIC Calc EXOC049-CALC-004 "4160V and Battery Room C Heat p fpr BDBEE with Extended Loss of AC Power", FSG-15, "Establishing MCR and Battery Room Ventilation."	
SE 5 - Discuss all areas of where local manual actions are credited in FLEX strategies Can operators safely enter these areas to complete necessary actions during extreme hot and cold hazard during an ELAP? (heat, cold, humidity, etc.) Are these actions feasible based on ELAP conditions and time constraints? Will sufficient lighting be available to complete tasks	GOTHIC calculation EXOC049-CALC-001, "Control Room Flex Heat Up," to evaluate the heat-up rate for the Main Control Room was completed per evaluation 2656138-11 on August 15, 2016. Per the GOTHIC calculation, Main Control Room ventilation will be established prior to exceeding 30 hours. Strategies relative to the evaluation have been incorporated into FSG-15, "Establishing MCR and Battery Room Ventilation." GOTHIC calculation EXOC049-CALC-003, "480V Switchgear Room Flex Heat Up," to evaluate the heat-up rate of the 480VAC	Complete

(e.g., portable lighting, headlamps, flashlights, etc.) Is communication with control room possible based on noise in area of local manual actions? Will portable ventilation be established? When will it be established? Licensee to provide an assessment of personnel habitability during an ELAP to demonstrate that plant personnel are able to perform necessary actions.	Room was completed per evaluation 2656138-14 on August 15, 2016. Per the GOTHIC calculation, with no mitigation actions taken, the 480VAC Room will not exceed 124°F within 72 hours. The calculation finds that with no mitigation actions taken, the opening of access doors at ≤50 hours will prevent the 480VAC Room from exceeding 120°F. FSG-06, "FLEX 480V Cable Deployment and Connection," will be executed and complete by ≤2.5 hours, establishing the propping open of the 480VAC Room Access Doors. GOTHIC calculations EXOC049-CALC-002, "A/B Battery Room Flex Heat Up," and EXOC049-CALC-004, "4160V and Battery Room C Heat Up for BDBEE with Extended Loss of AC Power" were completed August 5, 2016 under ATIs 2656138-12 and 2656138-13. Per the GOTHIC calculations, A/B Battery Room ventilation will be established prior to exceeding 86 hours. Strategies relative to the evaluation have been incorporated into FSG-15, "Establishing MCR and Battery Room Ventilation." Per calculation C-1302-735-E320-050, C Battery Room ventilation will be established prior to exceeding 30 hours. Strategies relative to the evaluation have been incorporated into the FSG-15, "Establishing MCR and Battery Room Ventilation." Evaluation A2392457 E16 for spent fuel pool area for steam and condensation was completed on August 17, 2016. This evaluation was for the highest Reactor Building elevation (RB 119') where manual actions are taken. All other manual actions are below the RB 119' elevation (RB 23,' RB 51,' RB 75,' and RB 95') and are, therefore, bounded (heat naturally rises) by this evaluation. Per ATI 2392457-64, a walkdown for the	

	adequacy of supplemental lighting and for the adequacy and practicality of using portable lighting to perform FLEX strategy actions was performed. This walkdown included travel paths to various areas necessary to implement the FLEX strategies, making required mechanical and electrical connections, performing instrumentation monitoring, and component manipulations. Battery Powered (10CFR50 Appendix "R") emergency lights were determined to provide adequate lighting for most Primary FLEX connection points in the FLEX strategies, including the illumination of interior travel pathways needed to access the connection points. These emergency lights are designed and periodically tested to insure the battery pack will provide a minimum of eight (8) hours of lighting with no external AC power sources. For the FLEX areas requiring lighting not covered by Appendix "R," those areas will have available lighting using non-appendix "R" DC lighting, and using the portable flashlights carried by station operators. It is proceduralized in OC-OP-100-101, "Shift Coverage Guidelines," that station plant operators carry with them at all times, as part as their gear, a portable handheld flashlight. Communication with the Main Control Room is possible. Due to the ELAP condition, AC power is lost; therefore, all AC equipment noise is not present. Both the FLEX pump and the FLEX generator are staged at outside locations well away from internal locations where manual actions are taken. Therefore, no external noise created by the FLEX pump or generator will affect FLEX communications. Gothic Calculations EXOC049-CALC-001, EXOC049-CALC-002, EXOC049-CALC-003, EXOC049-CALC-004, and Evaluation A2392457 E16 were completed by August 15, 2016. From these calculations and evaluations, this information was accessed and inserted in OCGS FLEX Support	

	Guidelines using FLEX portable ventilation equipment, or creating a natural ventilation draft by opening access doors and a RB 119' airlock manway. GOTHIC calculation EXOC049-CALC-001, EXOC049-CALC-002, EXOC049-CALC-003, EXOC049-CALC-004, A2392457 E16, FSG-06, FSG-15, and ATI 2392457-64, have been posted on the ePortal.	
SE 9 - The final timeline will be time validated once detailed designs are completed and procedures developed. Licensee to provide a time validation of the timeline used to respond to an ELAP.	Detailed designs are complete, and procedures have been developed. The time validation process was completed and documented in OP-OC-118-1001, "Oyster Creek FLEX VALIDATION Plan," on September 30, 2016. OP-OC-118-1001, "Oyster Creek FLEX VALIDATION Plan" has been posted on the ePortal.	Complete

MILESTONE SCHEDULE – ITEMS COMPLETE

Milestone	Completion Date
Submit 60 Day Status Report	October 25, 2012
Submit Overall Integrated Plan	February 28, 2013
Contract with National SAFER Response Center	April 30, 2015
Submit 6 Month Updates:	
Update 1	August 28, 2013
Update 2	February 28, 2014
Update 3	August 28, 2014
Update 4	February 27, 2015
Update 5	August 28, 2015
Update 6	February 26, 2016
Update 7	August 26, 2016
Modification Development:	
Phase 2 modifications	October 3, 2016
National SAFER Response Center Operational	January 7, 2016
Procedure Development:	
Strategy procedures	October 3, 2016
Validate Procedures (NEI 12-06, Sect. 11.4.3)	October 3, 2016
Maintenance procedures	October 3, 2016
Staffing analysis	May 11, 2016

Milestone	Completion Date
Modification Implementation	
Phase 2 modifications	October 3, 2016
Storage plan and construction	October 3, 2016
FLEX equipment acquisition	October 3, 2016
Training completion	October 3, 2016
Implementation date	October 3, 2016

ORDER EA-12-049 COMPLIANCE ELEMENTS SUMMARY

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

Strategies - Complete

Oyster Creek Nuclear Generating Station 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 Oyster Creek Nuclear Generating Station 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 Oyster Creek Nuclear Generating Station 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 Oyster Creek Nuclear Generating Station has been procured in accordance with NEI 12-06, Section 11.1 and 11.2, received at Oyster Creek Nuclear Generating Station, 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 Oyster Creek Nuclear Generating Station Preventative Maintenance program such that equipment reliability is achieved.

Protected Storage – Complete

The storage configurations required to implement the FLEX strategies for Oyster Creek Nuclear Generating Station have been completed and provide protection from the applicable site hazards. The equipment required to implement the FLEX strategies for Oyster Creek Nuclear Generating Station is stored in its protected configuration.

Procedures – Complete

FLEX Support Guidelines (FSGs) for Oyster Creek Nuclear Generating Station 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 Oyster Creek Nuclear Generating Station 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 Oyster Creek Nuclear Generating Station has been completed in accordance with 10CFR50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident, Recommendation 9.3, dated March 12, 2012 (Reference 14), as documented in Reference 15.

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 Oyster Creek Nuclear Generating Station with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site-specific SAFER Response Plan.

Validation – Complete

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

FLEX Program Document - Established

The Oyster Creek Nuclear Generating Station FLEX Program Document has been developed in accordance with the requirements of NEI 12-06.

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

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 6th day of December 2016.

Respectfully submitted,

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

Enclosure: Oyster Creek Nuclear Generating Station Final Integrated Plan Document – Mitigating Strategies NRC Order EA-12-049

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region I
NRC Senior Resident Inspector – Oyster Creek Nuclear Generating Station
NRC Project Manager, NRR – Oyster Creek Nuclear Generating Station
Mr. John D. Hughey, NRR/JLD/JOMB, NRC
Manager, Bureau of Nuclear Engineering – New Jersey Department of Environmental Protection
Mayor of Lacey Township, Forked River, NJ

Enclosure

Oyster Creek Nuclear Generating Station

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

(121 pages)

Exelon Generation.

OYSTER CREEK GENERATING STATION

(OCGS)

FINAL INTEGRATED PLAN DOCUMENT – MITIGATING STRATEGIES NRC ORDER EA-12-049

October 2016

Table of Contents

1. Background

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

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

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

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

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

3. Licensees must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to the Order.

4. Licensees must be capable of implementing the strategies in all modes.
5. Full compliance shall include procedures, guidance, training, and acquisition, staging or installing of equipment needed for the strategies.

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

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

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

The Nuclear Energy Institute (NEI) developed NEI 12-06 R2 (Reference 5; December 2015), which provides guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Interim Staff Guidance JLD-ISG-2012-01 R1 (Reference 3; January 2016), which endorsed NEI 12-06 R2 with clarifications on determining baseline coping capability and equipment quality. OCGS is using the guidance provided in NEI 12-06 R2 and JLD-ISG-2012-01 R1.

NRC Order EA-12-051 (Reference 2) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level.

NEI 12-02 (Reference 6) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 4), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

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

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of an Oyster Creek Generating Station (OCGS) ELAP/LUHS event and the development of FLEX strategies are stated below.

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

- The BDBEE occurs impacting the unit at the site.
- The reactor is initially operating at power, unless there are procedural requirements to shut down due to the impending event. The reactors have been operating at 100% power for the past 100 days.
- The reactor is successfully shut down when required ((i.e., all control rods inserted, no ATWS (Anticipated Transient without Scram)). Steam release to maintain decay heat removal upon shutdown functions normally, and reactor coolant system (RCS) overpressure protection valves respond normally, if required by plant conditions, and reseat. The Isolation Condenser (IC) system initiates and operates normally, providing decay heat removal, thus obviating the need for further overpressure protection valve operation.
- On-site staff is at site administrative minimum shift staffing levels.
- No independent, concurrent events, e.g., no active security threat.
- All personnel on-site are available to support site response.
- The reactor and supporting plant equipment are either operating within normal ranges for pressure, temperature and water level, or available to operate, at the time of the event consistent with the design and licensing basis.

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

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

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

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

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

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

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

- The reactor water level and the primary containment analysis assumes a reactor coolant leak of 35 gpm per MAAP #7 in OC-MISC-010 R1 (MAAP Analysis to Support FLEX Initial Strategy). Because OCGS uses the same CAN2A seals, the seal performance evaluation is the same as Nine Mile

Point 1. The OCGS reactor recirculation pump CAN2A seals are assumed to leak a total of 20 gpm (gallons per minute) for all five recirculation pumps (NMP1 recirculation pump seal performance evaluation was completed that supports the assumed leakage rate). Taking this RCP seal leak rate of 20 gpm, and adding normal site operating drywell leak rates for identified (approximately 4 gpm) and unidentified (approximately 1 gpm), the total reactor coolant leak rate would be approximately 25 gpm. Therefore, using 35 gpm per the MAAP #7 analysis is a conservative value.

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

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

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

- Site access is impeded for the first 6 hours, consistent with NEI 12-01 (Reference 7). Additional resources are assumed to begin arriving at hour 6 with limited site access up to 24 hours. By 24 hours and beyond, near-normal site access is restored allowing augmented resources to deliver supplies and personnel to the site.

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 BDBEE by providing adequate capability to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities at the site. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety have been incorporated into the unit emergency operating procedures in accordance with established emergency operating procedure (EOP) change processes, which utilize approved BWROG

EOP/SAGs (References 85, 86), and their impact to the design and license bases capabilities of the unit evaluated under 10 CFR 50.59.

The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the BDB event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p). This position is consistent with the previously documented Task Interface Agreement (TIA) 2004-04, "Acceptability of Proceduralized Departures from Technical Specification (TSs) Requirements at the Surry Power Station", (TAC Nos. MC42331 and MC4332), dated September 12, 2006 (Reference 13).

2.2 Strategies

The objective of the FLEX Strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactor, 2) maintain the Containment function, and 3) maintain cooling and prevent damage to fuel in the spent fuel pool (SFP) using installed equipment, on-site portable equipment, and pre-staged off-site resources. This indefinite coping capability will address an extended loss of all AC power (ELAP) – loss of off-site power, loss of emergency diesel generators and loss of gas turbine generators, but not the loss of AC power to buses fed by station batteries through inverters. With a loss of access to the ultimate heat sink (LUHS), the water in the UHS remains available and robust piping connecting the UHS to plant systems remains intact.

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

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

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

The duration of each phase is specific to the installed and portable equipment utilized for the particular FLEX strategy employed to mitigate the plant condition. The strategies described below are capable of mitigating an ELAP/LUHS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at the Oyster Creek Generating Station. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety are incorporated into the Oyster Creek emergency operating procedures in accordance with established EOP change processes, which utilize approved BWROG EOP/SAGs (References 85, 86), and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

2.3 Reactor Core Cooling and Heat Removal Strategy

The FLEX strategy for reactor core cooling and decay heat removal is to initiate both Isolation Condensers.

Both Isolation Condensers (ICs) together will remain in service for 100 minutes – their design service time without make up (OCGS UFSAR; Reference 9). After 100 minutes, make up to the shell-side of the Isolation Condensers is required to maintain water level above the tube bundles. With the onset of a BDBEE, Oyster Creek's FLEX strategy is to recognize a potential ELAP condition within 10 minutes, and then from the time of recognition, establish Isolation Condenser make up within the next 90 minutes.

DC bus load shedding will ensure battery life is extended for Station Vital Battery B from 5.85 hours without DC load shed to 18 hours with DC load shed. Station Vital Battery C is extended from 14.28 hours without DC load shed to 25 hours with DC load shed (Nexus Report 12-4159.OCGS, Rev. 0: Exelon Corporation Oyster Creek Generating Station (OCGS) Battery Coping Evaluation Report).

Portable generators will re-power instrumentation prior to battery depletion. DC load shed of all non-essential loads would begin when an Extend Loss of AC Power (ELAP) condition is declared at the station, and completed within T=90 minutes. (Note: the time T=0 is the time the event occurs.)

Isolation Condenser operation at a Reactor Pressure Vessel (RPV) cool down rate of 50°F/hour, will minimize loss of RPV water inventory, and ensure reactor water level remains above Top of Active Fuel (TAF) to at least T=3.3 hours (Reference 54; OC-MISC-010 R1).

RPV makeup provided by a portable diesel driven pump, hereinafter called the FLEX Pump, will be initiated by 3.3 hours to ensure that reactor water level will remain above the Top of Active Fuel (TAF).

2.3.1 Phase 1 Strategy

2.3.1.1 Power Operation, Startup, and Hot Shutdown

At the initiation of the BDBEE, Main Steam Isolation Valves (MSIVs) automatically close, feed water flow to the reactor is lost, and Electromatic Relief Valves (EMRV) automatically cycle to control pressure, causing reactor water level to decrease. The Isolation Condensers will automatically initiate on high reactor pressure or low-low reactor water level after the initiation of the Station Blackout (SBO). Abnormal Operating Procedure ABN-1 (Reference 10) is used to manually control reactor pressure with both Isolation Condensers, and ABN-36 (Loss of Offsite Power & Station Blackout (Plant Control) Reference 11) is used to initially maintain a ≤10°F/hr. cooldown rate when it is determined that an SBO condition exists. The cooldown rate is raised to 50°F/hr. upon recognition of a potential ELAP event. The ≤10°F/hr. rate is initially used to conserve shell-side water inventory in the Isolation Condensers due to lack of makeup capability, but is raised to 50°F/hr. when operators recognize a potential ELAP condition to lower the driving head of RPV leakage and depressurize the reactor low enough to inject water via the FLEX pump at T≤3.3 hours.

The ICs are designed to remove 410 X 10^6 Btu/hr. and can provide emergency cooling for 100 minutes without makeup (UFSAR section 6.3.1.1.2 – Reference 9). The Isolation Condensers condensate return valves are DC operated and controlled by 3-position switches (Open/Auto/Closed). The switches snap into the three positions; the only position that the auto initiation or isolation function is active is in the auto position. Placing the switch in Open or Close will bypass these functions. In other words, placing the switch to "open" will open the respective valve, and placing the switch to "close" will close the respective valve regardless of initiation or isolation logic signals.

Upon determining a Loss of Off-Site Power (LOOP) has occurred, coupled with the inability of EDGs and Gas Combustion Turbine Generators to start, the operating crew will determine the site is in a potential ELAP condition per ABN-36. The assumption is that this potential ELAP determination is made in ≤10 minutes into the event. Overall coping time for core cooling in Phase 1 is 3.3 hours (time to TAF)

(Reference 54). This assumes both Isolation Condensers are in service at or near the onset of the event and adequate core cooling is maintained as a result of core submergence due to reactor water level staying above the TAF during this time period. This coping time is based on limited leakage from the reactor coolant pressure boundary as explained below.

Total reactor coolant pressure boundary leakage during an ELAP condition can be assumed to be ≤35 gpm. The 35 gpm leak rate is conservatively based on total Recirculation Pump (RCP) seal leakage, identified leakage, and unidentified leakage. This Reactor Coolant System (RCS) leakage is assumed to occur at the transient initiation. Because OCGS uses the same CAN2A seals, the seal performance evaluation is the same as NMP1. The OCGS reactor recirculation pump CAN2A seals are assumed to leak a total of 20 gpm for all five recirculation pumps (NMP1 recirculation pump seal performance evaluation was completed that supports the assumed leakage rate – Reference 55). Taking this RCP seal leak rate of 20 gpm, and adding normal site operating drywell leak rates for identified (approximately 4 gpm) and unidentified (approximately 1 gpm), the total reactor coolant leak rate would be approximately 25 gpm. Therefore, using 35 gpm per the MAAP #7 analysis is a conservative value for RCP seal leakage.

This leakage is modeled in MAAP using a fixed junction flow area which achieves a total of 35 gpm leakage at full operating pressure and temperature. As the RPV is depressurized, leakage will decrease. Although RCS leakage may initiate after transient initiation (i.e., up to one hour later), this is a reasonable representation of actual RCS leakage. Overall coping time for core injection is extended to 3.3 hours based on MAAP Analysis Oyster Creek Generating Station Document Number OC-MISC-010 (Reference 54).

This seal leakage is based on the testing that was performed on the CAN2A seal cartridge in 1992 and 1997. The leakage rate is derived from Atomic Energy Canada Limited (AECL) reports ET-S-331, Testing of the CAN2A Seal Cartridge under Station Blackout Conditions, and ET-S-426, Testing of the CAN2A Seal Cartridge under Station Blackout Conditions – Phase 2 (References 2.9 and 2.9A to ECR OC 14-00025: Reference 76). Note that the AECL reports were done for Nine Mile

Point. Attachment 12 to ECR OC 14-00025 provides data that the Nine Mile Point Unit 1 seals use the same design as Oyster Creek.

The reactor water level will remain above the TAF for at least 3.3 hours with shell-side makeup made available to the Isolation Condensers at ≤100 minutes from the initial time of the event T=0. Upon recognition of an ELAP (T=10) plant personnel will proceed immediately with deployment of a portable FLEX diesel driven pump that will take suction from Oyster Creek Intake/Discharge Canal (UHS – Ultimate Heat Sink) at one of two pre-staged locations with non-collapsible hose: 1) Discharge Canal Chemistry Sample Point, and 2) Intake Canal between the Traveling Screens and the Circ Water Pumps. The primary core injection pathway for core cooling is Core Spray System 1, and the alternate core injection pathway is through Core Spray System 2.

2.3.1.2 Cold Shutdown and Refueling

The overall strategies for core cooling for Cold Shutdown and Refueling are, in general, similar to those for Power Operation, Startup, and Hot Shutdown.

If an ELAP occurs during Cold Shutdown, water in the reactor pressure vessel (RPV) will heat up. When temperature reaches 212°F, (Hot Shutdown) the RPV will begin to pressurize. If re-pressurization takes place, the Isolation Condensers can be returned to service, or ERVs can be opened to prevent reactor heatup and further re-pressurization. The primary strategies for Cold Shutdown are the same as those for Power Operation, Startup, and Hot Shutdown as discussed above for core cooling.

During Refueling, many variables impact the ability to cool the core. In the event of an ELAP during Refueling, installed plant systems cannot be relied upon to cool the core. Thus, the deployment of Phase 2 equipment will begin immediately. To accommodate the activities of RPV disassembly and refueling, water levels in the RPV and the reactor cavity are often changed. The most limiting condition is the case in which the reactor head is removed and water level in the RPV is at or below the reactor vessel flange. If an ELAP/LUHS occurs during this condition then (depending on the time after shutdown) boiling in the core may occur in a relatively short period of time (e.g. approximately 3 hours).

Per NEI Shutdown/ Refueling Position Paper (Reference 58) endorsed by the NRC (Reference 59), pre-staging of FLEX equipment can be credited for some predictable hazards, but cannot be credited for all hazards per the guideline of NEI 12-06. Deployment of portable FLEX pumps to supply injection flow should commence immediately from the time of the event. During Cold Shutdown or Refueling conditions, if an ELAP event was to occur, makeup to the Isolation Condensers is not required, therefore, from the time of the ELAP declaration the 90 minutes used to add makeup water to the ICs during power conditions, would be used to add makeup water to the reactor vessel. This is possible because more personnel are on site during outages to provide the necessary resources. During outage conditions, sufficient area and haul paths will be maintained in order to ensure FLEX deployment capability is maintained. For planned outages and early in an unplanned outage, an outage risk profile is developed per Exelon Shutdown Safety Management Program, OU-AA-103. This risk assessment is updated on a daily bases and as changes are made to the outage schedule. Contingency actions are developed for high risk evolutions and the time needed for such evolutions is minimized.

2.3.2 Phase 2 Strategy

Primary strategy: Deployment of Phase 2 portable equipment will begin when it is recognized a potential SBO/ELAP condition exists (within 10 minutes) in Phase 1. A portable FLEX Pump will be deployed and aligned to add makeup water to the ICs within time T=90 minutes and inject makeup water into the RPV via Core Spray System 1 within T=3.3 hours. A portable FLEX Generator (500KW Diesel Generator), will be deployed and will enable re-energizing existing station Battery Chargers and vital instrumentation within the 2.5 hours which is well inside the battery coping times with or without DC load shed.

At T≤10 minutes into the event, a portable FLEX Pump and associated suction and discharge hoses will be deployed to the Intake/Discharge Canal. The suction hose will be routed from a chemistry sample point (primary suction) located in the Circulating Water discharge tunnel for an indefinite supply of water for make up to the RPV, the Isolation Condenser shells and the Spent Fuel Pool. Alternate staging for the FLEX Pump and suction hoses is available in the area between the Circulating Water Pumps and the intake screens if the primary suction is not accessible. Five inch Discharge hoses from the FLEX pump will be routed to a FLEX (distribution) manifold in the RB (Reactor Building) 23' elevation where make up can be directed to the ICs, RPV, and SFP (Reference 76; ECR-OC-14-00025).

Alternate strategy: If the situation exists where the FLEX Pump cannot discharge to Core Spray System 1; the capability exists to connect discharge hoses from the FLEX Pump to a hose connection into Core Spray System 2. As stated above, 5 inch hose will be routed from the FLEX Pump discharge to the FLEX manifold located inside the Reactor Building 23' elevation at V-917-14. V-917-17 can be used to provide flow from the FLEX manifold via a hose connection to Core Spray System 2 as required (Reference 76; ECR-OC-14-00025).

Primary Strategy for repowering 125 VDC: Prior to depletion of the Station Vital 125 VDC batteries, vital 125 VDC circuits will be re-powered to continue to provide key parameter monitoring instrumentation using a portable FLEX Generator (500KW Diesel Generator) stored on-site. The vital 125 VDC batteries are available for up to: Battery B – 5.85 hours (without DC load shed), 18 hours (with DC load shed); Battery C – 14.28 hours (without DC load shed), 25 hours (with DC load shed). Well before battery voltage can no longer support essential loads, the battery chargers will be repowered with AC power from the portable 500KW FLEX generator.

This strategy uses a portable FLEX generator to repower the existing USS 1A2 (Unit Substation 1A2) and USS 1B2 (Unit Substation 1B2). The repowering of both USS's occurs when the USS Cross-Tie Breaker (US2T) is closed per FSG-07 (Reference 34). Reenergizing the Unit Substations will supply the power necessary to repower the 125VDC Battery Chargers. The connections between the portable FLEX generator and the existing Unit Substations are via a temporary disconnect (called the FLEX Back Feed Device) and temporary cables with color-coded connectors are made per FLEX Support Guideline Procedures FSG-06 and FSG-07 (References 33, 34). The primary protected cable deployment is shown in Figure 18, and both the primary and alternate cable deployment pathways are provided in FSG-06.

An alternate method to powering up the station's vital batteries with the portable diesel driven generator is provided from a staged second FLEX Back Feed

Device in the 480VAC Room to be used as required. Additionally, a second set of cables with color-coded connectors are staged inside the Seavans (3 cables per Seavan) located at both FLEX Pads if backup cabling with connectors are required to meet the FLEX initiative.

Two portable 500KW FLEX generators will be stored at two Storage Pad locations, both inside the Protected Area, one at the far Northwest location and one in the far Southeast location per ECR OC-14-00027 (Reference 78). The primary strategies' electrical cables will be stored in six FLEX storage cabinets located in the Turbine Building North Mezzanine. The protected deployment pathway will be to stage the portable 500KW FLEX generator just outside the NW corner of the Turbine Building, and then deploy power cables through the Turbine Building North Mezzanine and around the stairway from the Lower Cable Spreading Room down to the 480v Room per FSG-06. A specific FLEX Support Guideline FSG-06 will be used to procedurally connect the FLEX generator to the station's Unit Substations, and another specific FSG-07 will install the portable FLEX Back Feed Device into the USS's.

Preparation of the portable FLEX generator for service will commence no later than ≤1.5 hours from the time of the initiating event (allowing 1.5 hours for connecting the FLEX hoses for makeup water to the ICs). Placing the portable FLEX generator into service can be completed in ≤2.5 hours from the start of the event. Therefore, the portable FLEX generator will be supplying power to the station's vital battery chargers and key instrumentation within 2.5 hours of a BDBEE which initiated an ELAP event.

2.3.3 Phase 3 Strategy

The Phase 3 strategy is to use the Phase 2 connections, both mechanical and electrical, but supply water using Phase 3 portable pumps and supply AC power using Phase 3 portable generators if necessary. The Phase 3 equipment will act as backup or redundant equipment to the Phase 2 portable equipment and is deployed from an off-site facility and delivered to the Oyster Creek Generating Station. The off-site facility supplying this equipment is the National SAFER Response Center (NSRC) through executed contractual agreements with Pooled Equipment Inventory Company (PEICo). The NSRC will support initial portable FLEX equipment delivery to the site within 24 hours of a request for deployment per the Oyster Creek Generating Station SAFER Response Plan (Reference 61). Phase 3 equipment to be supplied by SAFER is described in Table 5. The

OCGS SAFER Response Plan defines the actions necessary to deliver pre-specified equipment to the Oyster Creek Generating Station. Designated local staging areas have been selected to support deliveries of requested SAFER equipment from the NSRC to Oyster Creek Generating Station. Resources will be available, and sufficient, at the times required for Phase 3 implementation.

No plant modifications have been installed to support mitigating strategies for Phase 3. The connection of the majority of Phase 3 equipment can be made to connection points established for Phase 2 equipment and strategies. The remaining Phase 3 non-redundant equipment will be deployed as needed utilizing field established connections, without the reliance on plug and play type modifications. Other Phase 3 equipment that is not a backup or redundant to Phase 2 can be applied towards recovery efforts.

2.3.4 Systems, Structures, Components

2.3.4.1 Isolation Condenser System

The primary function of the Isolation Condenser (IC) system is to remove reactor decay heat when the vessel is isolated from the main heat sink. Following vessel isolation, the reactor pressure will rise causing EMRVs to cycle to control reactor pressure below safety valve set points. Normally, both IC loops are placed into operation automatically by opening the condensate return valves with signals from the Reactor Protection System (RPS) as follows: a high Reactor pressure of 1050 psig or low-low Rx water level less than or equal to 86" TAF for a time period of 1.5 ± 1 second will automatically initiate the Isolation Condensers. In a SBO (Station Blackout) condition the operators are directed to confirm closure of the MSIVs, and manually control reactor pressure using both ICs. This will minimize loss of inventory through the EMRVs and downstream steam loads. Also, this will result in lowering reactor pressure at a rate that will minimize coolant loss from any leakage and energy addition into primary containment. The Isolation Condenser system design provides for 100 minutes of continuous operation with both ICs available and without shell-side makeup. After 100 minutes, make up to the IC shells is necessary to keep the shell-side level above the tube bundles. For the FLEX strategy, makeup to the shell-side of the ICs will be provided within 90 minutes of commencing ELAP preparations which occurs at ≤10 minutes. This is accomplished by placing into service a FLEX Pump taking suction from the Intake/Discharge Canal (UHS) that will be capable of providing make up to the IC shells allowing for indefinite operation.

2.3.4.2 Batteries

The safety related batteries and associated DC distribution systems are located within safety related structures designed to meet applicable design basis external hazards and will be used to initially power required key instrumentation and applicable DC components required for monitoring RPV level and isolation condenser operation. Within 90 minutes of ELAP/LUHS event onset, load shedding of non-essential equipment provides an extension of estimated total service time from 5.85 hours to approximately 18 hours of operation (B Vital battery being the most restrictive). The FLEX initiative will repower the station vital batteries at T≤2.5 hours, well inside the 5.85 hours B vital battery will operate without DC load shed.

2.3.4.3 Primary RPV Make Up

Primary water makeup to the RPV, IC's, and SFP, will all be via a FLEX distribution manifold located in the OCGS Reactor Building 23' which will receive water from the FLEX Pump.

Primary RPV makeup (Figure 19) consists of a 2" hard pipe connecting the FLEX distribution manifold to a drain header for Core Spray System 1. The FLEX distribution manifold and the injection point into Core Spray System 1 are in close proximity located at RB 23' north. Valves V-917-14 and V-917-19 are opened in order to allow injection into the RPV. In order to prevent backflow, the injection point passes through the Core Spray System 1 check valves V-20-60 and V-20-88 which will prevent backflow into the FLEX injection line. At the drain line, V-20-1087 is closed to prevent flow from going to the Reactor Building Equipment Drain Tank (RBEDT), and V-20-1088 is opened to allow flow to Core Spray System 1. When either one of the Core Spray System 1 Parallel Isolation Valves V-20-15 or V-20-40 is manually fully opened, FLEX pump flow is established from the canal to Core Spray System 1 to the reactor. All the valves and the hose connections are close to the floor and no special equipment is needed for access. All actions are manual, and the bypassing of any system logic is not required.

2.3.4.4 Alternate RPV Make Up

In the event the primary RPV makeup method to the Core Spray System 1 is not available, an alternate make up connection is provided. Additional hose connections were installed in the RB 23' FLEX manifold and on the drain line for Core Spray System 2. The Core Spray System 2 drain line is located at RB 23' south wall. A 3 inch hose is routed from the RB 23' FLEX manifold to this hose connection located at the drain line for Core Spray System 2. Valves V-917-14 and V-917-17 at the FLEX manifold are opened in order to allow injection into the RPV. In order to prevent backflow, the injection point passes through the Core Spray System 2 check valves V-20-61 and V-20-89 which will prevent backflow into the FLEX injection line. At the drain line, V-20-1090 is closed to prevent flow from going to the RBEDT (Reactor Building Equipment Drain Tank), and V-20-1089 is opened to allow flow to Core Spray System 2. When either one of the Core Spray System 2 Parallel Isolation Valves V-20-21 or V-20-41 is manually fully opened, FLEX pump flow is established from the canal to Core Spray System 2 to the reactor. All the valves and the hose connections are close to the floor and no special equipment is needed for access. All actions are manual, and the bypassing of any system logic is not required.

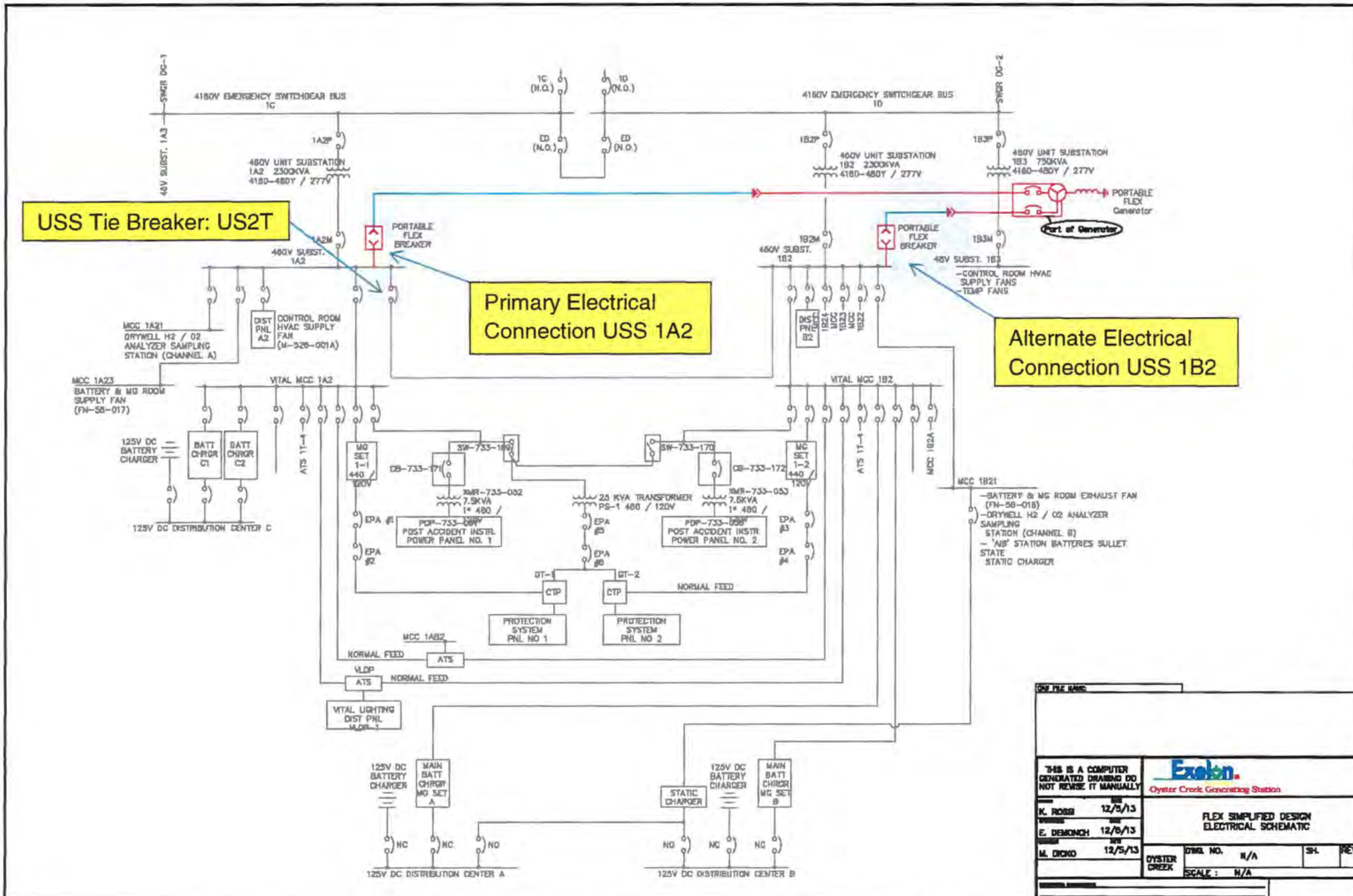
2.3.4.5 Primary Electrical Connection

The primary strategy (Figure 1) uses a portable 500KW FLEX generator to power the existing 480VAC Unit Substations 1A2 or 1B2.

Upon reenergizing USS 1A2 or USS 1B2 and closing the Cross-Tie breaker US2T, the 125VDC Station Battery Chargers are repowered to restore and maintain charging of the B 125VDC and C 125VDC vital batteries using FSG-12: Restoration of Plant Equipment with FLEX Generator. The connection between the portable FLEX generator and the existing 480VAC Unit Substations is via temporary power cables (FLEX cables) with color-coded connectors at a FLEX Back Feed Device staged in the 480V Room and installed in Unit Substation breaker location as directed by FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator. These FLEX cables with color-coded connectors are staged inside the protected pathway. All six required FLEX cables are stored in the Turbine Building (TB) North Mezzanine on reels and inside designated cabinets, such that, deployment can be accomplished. Each cable is 350' in length and can be connected on one end to the FLEX generator, and the other end to the portable FLEX Back Feed Device in the 480VAC room.

The primary strategy for maintaining power to the vital DC buses is to deploy the portable FLEX generator to the northwest side of the OCGS Turbine Building. Six (6) 350 foot 4/0 power cables are routed to the FLEX generator through the northwest TB access door (via security gate). These six FLEX cables are stored on reels within six cabinets for ease of deployment. When deployed, each FLEX cable is unreeled where one end is connected to the FLEX generator, and the other end is connected to the portable FLEX Back Feed Device in the 480VAC room. The FLEX Back Feed Device will be installed into USS 1A2 or USS 1B2 in accordance with FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator, and the FLEX cables will be deployed and connected via FSG-06: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator. Additionally, each FLEX generator trailer has a green 4/0 100' ground cable staged in a cabinet on the tongue to be deployed in accordance with FSG-06.

Figure 1: Primary and Alternate FLEX Unit Substation's Electrical Connections



2.3.4.6 Alternate Electrical Connection

If the primary electrical strategy is not available, an alternate strategy exists. For example, in the primary strategy, if USS 1A2 is not available to connect to the FLEX Back Feed Device, a second FLEX Back Feed Device is available and staged in the "B" 480VAC Room to connect to USS 1B2 using FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator.

This strategy uses the same portable FLEX generator to power Unit Substations 1A2 and 1B2. Upon reenergizing USS 1A2 or USS 1B2 and closing the cross-tie breaker US2T, the 125VDC Station Battery Chargers are repowered to restore and maintain charging of the B 125VDC and C 125VDC vital batteries using FSG-12: Restoration of Plant Equipment with FLEX Generator. The connection between the portable 500KW FLEX generator and the existing 480VAC Unit Substations is still via temporary FLEX cables with color-coded connectors at a temporary FLEX Back Feed Device staged in the 480V Room and installed in Unit Substation breaker location directed by FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator. These temporary FLEX cables with color-coded connectors are same ones staged inside the protected pathway. As stated prior, all six required power cables are stored in the TB North Mezzanine on reels and inside cabinets, such that, deployment can be readily accomplished. Each cable is 350' in length and can be connected on one end to the FLEX generator, and the other end to the portable FLEX Back Feed Device in the 480VAC Room.

For additional strategies, a full set of six temporary FLEX cables with color-coded connectors are staged inside the Seavans. Each Seavan has 3 power cables stored within it. These additional power cables can serve two functions if required and if available post a BDBEE. One function is to replace an existing power cable in the primary pathway if needed, and two, upon the initial assessment of the magnitude of BDBEE damage, determination can be made to provide additional power to the Unit Substations with the second portable FLEX generator (if available) or provide the hardware necessary if the opportunity for quicker deployment exists in non-seismic pathways. Alternate cable route deployment is from the north direction (coming from the MAC (Main Access Control) and is detailed in FSG-06: Deployment of FLEX 480V Cables and Connection to USS 1A2/1B2.

2.3.5 Key Reactor Parameters

Instrumentation providing the following key parameters is credited for all phases of the reactor core cooling and decay heat removal strategy with the indication available in the OCGS Main Control Room:

- RPV Level: FZ level – C & D: LI-622-1001 & LI-622-1002
- RPV Wide Range Pressure – C & D: LI-622-1018 & LI-622-1019
- Isolation Condenser Shell Level: – A & B: LT-IG0006A & LT-IG0006B

The above instrumentation is available prior to and after DC load shedding of the DC buses during SBO/ELAP response procedure implementation. DC bus load shedding will ensure battery life is extended for Station Vital Battery B from 5.85 hours without DC load shed to 18 hours with DC load shed. Station Vital Battery C is extended from 14.28 hours without DC load shed to 25 hours with DC load shed.

In the unlikely event that the Battery Bus infrastructures or supporting equipment is damaged and non-functional rendering key parameter instrumentation unavailable in the OCGS Main Control Room, alternate methods for obtaining the critical parameters locally are provided in procedure FSG-20, EOP Key Parameter–Alternate Instrumentation Reading (Reference 47).

Prior to Oyster Creek refueling outage 1R26, any Loss of Offsite Power (LOOP) and Station Blackout (SBO) event would cause a loss of MCR indication for the A isolation condenser shell-side level. For such an event, only B isolation condenser shell-side level was available. In 1R26, Oyster Creek installed "A" isolation condenser shell-side level indication for LOOP and SBO events per Engineering Change Request (ECR) OC-14-00164 (Reference 80). Therefore, post 1R26, any Extended Loss of AC Power (ELAP) event, MCR operators will have both the A and the B isolation condenser shell-side level indications.

2.3.6 Thermal Hydraulic Analysis

At the initiation of the BDBEE, Main Steam Isolation Valves (MSIVs) automatically close, feed water flow to the reactor is lost, and Electromatic Relief Valves (EMRV) automatically cycle to control pressure, causing reactor water inventory to lower. The Isolation Condensers will automatically initiate on high reactor pressure or low-low reactor water level and control reactor pressure upon initiation of Station Blackout (SBO) event. Abnormal Operating Procedure ABN-1 (Reference 10) is used to manually control reactor pressure with both Isolation Condensers, and ABN-36 (Loss of Offsite Power & Station Blackout (Plant Control) Reference 11) is used to initially maintain a ≤10°F/hr. cooldown rate when it is determined that an SBO condition exists. Upon recognition of a potential ELAP event, the cooldown rate is raised to 50°F/hr. The ≤10°F/hr. rate is initially used to conserve shell-side water inventory in the Isolation Condensers due to lack of makeup capability, but is raised to 50°F/hr. when operators recognize a potential ELAP condition to depressurize the reactor low enough to inject water via the FLEX pump at T≤3.3 hours. Reactor coolant inventory loss consists of reactor recirculation pump (RCP) leakage, unidentified leakage, and identified leakage.

The reactor water level and the primary containment analysis assumes a reactor coolant leak of 35 gpm (gallons per minute) per MAAP #7 in OC-MISC-010 R1 (MAAP Analysis to Support FLEX Initial Strategy). Because OCGS uses the same CAN2A seals as NMP1, the seal performance evaluation is the same. The OCGS reactor recirculation pump CAN2A seals are assumed to leak a total of 20 gpm for all five recirculation pumps (NMP1 recirculation pump seal performance evaluation was completed that supports the assumed leakage rate – Reference 55). Taking this RCP seal leak rate of 20 gpm, and adding normal site operating drywell leak rates for identified (approximately 4 gpm) and unidentified (approximately 1 gpm), the total reactor coolant leak rate would be approximately 25 gpm. Therefore, using 35 gpm per the MAAP #7 analysis is a conservative value for RCP seal leak rate.

This RCS leakage is assumed to occur at the transient initiation. This leakage is modeled in MAAP using a fixed junction flow area which achieves a total of 35 gpm leakage at full operating pressure and temperature. As the RPV is depressurized, leakage will decrease. Although RCS leakage may initiate after transient initiation (i.e., up to one hour later), this is a reasonable representation of actual RCS leakage.

Per MAAP #7 (Case 7) in OC-MISC-010 R1 (MAAP Analysis to Support FLEX Initial Strategy), with reactor coolant leakage at 35 gpm, establishing a 50°F/hr. cooldown rate via Isolation Condensers, and establishing makeup to the shells of the ICs at 1.5 hours, injection into the RPV at 100 gpm is established at 3.3 hours without lowering reactor water level below TAF, without exceeding HCTL (Heat Capacity Temperature

Limit), PSP (Pressure Suppression Pressure), Drywell temperature limits, Torus Load Limits, and without the need to vent the containment.

In comparison to other six cases run in the analysis, MAAP #7 (Case 7) provides a strategy that prevents collapsed shroud level from dropping below TAF by initiating external RPV injection earlier (≤3.3 hours).

Make up to the Reactor Vessel is commenced ≤3.3 hours (based on the revised MAAP run) from the start of the event. The flow rate credited by the MAAP is 100 gpm. It is postulated that FLEX pump water supply will be available, at the same time as the makeup to the Isolation Condensers (ICs). This is a reasonable maximum requirement as the Isolation Condenser makeup will be cycled on and off as needed and RPV makeup will be slowed considerably when Reactor Level is brought back into its normal band.

Per OCGS Calculation Number – C-1302-917-E310-002, Hydraulic Analysis for FLEX Implementation (Reference 63), once core makeup is re-established (≥3.3 hours), the amount of makeup is to account for inventory loss. C-1302-917-E310-002 states a maximum makeup flow of 50 gpm to the Reactor Pressure Vessel is required to keep the core covered. This maximum makeup flow is derived from TS (Tech Spec) 3.3.D (Reference 14); stating a 5 gpm unidentified leakage limit and a 25 gpm total (identified + unidentified) leakage limit. The maximum TS allowable leak rate is added to the 25 gpm seal leakage and the makeup rate is 50 gpm. Because this calculation uses conservative values of 5 gpm (instead of 4 gpm) for RCP seal leakage per pump and uses maximum (instead of normal) allowable TS limits leak rates, this calculation is highly conservative in computation. Furthermore, four of the five Reactor Recirculation pumps will be isolated (per the FLEX strategy timeline) at three hours. Therefore, actual lost inventory at three hours postulating maximum Tech Spec allowable leakage is 30 gpm.

The RCP leakage rate is derived from Atomic Energy Canada Limited (AECL) reports ET-S-331, Testing of the CAN2A Seal Cartridge under Station Blackout Conditions, and ET-S-426, Testing of the CAN2A Seal Cartridge under Station Blackout Conditions – Phase 2 (References 2.9 and 2.9A to ECR OC 14-00025: Reference 76). Note that the AECL reports were done for Nine Mile Point. ECR OC 14-00025 Attachment 12 provides data that the Nine Mile Point Unit 1 seals use the same design as Oyster Creek.

2.3.7 Reactor Coolant Pump Seals

The OCGS reactor recirculation pump CAN2A seals are assumed to leak a total of 20 gpm (gallons per minute) total for all five recirculation pumps and do not fail catastrophically during the ELAP.

Because OCGS uses the same CAN2A seals, the seal performance evaluation is the same as NMP1, and is therefore, stated below.

"A NMP1 recirculation pump seal performance evaluation was completed that supports the assumed leakage rate.

The NMP1 recirculation pump seal station blackout test reports document the recirculation pump CAN2A seal performance under loss of forced Reactor Building Closed Cooling Water (RBCCW) seal cooling conditions. The testing models the reactor depressurization that is expected for a single EC loop reactor cool down profile. The seal test pressure profile follows the expected reactor depressurization defined in the GE SBO SHEX referenced analysis.

The pump seal testing includes the full scale integral pump seal cooler. The integral seal cooler under SBO conditions maintains the seal cooling subcooled by the boiling heat transfer of the RBCCW coolant and counter current makeup RBCCW gravity driven makeup to the cooler. The test included a mockup of the RBCCW piping to simulate the static head available to maintain the boiling heat transfer and to model the counter current flow regime. The test report summarizes the seal subcooling. Because the integral seal cooler maintained subcooled inlet conditions, the SBO testing of the seal demonstrated the leakage remained single phase throughout the test time frame."

2.3.8 Shutdown Margin Analysis

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

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

For Oyster Creek Technical Specification 3.2.A (Reference 14):

The SHUTDOWN MARGIN (SDM) under all operational conditions shall be equal to or greater than:

(a) 0.38% delta k/k, with the highest worth control rod analytically determined; or

(b) 0.28% delta k/k, with the highest worth control rod determined by test.

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

As reported in the Oyster Creek Cycle 25 Cycle Management Report (the current operating cycle), the value of R is 0.000 % Δk. Therefore the minimum shutdown margin that occurs is at BOC. The BOC predicted minimum shutdown margin of 1.39% Δk/k, or approximately 3 to 4 times the Tech Spec requirement. Therefore, Oyster Creek will remain shutdown during a simultaneous ELAP and LUHS event with all control rods fully inserted.

2.3.9 FLEX Pumps and Water Supplies

Consistent with NEI 12-06, Appendix C, RPV injection capability is provided using FLEX Pumps through a primary and alternate connection. The FLEX Pump is a Dri-Prime HL130M Godwin Pump rated at (approximately1100 gpm @ 150 psid). The FLEX Pump is a trailer-mounted, self-priming, variable speed, diesel engine driven centrifugal pump. It has a custom 250 gallon fuel tank ensure pump operability for 19.23 hours with a using of 13 gallons per hour at 2000 rpm (note: OC FLEX pumps will run at 1800 rpm). Two FLEX Pumps are stored in the FLEX Storage Pads located in the NW and SE corner quadrants of OCGS inside the PA (Protected Area) per ECR-OC-14-00027, Outdoor Storage Structures for Portable FLEX Equipment.

A hydraulic calculation C-1302-917-E310-002, Hydraulic Analysis for FLEX Implementation was performed (Reference 63) to verify the capability of the FLEX Pumps and piping/hose system to deliver the required amount of water to each required location.

For RPV makeup, in OC-MISC-010 R1 (MAAP Analysis to Support FLEX Initial Strategy) conservatively determined an RPV makeup flowrate of 100 GPM was required with an assumed constant RPV leakage rate of 35 GPM despite slowly lowering RPV pressure. As documented in MAAP #7, the RPV leakage is assumed to be 35 GPM at the event onset but is RPV pressure dependent. MAAP #7 uses a RPV makeup rate of 100 GPM (35 gpm + margin) to verify that the RPV water level stays above Top of Active Fuel (TAF). RPV level begins to rise provided RPV injection starts at 3.3 hours from event onset.

For Isolation Condenser makeup, the hydraulic calculation (Reference 63) determined minimum makeup flowrate of 187 GPM is required. This flow rate is based on effectively removing reactor decay heat at the start of the event. The required makeup flowrate was developed in calculation C-1302-424-5360-001 R2

(Reference 63). Decay heat will decrease over time. Per the hydraulic calculation, with the IC makeup valve (V-917-21) full open, the flow to the ICs at 1.5 hours is 424 gpm at 121 psig. This flowrate is more than two times the minimum required flowrate of 187 gpm. For makeup to the ICs, the calculation finds that for every analyzed case the delivered flow rate exceeds the minimum required flow rate of 187 gpm. It is noted the design flow is with decay heat shortly after shutdown and the flow required will decrease over time. Also, the makeup method used is batch feeding (opening and closing the makeup valve) rather than by attempting to match makeup flow to inventory used. For a bounding result, the minimum available makeup is 237 gpm, providing a 50 gpm margin.

For Spent Fuel Pool (SFP) makeup, 41.2 GPM is the calculated boiling rate of the pool for a full core offload as given in OCGS USFSAR 9.1.3.2.3 (Reference 9). The ability to supply the minimum makeup rate in excess of the SFP boil off rate for the boundary conditions is a requirement of NEI 12-06 R2 (Reference 5). OCGS hydraulic calculation C-1302-424-5360-001 established 269 GPM makeup to the SFP which is inclusive of the 41.2 GPM normal boil off rate.

Per FLEX strategy, SFP makeup is required by T=12 hours from initiation of the event. The hydraulic analysis shows by T=12 hours, flowrate to the SFP is 340 gpm at 52 psig. This calculation shows the maximum available flowrate to the SFP with the other users being supplied is 269 gpm which provides a margin of 227.8 gpm. By this time into the event, RPV makeup will be relatively low and both RPV and IC makeup will be intermittent (i.e. batch makeup). Nevertheless, to be bounding, the lineup will use simultaneous makeup to all three users.

For the constant flow line, V-917-15 (isolation valve for hose connection to – overboard to discharge canal V-3-936), the hydraulic analysis shows relative constant flowrates from 223-277 gpm at 106-165 psig from T=1.5 hours to T-12 hours into the event. This system is required in freezing temperatures and must be maintained to prevent freezing. Also, a constant flow will be required so that the FLEX pump is never dead-headed and so a minimum flow is always present to prevent overheating/damage to the pump.

The effect of the water source on FLEX Pump performance as it relates to suction strainer clogging was also evaluated in A2392457-E41. The water source is taken from the discharge tunnel of the OCGS Circulating Water system which draws from Barnegat Bay. Assessment of reactor flowrate using present strainer design of one inch diameter holes was performed in A2392457-E41. This assessment (inserted into ECR OC-14-00025) stated that using this strainer at the FLEX suction points will satisfy the flowrate requirements for the FLEX initiative. The primary FLEX suction point is the discharge canal (chemistry sample point), and the alternate FLEX suction point is the intake canal (area between intake screens and CWPs). Primary FLEX water quality will be aided by drawing suction after the intake screens and the main condenser tubes, and alternate water quality will be aided by drawing suction after the intake screens. Due to the size of the suction strainer holes to the relative size of the Core Spray System spray spargers, the probability of clogging occurring in the reactor water makeup line is higher than either the isolation condensers or the spent fuel pool. Therefore, this analysis bounds the required flowrates to all FLEX points. Because this assessment showed the availability of required flow to the reactor, by definition, the required system flowrates will be available to the ICs and SFP.

Testing on the FLEX Pumps is performed by OCGS personnel to confirm pump performance. The tests will model flow and pressure requirements for the pumps. Results from reoccurring semi-annual and annual performance tests will show that the pumps are capable of providing the required pressure and flow for OCGS FLEX strategy makeup requirements.

For OCGS, one FLEX Pump is capable of supplying the primary make up requirements to the RPV, Isolation Condensers, and Spent Fuel Pool. A second identical FLEX pump will be staged at the second FLEX Pad, but the availability of the second FLEX pump is not guaranteed due to its requirement to meet the N+1 commitment.

2.3.10 Electrical Analysis

Oyster Creek Generating Station has two (2) vital batteries. The vital battery coping time for OCGS was calculated with Nexus Report 12-4159.OCGS, Rev. 0: Exelon Corporation Oyster Creek Generating Station (OCGS) Battery Coping Evaluation Report (Reference 71). Battery Coping was determined to be as follows: Battery B – 5.85 hours (without DC load shed), 18 hours (with DC load shed); Battery C – 14.28 hours (without DC load shed), 25 hours (with DC load shed). The time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the DC loads is approximately 3.35 hours without DC load shed, and 15.5 hours with DC load shed.

The strategy to repower the station's safety-related DC bus requires the use of a 480VAC diesel powered portable FLEX generator to repower installed station battery chargers via temporary connections. Both of the portable FLEX generators are stored at the seismic FLEX Storage Pads.

The FLEX generators are Cummings Powered Commercial Generators, trailer-mounted units rated at 500KW/625KVA, 480VAC, 3-phase, 60Hz; with an integral 500 gallon fuel tank capable of supporting 14.53 hours of operation at full load (consumption rate at full load is 34.4 gallons per hour). Per the FLEX generator sizing calculation (Reference 69), the FLEX generator will be loaded to a total of 79.5% of its continuous duty rating when supplying AC power to total Load (includes all continuous and intermittent loads).

Additionally, a calculation of the voltage drop across the portable FLEX cables was completed to ensure satisfactory cable performance (Reference 70). This calculation showed 2.8% voltage drop across the 350 foot length of cable. The Unit Substations will have 466.64VAC. Because the voltage drop is <5%, the FLEX cables are sized properly.

For FLEX Phase 3, the National SAFER Response Center (NSRC) provides the FLEX Phase 3 equipment necessary to provide a standard 2 MW capability at 4160VAC, composed of two 1 MW turbine generators. Additionally, SAFER will provide one low voltage generator with an 1100 kW capacity, de-rated to 1000 kW, at 480VAC. The generator has a continuous duty rating of 1000 kVA at 0.8 power factor. The prime movers are rated to meet load requirements after any de-rating factors, such as altitude, ambient temperature, fuel energy content, and accessory losses. This NSRC equipment is a backup to on-site phase 2 equipment. NSRC generators come with the same size connectors as the on-site Phase 2 FLEX generators.

2.4 Containment Integrity

With an ELAP, containment cooling is lost and over an extended period of time containment temperature and pressure can be expected to slowly increase. During an ELAP/LUHS event, per MAAP #7 (Case 7) in OC-MISC-010 R1 (MAAP Analysis to Support FLEX Initial Strategy), with reactor coolant leakage at 35 gpm, establishing a 50°F/hr. cooldown use Isolation Condensers, and establishing makeup to the shells of the ICs at 1.5 hours, injection into the RPV at 100 gpm is established at 3.3 hours without lowering reactor water level below TAF, without exceeding HCTL, PSP, Drywell temperature limits, Torus Load Limits, and without the need to vent the containment. Because no design limits are exceeded, it is reasonable to assume and justify that the instrumentation and controls in containment which are relied upon by the operators are sufficient to perform their intended functions. The result from this analysis was used to develop an appropriate mitigating strategy, including any necessary modifications.

Heat addition to the containment during Phase 1 is directly related to the radiative heat and leakage from the recirculation pump seals and components. This leakage is less than 35 gpm and does not result in any significant pressure or temperature challenge to the containment. Some heat addition does occur initially from two of five Electromatic Relief Valves (EMRVs) automatically cycling to control reactor pressure until the both ICs are placed into service automatically.

In Phase 2, heat addition continues to be primarily from the reactor coolant system piping and the reactor vessel. ICs are placed into service for the remaining duration of the event, rejecting decay heat to the atmosphere. This limits the peak primary containment pressure and temperature during Phase 2. MAAP #7 also ran "Timings for Failure Modes (time to exceed prescribed criteria)." This analysis showed containment pressure and temperature design limits were not exceeded.

2.4.1 Phase I

During Phase 1, Primary Containment integrity is maintained by normal design features of the containment, such as the containment isolation valves. In accordance with NEI 12-06, the containment is assumed to be isolated following the event. Two of five Electromatic Relief Valves (EMRVs) automatically cycle to control reactor pressure until the Isolation Condensers are automatically placed into service. Station LOOP/SBO procedure ABN-36 will be used to support immediate actions in FLEX Core Cooling Phase 1. The isolation condensers automatically initiate, and operators' achieve a ≤10°F/hour cooldown rate. Once the potential ELAP condition is recognized (≤10 minutes of the event), RPV cooldown rate will increase to 50°F/hour in order to meet the FLEX initiative. The ICs will remove the decay heat energy from the Reactor Pressure Vessel (RPV) and return the water to the RPV, therefore, its use conserves vessel inventory. The energy deposited to the containment is from radiative heat transfer, leakage from the reactor recirculation pump seals, and unidentified containment leakage. The total leakage to the containment is nominally 35 gpm based on conservative values for Technical Specification allowable identified leakage, unidentified leakage, and Recirculation Pump seal leakage.

2.4.2 Phase 2

Two Isolation Condenser loops continue to operate so that decay heat is removed from the RPV thus limiting the heat released to the Primary Containment. Transition for FLEX Phase 1 to FLEX Phase 2 is relatively quick. Once a potential ELAP/LUHS event is recognized (≤10 minutes), the isolation condensers will be manually placed into service, and operators achieve a 50°F/hour cooldown rate until the isolation condenser shell side inventory makeup is available. At T=90 minutes (from ELAP recognition), makeup water to the ICs is available. Primary IC makeup is accomplished by providing 5" hose from a portable FLEX Pump to a connection point on the RB 23' FLEX manifold. From this FLEX manifold, flow will go through a mechanical riser to a second FLEX manifold on RB 95'. From the RB 95' FLEX manifold, makeup flow will travel via a 3" hose to a common drain connection of the ICs V-14-132. The alternate make up method is from the RB 23' FLEX manifold to V-11-63. With the ICs in service, decay heat continues to be removed from the RPV and discharged to the environment thus limiting the heat released to the Primary Containment.

2.4.3 Phase 3

Necessary actions to reduce Containment temperature and pressure and to ensure continued functionality of the key parameters will utilize existing plant systems restored by off-site equipment and resources during Phase 3. During Phase 3, the ICs will remain in service with IC make-up continuing to be provided by Phase 2 portable equipment and backed up by NSRC pumps. The Containment pressure will be monitored and, if necessary, the Primary Containment will be vented using existing procedures and systems. MAAP #7 shows venting the primary containment is not required.

2.4.4 Key Containment Parameters

Instrumentation providing the following key parameters is credited for all phases of the Containment Integrity strategy:

- Torus Water Temperature: TI-664-42A, TI-664-42B
- Torus Narrow Range Water Level: IP10B
- Drywell Pressure Narrow Range: PI-642-009A, PI-642-009B
- RPV Level: FZ level – C & D: LI-622-1001. LI-622-1002
- RPV Wide Range Pressure – C & D: LI-622-1018. LI-622-1019
- Isolation Condenser Shell Level: – A & B: LT-IG0006A and LT-IG0006B

Additionally, OCGS has alternate methods for obtaining the critical parameters locally using procedure FSG-20, EOP Key Parameter–Alternate Instrumentation Reading (Reference 47).

2.4.5 Thermal-Hydraulic Analyses

Conservative evaluations (Reference 63) have concluded that Primary Containment temperature and pressure will remain below containment design limits.

Critical inputs to the analysis are as follows:

- Isolation Condensers (ICs) are credited for 1.5 hours
- 50°F/hour cooldown rate, using ICs
- IC shell side makeup begins at 1.5 hours.
- Reactor vessel injection begins at 3.3 hours @ 100 gpm.
- The reactor coolant leakage ≤35 gpm at 1000 psig.

Per MAAP #7 (Case 7), this shows peak suppression pool temperature to be 98°F, peak Torus airspace temperature to be 106°F, peak Torus airspace pressure to be

28.2 psia, peak Torus level to be 12.4 feet, peak Drywell airspace temperature to be 261°F, and peak Drywell pressure to be 29.8 psia. Therefore, at no time in the MAAP analysis are the limits for the Heat Capacity Temperature Limit, Pressure Suppression Pressure, Drywell Temperature, Torus Load Limit exceeded. Additionally, primary containment venting is not required.

Figure 2: Time to Exceed Prescribed Criteria (Hours)

	Time to Exceed Prescribed Criteria (Hours)				
Case	**HCTL Exceeded**	**PSP Exceeded**	**DW Temperature > 281°F**	**Torus Load Limit Exceeded**	**Containment Vent Opened**
1	25.3	22.2	3.9	22.2	4.3
2	22.3	24.5	3.9	24.5	39.2
3	22.1	24.8	Not exceeded	24.8	39.2
4	22.3	24.3	Not exceeded	24.3	39.5
5	Not exceeded	Not exceeded	3.3	Not exceeded	Not required
6	Not exceeded	Not exceeded	Not exceeded	Not exceeded	Not required
7	Not exceeded	Not exceeded	Not exceeded	Not exceeded	Not required

2.4.6 FLEX Pump and Water Supplies

The NSRC is providing additional pumps in Phase 3 that can be used if required to provide water for containment cooling. Water supplies are as described in Section 2.3.9 (Barnegat Bay).

2.5 Spent Fuel Pool Cooling/Inventory

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

2.5.1 Evaluations estimate that with no operator action following a loss of SFP cooling, at the SFP maximum design heat load (outage condition, full core offload, SFP gates installed, and initial pool temperature at max allowed by Technical Specification (125°F)), the SFP will reach 212°F in approximately 10.3 hours and boil off to a level 10 feet above the top of fuel in 45.6 hours from initiation of the ELAP / LUHS event. During non-outage conditions, the time to boiling in the pool is significantly longer typically greater than 24 hours. The FLEX strategy during Phase 1 of an ELAP / LUHS event for SFP cooling is to utilize the SFP water level instrumentation installed in response to NRC Order EA-12-051 to monitor the SFP water level. Within the first 6 hours, a FLEX Pump for the addition of makeup water to the SFP will be staged and operated as necessary in order to restore and maintain the normal level in Phase 2. Although the present FLEX strategy shows SFP makeup at T=12 hours, all the necessary equipment is physically staged, such that, makeup to the SFP could occur at or by T=6 hours if required.

2.5.2 <u>Phase 2 Strategy</u>

Using the design basis maximum heat load, the SFP water inventory will heat up from 125 °F to 212°F during the first 10.3 hours. Boil-off of the Spent Fuel Pool water inventory is equivalent to 41.2 GPM. There are approximately 656 gallons per inch of level in the SFP. Using the boil-off rate identified above, preliminary calculations identify that SFP water level will lower approximately 1 foot every 3.2 hours. At 23 feet above the fuel, it will take approximately 35.25 hours to reach a level 10 feet above the spent fuel (the level below which is assumed to prohibit access to the refuel floor from a radiological perspective). Thus, the transition from Phase 1 to Phase 2 for SFP cooling function is conservatively established to occur in Phase 2 within 24 hours of the onset of the ELAP/LUHS event.

SFP cooling will be established in Phase 2 utilizing a portable FLEX pump to makeup to the SFP keeping the spent fuel covered with water. Phase 2 actions to have the FLEX pump connected and available for SFP makeup are targeted to occur at less than or equal to 6 hours from onset of the ELAP/LUHS event. By then, SFP water level should not have lowered. The Phase 2 Primary strategy uses a permanent hose connection point on Reactor Building 75' elevation for a FLEX Pump to supply canal water to the SFP. The FLEX Pump takes suction from Circulating Water Discharge Tunnel to supply makeup water to a distribution FLEX manifold in the Reactor Building 23'. This RB 23' FLEX manifold is connected to a second FLEX manifold located on RB 95'. This second manifold has two discharge connection points to the Spent Fuel Pool. The primary SFP makeup is established by running a 3" hose from V-917-22 to the SFP diffuser connection V-18-1269 located on RB 75'. Hoses for deployment are staged in two FLEX cabinets located on RB 95'. The

FLEX Pump deployment is expected to be completed within 1.5 hours of the event onset as described previously in section 2.3.2.

The Alternate injection method to provide water to SFP is to run a 3" hose from the FLEX manifold on RB 95' to the SFP located on RB 119'. The pump will take suction from one of two intake/discharge canal locations discussed in section 2.3.2. The 3" diameter hose from the RB 95' manifold can be attached to a spray nozzle stored on the refuel floor (for 10CFR50.54(hh)(2)). The oscillating spray nozzle can be used to provide spray flow over the SFP for cooling the SFP.

The OCGS FLEX strategy has both the primary and alternate SFP injection methods established by T ≤ 6 hours from the initiation of the BDBE event. Because both injection methods are established at T ≤ 6 hours, the SFP is physically readied and in standby readiness for makeup at T ≤ 12 hours.

2.5.3 <u>Phase 3 Strategy</u>

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

2.5.4 Structures, Systems, and Components

2.5.4.1 Primary Strategy

FLEX Pumps are stored in the two FLEX Storage Pads located inside the PA at the outermost NW and SE quadrants. The procedure FSG-05 Debris Removal and FLEX Equipment Deployment (Reference 32) details the deployment path of the pumps from the FLEX storage locations to the specific FLEX strategic locations where they can be used. Both FLEX strategic staging locations at the intake are marked via paint on the macadam. The primary location for use is at the Intake/Discharge Canal chemistry sample point. Six 10 foot lengths of 6 inch hard suction hose are staged at each FLEX Pad location on the FLEX pumps. The primary FLEX penetration is simply a small square cover providing access to the Circ Water Pump Discharge Tunnel. Ten foot sections of the hard suction hose and the suction strainer will be connected, such that, one side will draw from the CWP Discharge Tunnel, and the other side will be connected to the suction of the FLEX Pump. Multiple sections of 5 inch collapsible FLEX hose are connected to the discharge side of the FLEX Pump and are routed to the Northwest corner of the Turbine Building. Five inch FLEX hoses staged in two Knack Boxes located on the TB North Mezzanine will be connected, such that, one side will connect to the RB 23' FLEX manifold, and the other side will connect to the staged outside the TB NW corner. Primary water makeup to the RPV, Isolation Condensers, and SFP will all be available via the RB 23' FLEX manifold. After routing of the FLEX hoses is complete, this manifold will receive water when the FLEX Pump is started.

From the RB 23' FLEX manifold, a hard pipe connection is made to a second FLEX manifold located on RB 95' through a mechanical riser. Flow to the second RB 95' FLEX manifold is established when V-917-20 is opened on RB 23' FLEX manifold. Because this line is hard piped, the 95' FLEX manifold is immediately available to provide makeup to the SFP (primary and alternate) and ICs (primary) once the manifold is pressurized by opening V-917-20. Two Knack boxes located on RB 95' house the necessary 3" FLEX hoses to route makeup water from the RB 95' FLEX manifold (V-917-23) to the SFP.

Access to the Reactor Building 75' elevation is necessary in order to route the hose to the SFP diffuser return line connection (V-18-1269). Evaluation A2392457 E16 (Reference 87) has determined that the Reactor Building elevation 119' will reach a peak temperature of 109° F and limit stay-time access to 55 minutes for moderately heavy work for up to 8 hours into the ELAP/LUHS event. It is reasonable to assume that the maximum temperatures determined by Evaluation A2392457 E16 will bound the maximum temperatures and stay times for the elevations below it.

The SFP primary strategy to deploy hoses from Reactor Building elevation 95' to the Reactor Building elevation 75' is directed ≤6 hours from the start of the event, well in excess of the initial time for SFP makeup of ≤12 hours.

2.5.4.2 Alternate Strategy

The FLEX implementation guidance given in NEI 12-06 requires that alternate methods of water make up are available.

Hoses can be deployed to the SFP located on RB 119' using either the SE or NW stairways, or can be dropped from RB 119' down through the equipment hatch to RB 95'. FLEX hoses can be staged, such that, an oscillating spray can be established over the SFP using the B.5.b blitzfire monitors FSG-09: Makeup to SFP (Reference 36).

Access to the Reactor Building 119' elevation is necessary in order to route the hose to the spent fuel pool. Evaluation A2392457 E16 (Reference 87) has determined that the Reactor Building elevation 119' will reach a peak temperature of 109°F and limit stay-time access to 55 minutes for moderately heavy work for up to 8 hours into the ELAP/LUHS event.

The SFP alternate strategy to deploy hoses from Reactor Building elevation 95' to the Reactor Building elevation 119' is directed ≤6 hours from the start of the event, well in excess of the initial time for SFP makeup of ≤12 hours.

2.5.4.3 Ventilation

During an ELAP/LUHS event, normal and emergency Reactor Building ventilation will be non-functional. In addition to the spent fuel pool, the OCGS Reactor Building 95' area also contains two isolation Condensers which will generate heat when placed into service. FLEX manual actions have to be performed on the Reactor Building elevation 95' following an ELAP/LUHS event. To identify any temperature limitations for accessibility on Reactor Building elevation 119' (Spent Fuel Pool) following an ELAP, Evaluation A2392457 E16: Area for Steam/Condensation and Habitability (Reference 87) was completed. Evaluation A2392457 E16 has determined that the Reactor Building elevation 119' will reach a peak temperature of 109° F and limit stay-time access to 55 minutes for moderately heavy work for up to 8 hours into the ELAP/LUHS event. With the Reactor Building elevations (95', 75', 51', and 23') open to the RB 119' elevation through the NW stairway and the RB Equipment Hatch and understanding heat will rise. It is reasonable to assume that the maximum temperatures determined by Evaluation A2392457 E16 will bound the maximum temperatures and stay times for the elevations below it.

The SFP Primary and Alternate strategies to deploy hoses on Reactor Building elevation 95' to Reactor Building elevations 119' and 75', are directed before 6 hours has elapsed from the start of the event, in accordance with the FSG-09: Makeup to SFP (Reference 36). Deployment of SFP makeup hoses within 55 minutes is conservatively reasonable.

Additional actions to initiate natural circulation cooling and ventilation in the OCGS Reactor Building to prevent excessive steam accumulation and high temperature conditions are directed ≤6 hours of the event onset in accordance with FSG-09: Makeup to SFP and FSG-18: Lower RB Temperature – Post BDBEE (Reference 45). The passive cooling actions are to open specified doors in the Reactor Building to cooldown elevations in the Reactor Building and channel potentially contaminated air/steam mixture from the Reactor Building roof to atmosphere.

2.5.5 Key SFP Parameters

The key parameter for the SFP Make-up strategy is the SFP water level. The SFP water level is monitored by the instrumentation that has been installed in response to Order EA-12-051, *Reliable Spent Fuel Pool Level Instrumentation* (Reference 2). SFP wide range level indicators were installed (Reference 4) to comply with NRC issued order EA-12-051, per design change ECP-13-000651 and complies with the industry guidance provided by the Nuclear Energy Institute guidance document NEI 12-02 (Reference 6).

Spent Fuel Pool Wide range level is a Westinghouse guided radar type indication consisting of two (2) physically separate channels utilizing waveguides mounted at the Southwest and Southeast edges of the Spent Fuel Pool. SFP level can be monitored on indicators LI-18-1A and LI-18-1B on panels PNL-18-1A and PNL-18-1B on located in the UCSR (Upper Cable Spreading Room). SFPLI level 1 is set at 117' 10," level 2 is set at 106' 1 1/8," and level 3 is set at 96' 9." The accuracy of the level measurement instrument is ± 1 inch considering both the reference accuracy conditions and effects of losses in the waveguide. Under conditions of saturated steam at the horn end of the waveguide and 176°F at the sensor, the accuracy is ±3 inches. Each channel has backup batteries (24 VDC) which can be selected to power the unit on loss of normal 120 VAC power >72 hours (>3 days: OC site tested). Westinghouse has factory tested these batteries to last 8.11 days.

Normal power to panels PNL-18-1A and PNL-18-1B is PDP-733-57 and PDP-733-58 respectively. When normal power is lost, alternate power is supplied from the 24

VDC batteries. Additionally, a 110 VAC receptacle is located on each panel where power can be supplied via an extension cord from the portable diesel generators.

2.5.6 Thermal-Hydraulic Analyses

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

Using the design basis maximum heat load, the SFP water inventory will heat up from 125 °F to 212°F during the first 10.3 hours. Boil-off of the Spent Fuel Pool water inventory is equivalent to 41.2 GPM. There are approximately 656 gallons per inch of level in the SFP. Using the boil-off rate identified above, preliminary calculations identify that SFP water level will lower approximately 1 foot every 3.2 hours. At 23 feet above the fuel, it will take approximately 35.25 hours to reach a level 10 feet above the spent fuel (the level below which is assumed to prohibit access to the refuel floor from a radiological perspective). Thus, the transition from Phase 1 to Phase 2 for SFP cooling function is conservatively established to occur in Phase 2 within 24 hours of the onset of the ELAP/LUHS event.

The FLEX Pump and FLEX hoses required to establish SFP cooling will be at ≤6 hours in Phase 2 utilizing a FLEX Pump to makeup to the SFP keeping the spent fuel covered. Phase 2 actions to have the pump connected and available for makeup to occur at ≤12 hours. By then, worst case, SFP water level should only have lowered by about .5 feet.

2.5.7 Flex Pump and Water Supplies

2.5.7.1 FLEX Diesel-driven Portable Pump (Refer to 2.3.9)

The FLEX Pump is a Dri-Prime HL130M Godwin Pump rated at (approximately 1100 gpm @ 150 psid). The FLEX Pump is a trailer-mounted, self-priming, variable speed, diesel engine driven centrifugal pump. A hydraulic calculation was performed (Reference 63) to verify the capability of the FLEX Pumps and piping/hose system to deliver the required amount of water to each required location in the plant.

For Spent Fuel Pool (SFP) makeup, 41.2 GPM is the calculated boiling rate of the pool for a full core offload as given in OCGS USFSAR 9.1.3.2.3 (Reference 9). The ability to supply the minimum makeup rate in excess of the SFP boil off rate for the boundary conditions is a requirement of NEI 12-06 R2 (Reference 5). OCGS hydraulic calculation C-1302-424-5360-001 established 269 GPM makeup to the SFP which is inclusive of the 41.2 GPM normal boil off rate.

Per FLEX strategy, SFP makeup is required by T=12 hours from initiation of the event. The hydraulic analysis shows by T=12 hours, flowrate to the SFP is 340 gpm at 52 psig. This calculation shows the maximum available flowrate to the SFP with the other users being supplied is 269 gpm which provides a margin of 227.8 gpm. By this time into the event, RPV makeup will be relatively low and both RPV and IC makeup will be intermittent (i.e. batch makeup). Nevertheless, to be bounding, the lineup will use simultaneous makeup to all three users.

For OCGS, one FLEX Pump is capable of supplying the primary make up requirements to the RPV, Isolation Condensers, and Spent Fuel Pool. A second duplicate FLEX Pump (N+1), staged at one of the two FLEX Storage Pad locations could be used if required assuming it survives the BDBEE. In a BDBEE, it is assumed that one of the two FLEX Pumps will not survive.

2.5.7.2 Water Supplies

Intake/Discharge Canal (Barnegat Bay) is the primary source of water for deployment of the Phase 2 strategy. The water sources are taken from the Circulating Water Pump (CWP) discharge tunnel (primary) or the area between the intake screens and CWPs (alternate) which draw from Barnegat Bay.

2.5.8 Instrumentation

Spent Fuel Pool Wide range level is a Westinghouse guided radar type indication consisting of two (2) physically separate channels utilizing waveguides mounted at the Southwest and Southeast edges of the Spent Fuel Pool. SFP level can be monitored on indicators LI-18-1A and LI-18-1B on panels PNL-18-1A and PNL-18-1B located in the UCSR (Upper Cable Spreading Room). SFPLI level 1 is set at 117' 10," level 2 is set at 106' 1 1/8," and level 3 is set at 96' 9." The accuracy of the level measurement instrument is ± 1 inch considering both the reference accuracy conditions and effects of losses in the waveguide. Under conditions of saturated steam at the horn end of the waveguide and 176°F at the sensor, the accuracy is ±3 inches. Each channel has backup batteries (24 VDC) which can be selected to power the unit on loss of normal 120 VAC power >72 hours (>3 days: OC site tested). Westinghouse has factory tested these batteries to last 8.11 days. Batteries may be replaced, if required, since the power control panels are readily accessible in the Upper Cable Spreading Room.

Normal power to panels PNL-18-1A and PNL-18-1B is PDP-733-57 and PDP-733-58 respectively. When normal power is lost, alternate power is supplied from the 24 VDC batteries. Alternative power to either instrument channel will be provided within 2.5 hours using FLEX portable generators to provide power to the instrumentation and panels per the Phase 2 FLEX electrical strategy.

Additionally, a 110 VAC receptacle is located on each panel where power can be supplied via an extension cord from the portable diesel generators.

2.6 Characterization of External Hazards

2.6.1 Seismic

Seismic Hazard Assessment:

In response to the NRC Request for Information Pursuant to the 10 CFR 50.54(f) letter Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (ML12053A340), Oyster Creek developed a Seismic Hazard and Screening Report (ML14090A241) utilizing the guidance in NRC endorsed EPRI Report 1025287, "Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic". The Oyster Creek Seismic Hazard and Screening Report was submitted to the NRC on March 31, 2014.

Per Oyster Creek Updated Final Safety Analysis Report (UFSAR), the original safe shutdown earthquake (SSE) for seismic design at Oyster Creek was based on a Housner-shaped ground response spectrum and a peak ground acceleration (PGA) of 0.22g (22 percent of the acceleration due to earth's gravity) derived from the El Centro earthquake ground acceleration scaled to account for the regional seismic activity appropriate for New Jersey. The UFSAR was updated to specify that starting in September 1995, the Weston Geophysical Site Specific Response spectrum (SSRS) and associated in-Structure Response Spectra (ISRS) would be used as the design and licensing bases SSE going forward. The 1995 Weston SSRS anchored at 0.184g horizontal PGA represents the lower bound capacity earthquake for plant safe shutdown and is therefore appropriate for use in the seismic screening.

However, the 1995 Weston SSRS provides additional capacity over the Housner-shape design spectrum anchored at 0.22 g in the approximate range of 3 to 15 Hz.

As such, NRC requested clarification whether the safety-related SSCs built prior to 1995 were also evaluated to the Weston SSRS. In the August 21, 2014, response (ML14234A124), Oyster Creek provided supplemental information regarding the Seismic Hazard and Screening Report.

According to NRC staff assessment dated February 17, 2016 (ML15350A353), after reviews of the Weston SSRS, the supplemental information and the Oyster Creek UFSAR, NRC could not confirm that all safety-related SSCs were evaluated to the 1995 Weston SSRS and therefore, would demonstrate that it is the equivalent of the original plant design basis SSE. Therefore, NRC performed its screening evaluation for Oyster Creek based on a comparison of the re-evaluated seismic hazard (GMRS) with the lower value of the Housner-shape design spectrum anchored at 0.22 g. Based on its review, NRC concluded that Oyster Creek conducted the hazard reevaluation using present-day methodologies and regulatory guidance, it appropriately characterized the site given the information available, and met the intent of the guidance for determining the reevaluated seismic hazard. NRC concluded that Oyster Creek provided an acceptable response to Requested Information Items (1) - (9) identified in Enclosure 1 of the 50.54(f) letter. In reaching this determination, NRC confirmed that the GMRS for the Oyster Creek site is bounded by the Housner-shape design spectrum anchored at a PGA of 0.22 g in the 1 to 100 Hz range. As such, based on its screening criteria, NRC concluded that a seismic risk evaluation, Spent Fuel Pool evaluation, and a HF (High Frequency) confirmation are not merited. NRC concluded that Oyster Creek responded appropriately and has completed its response to Enclosure 1, of the 50.54(f) letter.

In the "STAFF REVIEW OF MITIGATION STRATEGIES ASSESSMENT REPORT OF THE IMPACT OF THE REEVALUATED SEISMIC HAZARD DEVELOPED IN RESPONSE TO THE MARCH 12, 2012, 50.54(f) LETTER", dated June 16, 2016 (ML 16161A477), NRC confirmed that Oyster Creek's seismic hazard mitigation strategies assessment (MSA) is consistent with the guidance in Appendix H.4.1 of NEI 12-06, Revision 2, as endorsed, by JLD-ISG-2012-01, Revision 1. Therefore, the methodology used by Oyster Creek is appropriate to perform an assessment of the mitigation strategies that addresses the reevaluated seismic hazard. The NRC staff concluded that sufficient information has been provided to demonstrate that Oyster Creek's plans for the development and implementation of guidance and strategies under Order EA-12-049 appropriately address the reevaluated seismic hazard information stemming from the 50.54(f) letter.

Since an earthquake could damage non-seismically designed structures and equipment, they may fail in a manner that would prevent accomplishment of FLEX-related activities (normal access to plant equipment, functionality of non-seismic plant equipment, deployment of beyond-design-basis (BDB) equipment, restoration of normal plant services, etc.). Alternate FLEX strategies and alternate deployment paths have been developed to accommodate impact from a seismic event. Debris removal equipment is stored in the FLEX Storage Pads.

Existing evaluations concluded that based on the original soil borings, and the soil borings performed for the installation of the security walls around the Emergency Diesel Generator Building, the consequence of soil liquefaction would not adversely affect the FLEX strategies at Oyster Creek. Additional evaluation was performed with new bore holes to assess the impact of soil liquefaction at the off-site SAFER staging area. It was concluded that the consequence of soil liquefaction at the SAFER staging area would not adversely affect the FLEX strategies.

2.6.2 External Flooding

Site Information:

The OCGS site is located on the eastern coastline of New Jersey, about two miles inland from the shore of Barnegat Bay and about seven miles west northwest of Barnegat Light. It is approximately nine miles south of Toms River, New Jersey, 50 miles east of Philadelphia, Pennsylvania, and 60 miles south of Newark, New Jersey (OCGS UFSAR). Site grade elevation is 23 feet (ft) mean sea level (MSL). The deck elevation of the intake structure is set at elevation 6.0 ft MSL. Hurricane storm surge analysis performed after the completion of the OCGS concluded a Probable Maximum Hurricane (PMH) still water level of +22 ft MSL could occur at the site. During such an event, the safety related buildings and structures at the plant island remain above flood levels. However, the Intake Structure deck, which is at an elevation of 6 ft, will become flooded. The Circulating Water, Service Water and Emergency Service Water pumps installed on this deck will have to be shutdown, leading to the shutdown of the reactor (OCGS UFSAR).

Current Design Basis:

a. The current design basis is defined in the OCGS UFSAR and by reference to an NRC Systematic Evaluation Program (SEP). The following is a list of flood causing mechanisms and their associated water surface elevations that were considered for the OCGS current design basis.

1. LIP – The UFSAR indicates that the topography of the plant site is such that the surface drainage flows from the high point in the center of the island towards the intake canal to the north and west, the discharge canal to the south and west, and Route 9 to the east. The UFSAR by reference to the SEP indicates that due to the

time lag between the runoff and rainfall, some local site ponding occurs but it does not result in flooding of the site. The flood elevation for the Probable Maximum Precipitation (PMP) was established at 23.5 ft. MSL (OCGS UFSAR).

2. Flooding in Streams and Rivers – The UFSAR by reference to the SEP identifies that no flooding due to PMF (Probable Maximum Flood) on streams and rivers that would affect safety related structures has been postulated for the site. Water levels in Barnegat Bay and at the plant site are influenced solely by storm and tidal action. There is no significant stream flow in either the Oyster Creek or the Forked River. Floods or droughts in these streams will not have a measurable effect on the water levels at the plant (OCGS UFSAR).

3. Dam Breaches and Failures – Two small dams are located on the Oyster Creek. Incremental flood flows were calculated based on their breaching by any unspecified cause as part of the SEP. It was determined that no flooding which would affect safety related structures is postulated for the site (OCGS UFSAR).

4. Storm Surge – Due to the proximity of the site to Barnegat Bay and the Atlantic Coast, and the relatively small size of the onsite freshwater streams, it was noted in the design stage that storm and tidal flooding should be used as the design basis in establishing the elevations of various plant components. Several detailed studies of flooding potential due to probable maximum surges and wind wave action have been performed. The two more important studies were conducted by Eaton and Haeussner, Consulting Engineers, and Dames and Moore Inc. The maximum flood still water level is based on storm surge from the probable maximum hurricane (PMH). The maximum flood still water level at the plant site is identified as Elevation 22 feet MSL, with an additional height of less than 1 ft. that represents the maximum wave run-up at the plant site (OCGS UFSAR).

5. Seiche – Seiche was not considered in the OCGS UFSAR.

6. Tsunami – The UFSAR indicates flooding due to tsunamis was not considered for OCGS. Tsunamis were not considered typical of the eastern coast of the United States and were not included in the design basis (OCGS UFSAR).

7. Ice Induced Flooding – The UFSAR indicates that during normal plant operation, icing has been limited to the canal area outside of the steel trash grates. The area in close proximity to the intake, where the suction of the pumps is taken, is kept from freezing by the thermal dilution gates, which recirculate discharge water through the intake bay, and by the turbulence induced by the circulating water pumps. The discharge canal remains free of ice during normal operation due to the plant heated effluent (OCGS UFSAR). The UFSAR also indicates that it is unlikely that ice blockage would cause problems to any safety related systems as the emergency

service water flow utilizes approximately only 3 percent of the design capacity of the 6 screens on the intake structure (OCGS UFSAR).

8. Channel Migration or Diversion – Channel migration and diversion was not considered in the OCGS UFSAR.

9. Combined Effect Flood (including Wind-Generated Waves) – The UFSAR indicates that the PMH still-water level at the plant site was calculated to be 22.0 feet MSL. The UFSAR also indicates that an additional height of less than 1.0 feet represents the maximum wave run-up at the plant site (OCGS UFSAR).

b. Flood Related Changes to the License Basis:

OCGS is in the process of implementing strategies to better cope with PMF flooding under the current licensing basis. No other physical modifications have been installed specifically in support of the external flooding response, with the exception of the dike at the diesel generator building. Plant procedures in response to external flooding have been revised to reflect abnormal conditions such as high intake levels throughout the life of the plant.

c. Changes to the Watershed and Local Area since License Issuance:

The watershed contributory to the Oyster Creek is 11.4 square miles and the watershed contributory to the South Branch of the Forked River is 2.5 square miles (Exelon 2013a). Based on aerial images of the watershed, the changes to the watershed include commercial and residential development within the watershed area. The changes to the local area sub watershed for the OCGS include building and security barrier upgrades that have been added to the site since license issuance.

d. Current Licensing Basis Flood Protection and Pertinent Flood Mitigation Features:

The current license basis maximum flood level due to PMH is elevation 22 ft MSL. The plant grade, elevation 23 ft MSL, is one foot above the PMH flood level. Therefore, the flood will not find its way into the plant buildings, the floor levels of which are generally six inches above grade at elevation 23'-6". The intake structure with its deck at elevation 6 ft will be under water. This deck supports, apart from the other equipment, the circulating water pumps, service water pumps and the emergency service water pumps. During a PMH flood, the circulating water, service water pumps and the emergency service water pumps will become inoperable and thus emergency plant procedures have been instituted which require the plant to be shutdown when flood waters reach a predetermined level as to ensure the capability for safe shutdown under either normal or abnormal conditions.

The two entrances to the emergency diesel generator building are at elevation 23 ft. MSL, which is 6 inches below the flooding level which would be caused by local probable maximum precipitation (23.5 ft. MSL). A 6 inch high asphalt dike is provided at these entrances to provide protection against internal flooding of the emergency diesel generator building (OCGS UFSAR).

SUMMARY OF FLOOD HAZARD REEVALUATION:

NUREG/CR-7046 *Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America* (NUREG/CR-7046), by reference to the American Nuclear Society (ANS), states that a single flood-causing event is inadequate as a design basis for power reactors and recommends that combinations should be evaluated to determine the highest flood water elevation at the site. For the OCGS site, the combination that produces the highest flood water elevation at the site is the probable maximum storm surge due to a probable maximum hurricane combined with the probable maximum flood due to all-season PMP on the Oyster Creek and South Branch of Forked River watershed and the effects of coincident wind wave activity.

The UFSAR Section 2.4 provides elevations in MSL datum. The hazard reevaluation calculations provide elevation results based on the North American Vertical Datum (NAVD 88). Based on the datum information available from the nearest National Oceanic and Atmospheric Administration (NOAA) gage at Barnegat Inlet (NOAA 2013), the difference in datum between MSL and NAVD88 is 0.02 ft. NOAA 2013 suggests-

MSL (ft) = NAVD88 (ft) – 0.02

The reevaluation results were mostly bounded by the original Oyster Creek UFSAR/USAR site flooding vulnerabilities and characteristics evaluations. No new flooding hazards were identified in the reevaluation and the limiting flood event for Oyster Creek continues to be a Local Intense Precipitation (LIP) event.

The OC FHRR report describes the approach, methods, and results from the reevaluation of flood hazards at the site. The nine flood-causing mechanisms and a combined effect flood are described in the report along with the potential effects on OC. Only one reevaluated flood mechanism, Local Intense Precipitation (LIP) for OC, exceeded the current design basis flood. The assumed flood duration will last for 2 hours at the major doors. The flood elevation height has increased above the current license basis value (23.5 feet) by 0.88 feet. Details of the LIP event can be obtained from Local Intense precipitation evaluation report, rev 8. Flooding protective measures have been proceduralized and integrated into FLEX strategy implementation. The reevaluated flood hazard will not prevent OC from implementing

FLEX strategies provided the specified flooding protective measures planned are implemented.

2.6.3 Severe Storms with High Wind

Oyster Creek Nuclear Generating Station is located in Lacey Township, New Jersey, roughly 9 miles south of Toms River, 50 miles east of Philadelphia, Pennsylvania, and 75 miles south of New York City. OCGS Coordinates per Wikipedia (Reference 18) is: 39°48'53"N latitude, 74°12'18"W longitude. The plant gets its cooling water from Barnegat Bay, a brackish estuary that empties into the Atlantic Ocean through the Barnegat Inlet.

The site is adjacent to Oyster Creek, about two miles inland from the shore of Barnegat Bay. Per NEI 12-06 guidance hurricanes and tornado hazards are applicable to Oyster Creek. Figure 7-2 from the NEI FLEX implementation Guide was used for this assessment. Thus, Oyster Creek screens in for an assessment for High Wind Hazard.

Large FLEX equipment pumps and generators (N & N +1) are normally stored on the outdoor FLEX Storage Pads. During predicted hurricane conditions, site procedures will relocate the large FLEX equipment to site truck bays. The N set of large FLEX equipment will be moved into the Turbine Building truck bay, a robust building meeting the plant's design basis for high wind hazards. The N set of cable and hoses, that are pre-staged in the Turbine and Reactor buildings will not need to be relocated. Turbine and Reactor buildings are robust buildings meeting the plant's design basis for high wind hazards. The N+1 of large FLEX equipment will be relocated to the LLRW (Low Level Radwaste) truck bay.

The FLEX Storage Pads, located inside the PA, are located in such a manner as to avoid the damage of both sets in the case of a tornado. The pads are located approximately 1200 ft. apart. The FLEX Storage Pad location and storage strategy is contained in "Appendix 1" and incorporates the guidance contained in FAQ 2013-01 Tornado Missile Separation (Reference 19).

Below are the details the storage strategy for tornado winds. The maximum recorded tornado width in Ocean County was 750 ft. and the typical approach path is from the West Southwest (WSW) (historical data, Reference 21).

Figure 3: FLEX Storage Pad location for tornado wind protection

Historical Tornado storm data provided by NOAA National Weather Service (http://www.spc.noaa.gov/wcm/) for New Jersey from 1950 to 2013 was reviewed. There were 12 recorded tornados in Ocean County. The widest recorded path was 750 ft. Most tornados were of short contact duration so a travel path or bearing could not be obtained. In those cases only the contact width was considered. Three tornados provided touch down and lift off coordinates. These points provide an overall direction of travel. Tornados in Ocean County that had travel path data recorded have had a travel path from West-Southwest (WSW) 241.88° to 253.12. °

Figure 4: Tornado Data for Ocean county 1950 to 2013 (Reference 21)

Date	Time	Event #	F-scale	Width in feet	Begin latitude	Begin longitude	End latitude	End longitude	*Begin County	*End County
6/13/1958	16:45:00	2	1	450	40.03	-74.07	0	0	29	0
7/1/1960	16:00:00	3	1	150	40.05	-74.05	0	0	29	0
3/10/1964	14:20:00	1	1	600	39.83	-75.15	40.2	-74.17	15	29
7/24/1974	17:30:00	2	1	150	39.8	-74.2	0	0	29	0
6/29/1982	17:15:00	1	2	69	39.88	-74.25	0	0	29	0
7/21/1983	19:30:00	1	3	30	39.67	-74.28	0	0	29	0
8/17/1988	17:30:00	5	0	300	40.1	-74.22	0	0	29	0

11/20/1989	20:00:00	17	0	51	39.92	-74.1	0	0	29	0
10/21/1995	9:15:00	5	0	90	39.83	-74.18	0	0	29	0
8/20/1999	13:50:00	2	2	300	39.55	-74.25	0	0	29	0
9/16/2010	16:05:00	1	1	750	40.06	-74.49	40.07	-74.45	29	0
8/13/2013	8:05:00	0	0	300	39.6849	-74.2688	39.7133	-74.2223	29	0

*County code 29 = Ocean County

A straight line draw between the FLEX Storage Pads (red line) provides a bearing of approximately 310°. This rotation from a direct north to south orientation provides a separation of approximately 1050 ft. (blue line) when the site is approached along the typical tornado path for Ocean County of WSW (yellow and black lines).

Figure 5: FLEX Storage Pad locations for tornado path for Ocean County

Storage Pads have a separation of approximately 1050 ft. when tornados approach from the WSW. (Appendix 1 section 2.3). The Storage Pad locations were chosen to keep the FLEX equipment from being blocked from downed power lines. Downed power lines are one of the most likely site damage scenarios that can delay FLEX deployment.

Equipment (N set hose and cable) normally stored in the Turbine and Reactor Buildings meet the plant's design basis for high wind hazards. The N+1 set of cable and hoses can be stored at either pad location due to the pre-staging of the N set of cable and hoses in a robust structure.

During predicted hurricane conditions procedures will relocate the equipment to site truck bays. The F750 (or equivalent), FLEX generator, and FLEX pump will be stored the Turbine Building truck bay, a robust building meeting the plant's design basis for high wind hazards. The N+1 FLEX generator and FLEX pump will be relocated to the LLRW truck bay.

This strategy is in accordance with FAQ 2013-07 Reasonable Protection (Reference 20). Where for a single unit site One set (N) will be stored in a structure(s) that meets the plant's design basis for high wind hazards (hurricane) and one set (N+1) stored in a location not evaluated for protection from high (hurricane) winds.

The primary truck bay location for the N+1 equipment will be the Low Level Radwaste (LLRW) storage building. The roll up door for the LLRW truck bay has a manual override and does not need electrical power to be opened.

FLEX equipment pumps and generators (N & N +1) will be stored outdoors on pads The pads will be located in such a manner as to avoid the damage of both sets in the case of a tornado. The pads are located approximately 1200 foot apart. The FLEX Storage Pad location and storage strategy is contained in "Appendix 1" and incorporates the guidance contained in FAQ 2013-01 Tornado Missile Separation (Reference 19). Appendix 1 Section 2 details the storage strategy for tornado winds. The maximum recorded tornado width in Ocean County was 750ft and the typical approach path is from the West South West (WSW) (see historical data Appendix 1 section 2.2).

Storage Pads have a separation on approximately 1050 feet when tornados approach from the WSW. The Storage Pad locations were chosen to keep the FLEX equipment from being blocked from downed power lines. Downed power lines are one of the most likely site damage scenarios that can delay FLEX deployment.

FLEX equipment stored at the pads is secured to prevent damage or becoming airborne.

The most limiting event for flooding is a combined flooding event which includes hurricane driven wave run up and a LIP event (i.e. Combine Event). Relocation of FLEX equipment for flooding is therefore bounded by hurricane conditions. Equipment (N set hose and cable) normally stored in the Turbine and Reactor Buildings meet the plant's design basis for high winds, and severe weather hazards.

Primary FLEX strategies system connections located indoors and are located at or above the site 23' elevation.

Site procedure OP-OC-108-109-1001, Severe Weather Preparation TRM for Oyster Creek has been updated with the data from the flooding reevaluation. The procedure revision includes areas to protect, pre-staging of materials, and time for deployment.

During predicted hurricane or heavy snow conditions site procedures will relocate the equipment to site truck bays.

During predicted hurricane conditions or heavy snow the N set of FLEX equipment will be stored in the Turbine Building. This is the N set of cables and hoses normal pre-staged location. The F750, FLEX generator and FLEX pump will be stored the Turbine Building truck bay, a robust building, meeting the plant's design basis for high wind hazards.

This strategy is in accordance with FAQ 2013-07 Reasonable Protection (Reference 20). Where for a single unit site One set (N) will be stored in a structure(s) that meets the plant's design basis for high wind hazards (hurricane) and one set (+1) stored in a location not evaluated for protection from high (hurricane) winds.

The primary N+1 FLEX Equipment storage location for hurricane conditions is the Low Level Radwaste building (LLRW). The LLRW building has a roll up door with a manual override, and as such, it does not require power to open the door and access or deploy the FLEX equipment.

The blue lines in the below photo, show the relocation of the FLEX equipment from outdoor storage locations to its temporary storage locations for predicted hurricanes or predicted heavy snow or icing accumulations.

Figure 6: FLEX Storage Pad Equipment Relocation due to Hurricane

2.6.4 <u>Ice, Snow and Extreme Cold</u>

The guidelines provided in NEI 12-06 (Section 8.2.1) generally include the need to consider extreme snowfall at plant sites in the northeastern U.S. above the 35th parallel. The OCGS is located above the 35th parallel (actual latitude and longitude N 39° 49' and W 74° 12') and thus the capability to address impedances caused by extreme snowfall with snow removal equipment need to be provided. Icing effects have been considered during the Systematic Evaluation Program (SEP) assessment. During normal plant operation, icing has been limited to the canal area outside of the steel trash grates. The area in close proximity to the intake, where the suction of the pumps is taken, is kept from freezing by the thermal dilution gates, which recirculate discharge water through the intake bay, and by the turbulence induced by the circulating water pumps. The discharge canal remains free of ice during normal operation due to the plant-heated effluent.

It is unlikely that ice blockage would cause problems to any safety related systems as the emergency service water flow utilizes approximately only 3 percent of the design capacity of the 6 screens on the intake structure (UFSAR section 2.4.7). The FLEX equipment is moved into a building that is heated during the winter months. The FLEX Storage Pad locations are maintained energized, and the FLEX pump engine and Ford F750 truck both have block heaters.

The site is subject to heavy winter storms. Based on figure 8-1 in NEI 12-06 (Section 8.2.1), impedance caused by extreme snowfall with snow removal equipment has to be considered for FLEX equipment deployment. The FLEX truck (Ford F750) is equipped with a plow for debris and snow removal.

Thus, the Oyster Creek site screens in for an assessment for Extreme Cold Hazard Assessment.

Equipment normally pre-staged in the Turbine and Reactor Buildings meet this requirement.

For predicted snow, ice plant procedures will direct the relocation of the N set of FLEX equipment to the Turbine Building truck bay; this location meets the plant's design basis for the snow, ice and cold conditions. When stored outdoors at the FLEX Storage Pad power will be provided to supply direct heating (e.g., jacket water, battery, engine block heater, etc.).

Snow and ice storms can provide enough buildup to affect travel within the site. However, reasonable warning time should provide enough time for progressive snow / ice removal by normal means. Clearing of FLEX deployment pathways has been incorporated into the OCGS snow removal plan. During an event the FLEX frontend loader can be used for snow removal of FLEX deployment pathways along with the F750 which is equipped with a snow removal blade. Each of the vehicles, generators, and pumps is also equipped with a starting battery trickle charger to maintain the batteries at full charge for cold weather starts.

Diesel fuel for FLEX equipment is treated with a fuel additive during cold weather conditions to prevent gelling.

2.6.5 High Temperatures

Per NEI 12-06 Section 9.2, "all sites will address high temperatures" for impact on deployment of FLEX equipment. Per UFSAR section 2.3 Meteorology Table 2.3.2, the maximum recorded temperature at Oyster Creek as recorded at Pleasantville NJ was 106°F July of 1936. This temperature is below the maximum operating temperature of the commercial grade large FLEX equipment.

Portable diesel equipment and portable static battery chargers will be operated in areas outdoors, where the temperature will effectively be ambient. Vendor information has been reviewed to verify the equipment is expected to operate at high temperatures.

FLEX pumps and generators will be stored outdoors. The equipment will be maintained at a temperature which ensures functionality when called upon.

2.7 Planned Protection of FLEX Equipment

OCGS has constructed two FLEX Storage Pads of approximately 1200 square feet apart that meet the requirements for the external events identified in NEI 12-06, such as earthquakes and storms (high winds, and tornadoes). The FLEX Storage Pads are positioned inside the Protected Area (PA) at the far NW and SE locations.

The FLEX Storage Pads are designated as a seismic Category I.

Large FLEX portable equipment such as the F750, pumps, generators, frontend loader, hose trailers, are secured with tie-down straps to seismic block anchors located at the FLEX Storage Pads to protect them during a seismic event.

Debris removal equipment such as the F750 and FLEX frontend loader are secured at the FLEX Pads in order to be reasonably protected from external events such that the equipment will remain functional and deployable to clear obstructions from the pathway between the FLEX Storage Pads and its deployment location(s).

Deployments of the FLEX and debris removal equipment from the FLEX Storage Pads are not dependent on off-site power. Because the FLEX Storage Pads are outdoors, all actions required to access and deploy debris removal equipment and BDBEE/FLEX equipment can be accomplished manually.

As required by NEI 12-06, all equipment credited for implementation of the FLEX strategies at OCGS is either stored at the FLEX Storage Pads or in a plant structure that meets the station's design bases for Safe Shutdown Earthquake (SSE), specifically the OCGS Reactor Building, Turbine Building, and Main Stack.

For severe storms, such as, high winds, hurricanes, and tornados, OCGS may have some significant "warning time" prior to the event. Actions would be performed to ensure the station is ready per ABN-31 (High Winds), and OP-OC-108-109-1001 (Severe Weather Preparations TRM – Reference 51).

The most limiting event is a combined flooding event which includes hurricane driven wave run up and a LIP event (i.e. Combine Event. Relocation of FLEX equipment for flooding is therefore bounded by hurricane conditions). Equipment (N set hose and cable) normally stored in the Turbine and Reactor Buildings meet the plant's design basis for high winds, and severe weather hazards. Primary FLEX strategies system connections located indoors and are located at or above the site 23' elevation.

Site procedure OP-OC-108-109-1001, Severe Weather Preparation TRM for Oyster Creek has been updated with the data from the flooding reevaluation. The procedure revision includes areas to protect, pre-staging of materials, and time for deployment.

During predicted hurricane or severe weather conditions site procedures will relocate the equipment to site truck bays.

During predicted hurricane conditions the N set of FLEX equipment will be stored in the Turbine Building. This is the N set of cables and hoses normal pre-staged location. The FLEX diesel generator and diesel pump will be stored the Turbine Building truck bay, a robust building, meeting the plant's design basis for high wind hazards.

This strategy is in accordance with FAQ 2013-07 Reasonable Protection (Reference 20). Where for a single unit site One set (N) will be stored in a structure(s) that meets the plant's design basis for high wind hazards (hurricane) and one set (+1) stored in a location not evaluated for protection from high (hurricane) winds.

The N+1 FLEX Equipment storage location for hurricane and will be the Low Level Radwaste building (LLRW). The LLRW building has a roll up door with a manual override and as such it does not require power to open the door and access or deploy the FLEX equipment.

The blue lines in the below photo, show the relocation of the FLEX equipment from outdoor FLEX Storage Pad locations to its temporary storage locations for predicted hurricanes or predicted severe weather conditions. The NW FLEX Storage Pad is moved to LLRW as indicated by the "red" flag in figure 7. The SE FLEX Storage Pad is move to Turbine Building Truck Bay as indicated by the "green" flag in figure 7.

Figure 7: Site Storage Locations due to Severe Weather

2.8 Planned Deployment of Flex Equipment

2.8.1 Haul Paths and Accessibility

Pre-determined, preferred haul paths have been identified and documented in procedure FSG-05: Debris Removal and FLEX Equipment Deployment (Reference 32). Figures 8 and 9 show the primary and alternate haul paths from the SE FLEX Storage Pad to deployment locations. Figures 10 and 11 show the primary and alternate haul paths from the NW FLEX Storage Pad to deployment locations. Due to the two FLEX Storage Pad locations; there are four haul pathways for deployment. Although these haul paths have been walked down for possible obstructions in FSG-05, it is reasonable to assume that one of four haul pathways will have the existence of debris, such that, timely FLEX strategy deployment will occur. Debris removal equipment is stored at the FLEX Storage Pads where it is protected from the severe storm and high wind hazards, such that, the equipment remains functional and deployable to clear obstructions from the pathway between the FLEX Storage Pads and the deployment location(s).

The outdoor FLEX Storage Pads are constructed and evaluated to withstand the maximum potential earthquake stresses for the site. The Storage Pads will have electrical connections available to provide power to FLEX equipment chargers and block heaters. From ECR OC-14-00027, the electrical power source for the Northwest Storage Pad is supplied by JCP&L Line #69361, and the electrical power source for the Southeast Storage Pad is supplied by JCP&L Line #67401. Therefore, should one electrical source fail the other electrical source will be available.

The Storage Pads use diverse locations to provide FLEX equipment protection from tornado winds. The Storage Pads will be located along a circular deployment path. Equipment from the pads can travel either clockwise or counter clockwise to reach its deployed location. Additionally in selecting diverse FLEX storage locations, consideration was given to the location of the diesel generators and switchyard such that the path of a single tornado would not impact all locations.

The northwest pad is located to the north of the maintenance office building (Old North guard house). The pad will contain one (1) Kubota frontend loader, one (1) 500KW FLEX generator, one (1) FLEX pump, one (1) hose trailer, and one (1) Seavan container for small equipment storage. The pads will have electrical connections available to provide power to FLEX equipment chargers, block heaters, and lighting. The items listed for storage at the pad may be adjusted to ensure that a complete N set of equipment is available for deployment after a given hazard. The FLEX equipment is stored with sufficient means of anchorage to prevent seismic interaction with nearby components. The northwest pad is located as to avoid seismic interaction with buildings in the area. It is also positioned to avoid downed power lines from blocking the FLEX equipment deployment paths.

The southeast pad is located to the east of the OCAB. The pad is located at a distance so that a toppled building in a seismic event would not fall on the equipment. The pad will contain one (1) F750 truck, one (1) 500KW FLEX generator, one (1) FLEX pump, and (1) Seavan container for small equipment storage. The items listed for storage at the pad may be adjusted to ensure that a complete N set of equipment is available for deployment after a given hazard. The FLEX equipment will be stored with sufficient means of anchorage to prevent seismic interaction with nearby components. The southeast pad is located as to avoid seismic interaction with buildings in the area. It is also positioned to avoid downed power lines from blocking the FLEX equipment deployment paths.

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

Doors and gates serve a variety of barrier functions on the site. One primary function is security and is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and HELB (High Energy Line Break). As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following a BDBEE and subsequent ELAP/LUHS event, FLEX coping strategies require the routing of hoses and cables to be run through various barriers in order to connect FLEX equipment to station fluid and electrical systems. For this reason, certain barriers (gates and doors) will be opened and remain open. This violation of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies.

The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms are barriers of concern. The Security force will initiate an access contingency upon loss of power as part of the Security Plan. Access to the Owner Controlled Area, site Protected Area, and areas within the plant structures will be controlled under this access contingency as implemented by Security personnel.

The deployment of onsite FLEX equipment to implement coping strategies beyond the initial plant capabilities (Phase 1) requires that pathways between the FLEX

Storage Pads and various deployment locations be clear of debris resulting from seismic, high wind (tornado), excessive snow/ice, or flooding events. Clearing of FLEX deployment pathways are part of the OCGS snow removal plan. Signs requiring paths and areas to remain clear of obstructions have been posted along deployment pathways and at FLEX equipment deployment locations.

The FLEX debris removal equipment includes a F750 truck equipped with a snow removal blade and tow connections in order to move or remove debris from the needed travel paths. A Kubota frontend loader is also available to deal with significant debris conditions when deployment is from the NW FLEX Storage Pad location. FLEX debris removal hand tools such as tow chains, diesel-powered chainsaws, axes, sledgehammers, shovels, Cant hook, bolt cutters, etc. are also available. This equipment is stored in two Seavans located at each FLEX Storage Pad.

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC with various commodities such as fuel and supplies. Transportation of these deliveries will be through airlift or via ground transportation utilizing the OCGS SAFER Response Plan (Reference 61). Debris removal for the pathway between Staging Areas 'A' and the NSRC receiving location Staging Area 'B' and from the various plant access routes may be required based on conditions present.

Figure 8: Southeast FLEX Storage Pad Location and Haul Route – Primary
(Figures 8-11: **RED**: FLEX Pump staging location; **BLUE**: FLEX Generator staging location)

Figure 9: Southeast FLEX Storage Pad Location and Haul Route – Alternate

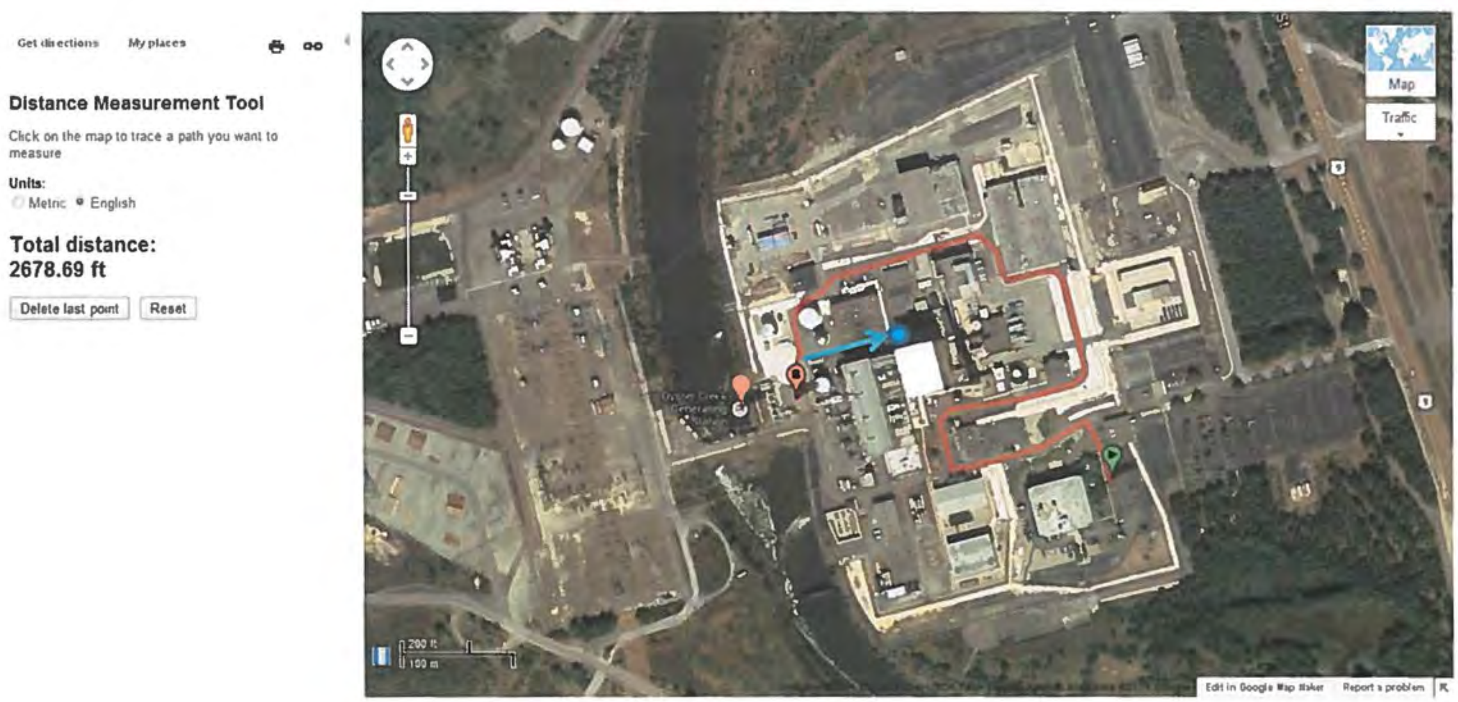


Figure 10: Northwest FLEX Storage Pad Location and Haul Route - Primary

Figure 11: Northwest FLEX Storage Pad Location and Haul Route - Alternate

2.9 Deployment of strategies

2.9.1 Makeup Water Supply Strategy

Barnegat Bay provides an indefinite supply of water as make-up to the Canal Intake/Discharge structure. Canal water is normally clear of heavy debris. Heavy debris is filtered via the intake trash grates, and further filtering of debris is performed by the intake trash screens due to the size of screen holes being 3/8" by 3/8." Primary suction will be drawn from the Circulating Water System discharge tunnel, and the alternate suction will be drawn from the area between the intake screens and the CWPs (Circulating Water Pumps). Canal water will be flowing at a very low velocity due to loss of power to all intake pumps, therefore, it is not expected that significant debris will be carried into the area where the FLEX Pumps will be taking their suction. However, to be conservative, an inlet barrel strainer (with one inch circular holes) will be installed at the end of the suction hose.

The portable FLEX Pump will be transported from the FLEX Storage Pads to a location near the selected water source. At the intersection of the intake and the dilution plant roadways, the chemistry discharge tunnel sample point penetration is used as the primary FLEX suction point. This penetration is hinged and painted for easy access and identification. The penetration is sized such that it easily accommodates the 6" diameter suction hoses, hose fittings, and suction strainer. The cross sectional area through this strainer is large compared to the cross sectional area of the suction hose such that pressure losses are expected to be negligible. Should debris block a portion of the inlet strainer, there will still be enough flow area to prevent significant pressure loss that would jeopardize the NPSH (Net Positive Suction Head) at the pump suction. Particulate small enough to pass through the inlet strainer will also pass through the FLEX Pumps without adverse impact. The suction end of the barrel strainer will be located at an elevation well below the water surface but well above the floor of the discharge tunnel, preventing any debris floating near the surface and preventing debris that may have settled on the bottom of the tunnel to be lifted into the suction hose.

An alternate staging area for the FLEX Pump and suction hose is available from the east side of the CWPs. In the event the primary suction point is not accessible, the alternate staging area will be used. In order to access the circulating water system intake tunnel, deck plate access openings can be repositioned in between the Intake Traveling Screens and the CWPs. The 6 inch suction hose can be routed from the FLEX Pump suction through the opening in the deck plate to the water source where water will be drawn through a strainer to further limit solid debris to prevent potential damage to the FLEX Pump. Here to, the suction end of the barrel strainer will be located at an elevation well below the water surface but well above the floor of the intake canal, thus preventing any debris floating near the surface and preventing debris that may have settled on the bottom of the tunnel to be lifted into the suction hose.

2.9.2 RPV Make-up Strategy

The FLEX Pumps are stored on the FLEX Storage Pads and are protected in accordance with the guidance of NEI 12-06.

The Primary water make up to the RPV, Isolation Condensers, and SFP, will all be via a permanently installed FLEX manifolds, located in the Reactor Building 23' North and RB 95' Northeast. The RB 23' FLEX manifold will receive water from the portable FLEX Pump and feed the RB 95' FLEX manifold via an installed mechanical riser. When not in use, the two installed manifolds will be in standby readiness. The RB 23' FLEX manifold provides the ability for a single operator to control the flow rate to the primary RPV injection point (Core Spray System 1) when deployment of the primary injection paths is successful. Five inch diameter hose is used to make the connection between the FLEX Pump discharge and the inlet of the RB 23' FLEX (distribution) manifold. A hard pipe connection is installed between the RB 23' FLEX manifold and Core Spray (CS) System 1. When V-917-14, V-917-19, and one of two CS System 1 Parallel Isolation valves are opened, a makeup flow path exists between the manifold and the RPV. Once the FLEX pump has started and pressurized the RB 23' FLEX manifold, makeup to the RPV will be executed via the batch feed method. Another connection on the outlet side of the manifold is used as a minimum flow line (ESW – Emergency Service Water discharge overboard). The minimum flow line also supports the FLEX freeze protection strategy of maintaining flow in supply hoses routed outside of buildings.

If Core Spray System 1 is not available, an alternate method to makeup to the RPV is through Core Spray System 2. Three inch diameter hose is run from the RB 23' FLEX manifold to the drain line on Core Spray System 2; similar to the connection method used on CS System 1. From the Reactor Building 23' FLEX manifold, the 3" diameter hose is routed SE, then wraps along the length of the RB east wall, and then connects to CS System 2 approximately halfway down the length of the RB south wall. To make this connection it will take two lengths of three inch 100' hose which is stored in the north FLEX hose cabinet. With the hoses staged, V-917-14 and V-917-17 opened, and one of two CS System 2 Parallel Isolation valves opened, a makeup flow path exists between the RB 23' FLEX manifold and the RPV.

Primary RPV make-up utilizes the short run of hard pipe only. No hoses are required to be staged between the RB 23' manifold and CS System 1 to establish RPV makeup capability.

2.9.3 Isolation Condenser Make-up Strategy

Primary Isolation Condenser (IC) make-up strategy uses a permanent hose connection point on Reactor Building 95' elevation using the IC common drain line V-14-132. Three inch hose is connected from the RB 95' FLEX manifold to V-14-132. The FLEX Pump takes suction from CWP discharge tunnel at the canal location to supply water from the CWP discharge tunnel to the RB 23' FLEX (distribution) manifold. The RB 23' FLEX manifold is pressurized with the FLEX pump, the installed mechanical riser will pressurize the RB 95' FLEX manifold once V-917-20 is opened. Opening the RB 95' FLEX manifold V-917-21, opening V-14-132, opening V-11-96, sets the flow path for makeup to the ICs. With these valves opened, the opening of V-14-16 and V-14-17 will complete a makeup flow path to IC A. Additionally, the opening of V-14-15 and V-14-18 will complete a makeup flow path to IC B. Two cabinets exist on RB 95' which house six 100' lengths of hose (each cabinet with 3). Only one length of 100' hose is required to make up the connection between the RB 95' FLEX manifold and V-14-132.

For the Alternate IC make-up strategy, a FLEX Pump is used to supply Barnegat Bay canal water to the RB 23' FLEX manifold. The FLEX Pump takes suction from CWP discharge tunnel to supply water to the RB 23' manifold. Once the RB 23' FLEX manifold is pressurized, opening V-917-16, V-11-63, V-11-49, V-11-257, and closing V-9-2099, V-11-41, will set up makeup flow to either IC.

2.9.4 Spent Fuel Pool Make-up Strategy

Using the design basis maximum heat load, the SFP water inventory will heat up from 125 °F to 212°F during the first 10.3 hours. Boil-off of the Spent Fuel Pool water inventory is equivalent to 41.2 GPM. There are approximately 656 gallons per inch of level in the SFP. Using the boil-off rate identified above, preliminary calculations identify that SFP water level will lower approximately 1 foot every 3.2 hours. At 23 feet above the fuel, it will take approximately 35.25 hours to reach a level 10 feet above the spent fuel (the level below which is assumed to prohibit access to the refuel floor from a radiological perspective). Thus, the transition from Phase 1 to Phase 2 for SFP cooling function is conservatively established to occur in Phase 2 within 24 hours of the onset of the ELAP/LUHS event.

SFP cooling will be established in Phase 2 utilizing a portable FLEX pump to makeup to the SFP keeping the spent fuel covered with water. Phase 2 actions to have the FLEX pump connected and available for SFP makeup are targeted to occur at less than or equal to 6 hours from onset of the ELAP/LUHS event. By then, SFP water level should not have lowered. The Phase 2 Primary strategy uses a permanent hose connection point on Reactor Building 75' elevation for a FLEX Pump to supply canal water to the SFP. The FLEX Pump takes suction from Circulating Water

Discharge Tunnel to supply makeup water to a distribution FLEX manifold in the Reactor Building 23'. This RB 23' FLEX manifold is connected to a second FLEX manifold located on RB 95'. This second manifold has two discharge connection points to the Spent Fuel Pool. The primary SFP makeup is established by running a 3" hose from V-917-22 to the SFP diffuser connection V-18-1269 located on RB 75'. Hoses for deployment are staged in two FLEX cabinets located on RB 95'. The FLEX Pump deployment is expected to be completed within 1.5 hours of the event onset as described previously in section 2.3.

The Alternate injection method to provide water to SFP is to run a 3" hose from the FLEX manifold on RB 95' to the SFP located on RB 119'. The pump will take suction from one of two intake/discharge canal locations discussed in section 2.3.2. The 3" diameter hose from the RB 95' manifold can be attached to a spray nozzle stored on the refuel floor (for 10CFR50.54(hh)(2)). The oscillating spray nozzle can be used to provide spray flow over the SFP for cooling.

The OCGS FLEX strategy has both the primary and alternate SFP injection methods established by T≤6 hours from the initiation of the BDBE event. Because both injection methods are established at T≤6 hours, the SFP is physically readied and in standby readiness for makeup at T≤12 hours.

2.9.5 Electrical Strategy

The primary strategy (Figure 1; pg. 20) uses a portable 500KW FLEX generator to power the existing 480VAC Unit Substations 1A2 or 1B2.

Upon reenergizing USS 1A2 or USS 1B2 and closing the cross-tie breaker US2T, the 125VDC Station Battery Chargers are repowered to restore and maintain charging of the B 125VDC and C 125VDC vital batteries using FSG-12: Restoration of Plant Equipment with FLEX Generator. The connection between the portable 500KW FLEX generator and the existing 480VAC Unit Substations is via temporary power cables with color-coded connectors at a FLEX Back Feed Device staged in the 480V Room and installed in Unit Substation breaker location directed by FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator. These temporary power cables with color-coded connectors are staged inside the protected pathway. All six required power cables are stored in the Turbine Building North Mezzanine on reels and inside cabinets, such that, deployment can accomplished. Each cable is 350' in length and can be connected on one end to the FLEX generator, and the other end to the FLEX Back Feed Device in the 480VAC Room.

The Primary strategy for maintaining power to the vital DC buses is to deploy the FLEX portable generator to the northwest side of the OCGS Turbine Building. Six (6) 350 foot 4/0 power cables are routed to the FLEX generator through the northwest

TB access door (via security gate). These six FLEX generator cables are stored in six cabinets in the TB North Mezzanine. All of these FLEX cables are stored on reels within each cabinet for ease of deployment. When deployed, each FLEX cable is unreeled where one end is connected to the FLEX generator, and the other end is connected to the FLEX Back Feed Device in the 480V room. The FLEX Back Feed Device will be installed into USS 1A2 or USS 1B2 in accordance with FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator.

If the primary electrical strategy is not available, an alternate strategy exists. For example, in the primary strategy, if USS 1B2 is not available to connect to the FLEX Back Feed Device, a second FLEX Back Feed Device is available and staged in the "A" 480VAC Room to connect to USS 1A2 using FSG-12: Restoration of Plant Equipment with FLEX Generator.

This strategy uses the same portable FLEX generator to power Unit Substations 1A2 and 1B2. Upon reenergizing USS 1A2 or USS 1B2 and closing the cross-tie breaker US2T, the 125VDC Station Battery Chargers are repowered to restore and maintain charging of the B 125VDC and C 125VDC vital batteries using FSG-12: Restoration of Plant Equipment with FLEX Generator. The connection between the portable 500KW FLEX generator and the existing 480VAC Unit Substations is still via temporary power cables with color-coded connectors at a temporary FLEX Back Feed Device staged in the 480V Room and installed in Unit Substation breaker location directed by FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator. These temporary power cables with color-coded connectors are same ones staged inside the protected pathway. All six required power cables are stored in the TB MLO Mezzanine on reels and inside cabinets, such that, deployment can accomplished. Each cable is 350' in length and can be connected on one end to the FLEX generator, and the other end to the portable FLEX Back Feed Device in the 480VAC Room.

For additional strategies, a full set of six temporary power cables with color-coded connectors are staged inside the Seavans. Each Seavan has 3 power cables stored within it. These additional power cables serve two functions. One function is to replace an existing power cable in the primary pathway if needed, and two, upon the initial assessment of the magnitude of BDBEE damage, determination can be made to provide additional power to the Unit Substations with the second portable FLEX generator or provide the hardware necessary if the opportunity for quicker deployment exists in non-seismic pathways. Alternate cable route deployment is from the north direction (coming from the MAC: Main Access Control) and is detailed in FSG-06: Deployment of FLEX 480V Cables and Connection to USS 1A2/1B2.

FLEX strategy has USS 1A2 and USS 1B2 reenergized and repowering vital DC loads and vital instrumentation using the FLEX Back Feed Device at T≤2.5 hours of the event.

2.9.6 Fueling of Equipment

The FLEX strategies for safety functions and/or maintenance of safety functions involves several elements including the supply of fuel to necessary diesel powered generators, pumps, hauling vehicles, etc. The general coping strategy for supplying fuel oil to diesel driven portable equipment, i.e., pumps and generators, being utilized to cope with an ELAP / LUHS, is to draw fuel oil out of the OCGS Emergency Diesel Generator (EDG) Fuel Oil Storage Tank. The OCGS Emergency Diesel Generator Fuel Oil Storage Tank is above grade and will be accessible per the reevaluated flood hazard. In order to ensure proper sizing and strategies for appropriate response for the eventual simultaneous full implementation of FLEX mitigation strategies at OCGS, calculations associated with fuel consumption were performed assuming the equipment required for full implementation of mitigation strategies was at the full load consumption rate.

Fuel consumption for OCGS portable equipment to support FLEX (1 diesel driven portable pump, 1 diesel driven portable generator, and 6 small portable diesel driven generators) is approximately 13 GPH (gallons per hour) + 34.4 gph + 3.6 gph = 51 (gph) for all items operating at full load. The site Emergency Diesel Generator Fuel Oil Storage Tank (EDG FOST) is used as the makeup source for FLEX refuel-operations. The Technical Specification (TS) minimum fuel storage on site is 14,500 gallons in the Emergency Diesel Generator Fuel Oil Storage Tank. 14,500 gallons divided by 51 gallons per hour = 284 hours. With no other external sources of diesel fuel makeup provided to the site, this equates to approximately 11.8 days.

Figure 12: FLEX Pump and Generator Run-Time Capacities

Equipment	Fuel Tank Capacity	Full Load Consumption Rate	Total Run Time
FLEX Pump	250 gal	13 gal/hour	19.23 hrs
FLEX Generator	500 gal	34.4 gal/hour	14.53 hrs

OCGS FLEX strategy commences diesel fuel oil refuel operations at T = 14 hours, therefore, FLEX FO transfer equipment is readied at T ≤ 14 hours.

OCGS utilizes two (2) 118 gallon fuel tanks mounted on the F750, right behind the CAB area. Refuel operations are performed using FSG-19: Diesel Fuel Oil Transfer.

There are two portable Fuel Oil (FO) Transfer Rigs located in each of the FLEX Storage Pad Seavans. Upon initiation of a BDBE event, one of these two Fuel Oil transfer rigs, a portable 5500W diesel generator, and FO transfer hoses, is taken to an area just north of the Emergency Diesel Generator (EDG) Building. This location is also in close proximity of the two access pipes (ground level) that allow transition of hoses from inside the EDG building to outside the EDG building.

Once the equipment is staged, one FO hose is connected from the FO Transfer rig through one of the transitional access pipes to V-29-21 or V-29-22 (Figure 13). Due to physical location, either one of these two valves allows access to the full volume of the EDG FO storage tank. A second FO hose is connected from the portable FO transfer rig to the fill connection on the F750 truck. With the two hoses in place, the flow path between the EDG FO storage tank and the F750 for FO transfer is complete.

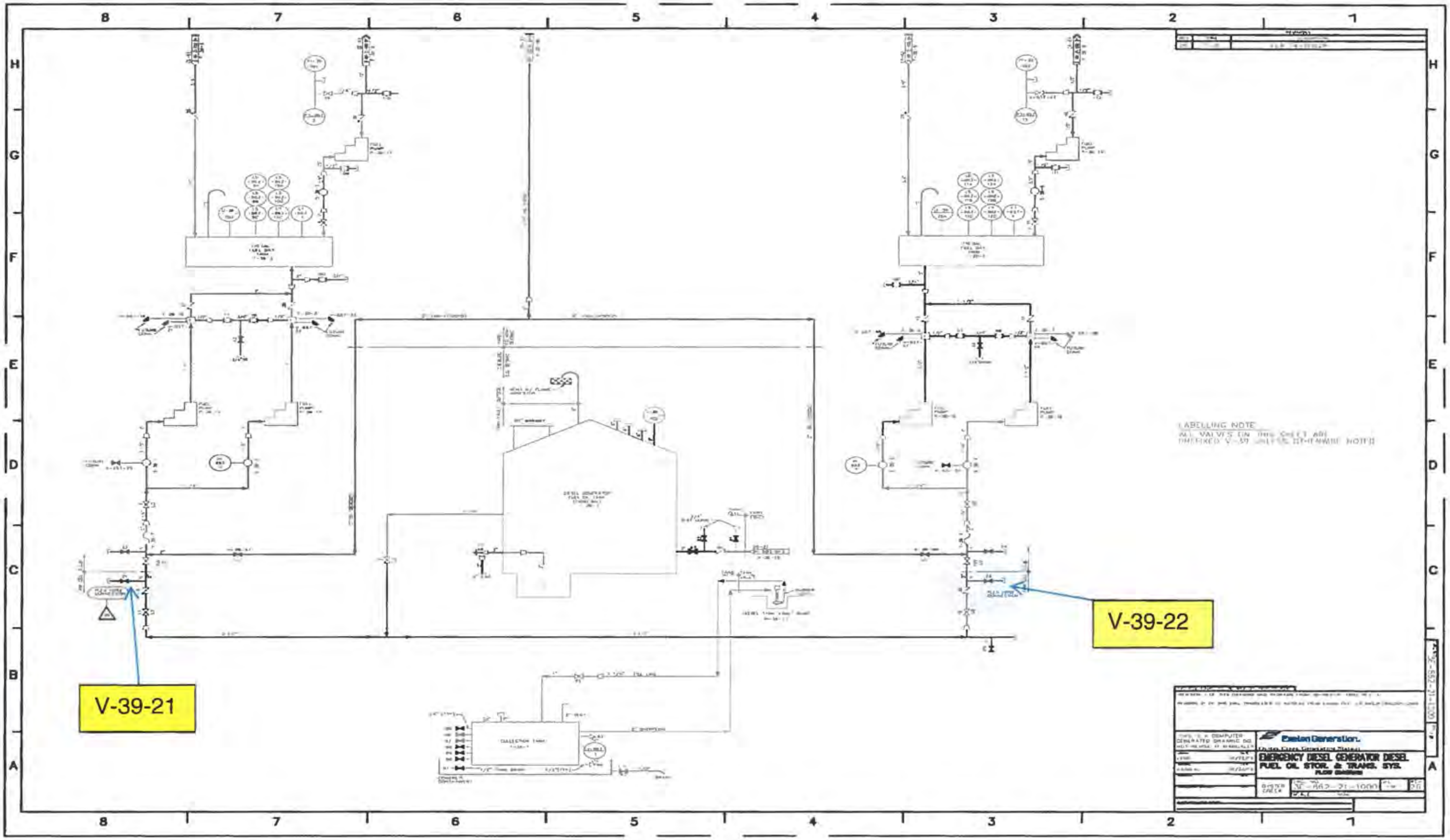
Power for the FO transfer rig comes from a portable 5500W diesel generator. Once started, the 110V FO transfer rig can be directly plugged in for use.

To meet the N+1 requirement, both the NW and the SE FLEX Storage Pads with its associated Seavans, contains a portable FO transfer rig, a portable 5500W diesel generator specific for the FO transfer rig, and two portable FO transfer hose reels with 100' of hose each.

At the SE Storage Pad location, the F750 truck contains two hose reels with another 100' of hose each. The F750 has two 18 gpm electric powered fuel pumps (one for each 100 gallon FO tank) to transfer FO from the F750 to its destination (i.e. FLEX pump, FLEX generator, etc.). These electric powered fuel pumps receive power from the F750.

At the NW Storage Pad location, a Kubota tractor equipped with frontend forks is used for FO transfer. A pallet with a 100 gallon poly tank is transported via the Kubota to the EDG building where the portable FO transfer rig is staged. The same process of filling this transport tank is used with the Kubota and the 100 gallon poly tank. Once this poly tank is filled, this tank is transported to the fill location. FO is transferred out of the poly tank at 10 gpm via an installed 12VDC pump that is integral to the 100 gallon poly tank. DC power is obtained using jumper cable clamps to the battery of the Kubota.

Figure 13: Fuel Oil Transfer Connections



2.10 Offsite Resources

2.10.1 National SAFER Response Center

The industry has established two (2) National SAFER Response Centers (NSRCs) to support utilities during BDB events. OCGS has established contracts and issued purchase orders to Pooled Inventory Management (for participation in the establishment and support of two (2) National SAFER Response Centers (NSRC) through the Strategic Alliance for FLEX Emergency Response (SAFER). Each NSRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested. The fifth set will have equipment in a maintenance cycle. In addition, on-site BDB/FLEX equipment hoses and cable end fittings are standardized with the equipment supplied from the NSRC. In the event of a BDBEE and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. For OCGS the local assembly area is the Atlantic City International Airport. From there, equipment can be taken to the OCGS site and staged at Staging Area 'B' (east side of site; just on the other side of US Highway Route 9) by helicopter if ground transportation is unavailable or inhibited. Communications will be established between the OCGS site and the SAFER team via satellite phones and required equipment moved to the site, (staging Area 'A') as needed. First arriving equipment will be delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in the OCGS SAFER Response Plan documented in procedure CC-OC-118-1002 Rev 1 (Reference 61).

2.10.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the OCGS Staging Area 'B' to support the response to a BDBEE at OCGS is listed in Table 5. Table 5 identifies the equipment that is specifically credited in the FLEX strategies for OCGS, but also lists the equipment that will be available for backup/replacement should on-site equipment break down. Since all the equipment will be located at the OCGS Staging Area 'B', the time needed for the replacement of a failed component will be minimal.

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

Following a BDBEE and subsequent ELAP/LUHS event at OCGS, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment will be lost. Per the guidance given in NEI 12-06, FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDBEE resulting in an ELAP/LUHS.

The primary concern with regard to ventilation is the heat buildup which occurs with the loss of forced ventilation in areas that continue to have heat loads. A loss of ventilation analysis was performed to quantify the maximum steady state temperatures expected in specific areas of the plant related to FLEX implementation to ensure the environmental conditions remain acceptable for personnel habitability and within equipment qualification limits, for specifically, the Main Control Room, Reactor Building, and Turbine Building. To protect station personnel from the adverse effects of performing FLEX related mitigation actions in thermally elevated environments, an evaluation of the plant areas requiring access for mitigation actions was performed and compensatory actions or restrictions were identified and incorporated into site procedures.

The key operating areas identified for all phases of execution of the FLEX strategy activities are the Main Control Room, Reactor Building, and Turbine Building. These areas have been evaluated (References 65, 66, 67, 68) to determine the temperature profiles following an ELAP/LUHS.

The Main Control Room temperature profiles are documented in the table below for Case 1 and Case 2, per Gothic Calculation: EXOC049-CALC-001: Control Room Flex Heat Up. Two cases were based on the maximum outside ambient temperature of 106°F. Based on Case 1, if no mitigating actions are taken, the Control Room temperature exceeds 110°F at approximately 41 hours. Case 2 determines that the use of one Super Vac P200S portable fan results in the Control Room temperature remaining below the acceptance criteria of 110°F for 72 hours.

Figure 14: MCR Temperature Case 1 and 2 Analysis

	1 hr. Temp (°F)	**1.5 hr. Temp (°F)**	**4 hr. Temp (°F)**	**24 hr. Temp (°F)**	**72 hr. Temp (°F)**	**Maximum Temp (°F)**
Case 1	108.0	109.7	87.5	102.3	117.9	117.9 (72 hours)
Case 2	108.0	109.7	87.5	93.2	97.0	109.7(1.5 hours)

FSG-15: Establishing MCR and Battery Room Ventilation following BDBEE will be used to maintain MCR temperatures below 110°F.

Gothic Calculation: EXOC049-CALC-002: A B Battery Room Flex Heat Up shows that the temperature in the A/B Battery Room can be maintained below the acceptance criteria of 120°F with the actions of blocking open the Office Building Vestibule Doors, Doors D-220, D-217, and D-207 at 4 hours and turning on a 9500 SCFM fan (as provided in the OIP [Ref. 8.2]) at approximately 14.5 hours after the ELAP. Figure 2 below shows that the A/B Battery Room temperature does not drop below the acceptance criteria of 60°F for the cool down case as long as Door D-220 is not opened during the transient. The temperature reaches a minimum of 77°F at 0 hours and a high of 117.8°F at 72 hours and is within the acceptance criteria of >60°F and <120°F.

The 480V Switchgear Room temperatures are documented Gothic Calculation: EXOC049-CALC-003: 480V Switchgear Room Flex Heat Up. Case 1 analyzes the temperature profile of the A and B rooms over 72 hours of an ELAP with no mitigation actions taken. Case 2 analyzes the temperature profile of the A and B rooms over 72 hours of an ELAP when mitigation actions listed in Section 1 are performed. In Case 2, mitigation actions (opening doors) are taken to ensure temperatures remain below the acceptance criteria of 120°F over the transient time.

Figure 15: Case 1 and 2 Temperatures for 1, 24, and 72 Hours

Room	Temperature at 1 hour (°F)	Temperature at 24 hours (°F)	Temperature at 72 hours (°F)	Meets Acceptance Criteria of 120°F?
		CASE 1		
A	96	114	124	No
B	97	93	103	Yes
		CASE 2		
A	96	110	120	Yes
B	97	101	111	Yes

Neither the 4160V Switchgear, A/B Room, nor the Battery C Room, exceed the acceptance criteria of 120°F over the 72 hours transient for the extreme heat case per EXOC049-Calc-004 4160 AND Battery Room C Heat Up. The diurnal outside temperature along with a low heat load in the 4160V Switchgear Room effectively mitigates the temperature rise in these rooms.

The Battery C Room does not fall below the acceptance criteria of 50°F over the 72 hours transient in the extreme cold case. The temperature reaches approximately 51°F at 72 hours. The resultant temperature of 51°F is the ambient air of the room; however, Technical Specification 4.7 monitors the temperature of the electrolyte, which would be at a higher temperature than the room itself due to the internal generation of heat from the batteries' operation.

An additional ventilation concern applicable to an ELAP/LUHS event is the potential buildup of hydrogen in the battery rooms. At OCGS, during normal plant operation, the A/B Battery Room ventilation is provided by its own A/B Battery Room ventilation system. The A/B Battery Room ventilation is non-safety related and during an ELAP condition this system is not functional. Therefore during an ELAP, the hydrogen gas will accumulate within the battery rooms. This condition had been previously analyzed for the loss of forced ventilation due to loss of offsite power in C-1302-735-E320-050, Rev 0, 20040225, Oyster Creek Batteries A, B, and C, Hydrogen Calculation.

Conservatively, for the A/B Battery Room, this calculation shows that with an ambient temperature of 77°F, it takes 218.5 hours (9.1 days) to raise the H2 concentration to 1%, and it takes 437 hours (18.2 days) to reach 2%. For the C Battery Room, this calculation shows that with an ambient temperature of 77°F, it takes 78 hours (3.25 days) to raise the H2 concentration to 1%, and it takes 156 hours (6.5 days) to reach 2%.

Conservatively, for the A/B Battery Room, this calculation shows that with an ambient temperature of 100°F, it takes 87.4 hours (3.64 days) to raise the H2 concentration to 1%, and it takes 174.8 hours (7.28 days) to reach 2%. For the C Battery Room, this calculation shows that with an ambient temperature of 100°F, it takes 31.2 hours (1.3 days) to raise the H2 concentration to 1%, and it takes 62.4 hours (2.6 days) to reach 2%.

FSG-15 will establish portable MCR ventilation in ≤ 30 hours to prevent exceeding MCR temperatures of 110°F. Unacceptable hydrogen gas concentrations in the Battery Rooms will be prevented by the performance of Attachment FSG-15. This will reestablish A/B Battery Room ventilation in ≤ 86 hours and C Battery Room ventilation in ≤ 30 hours.

2.11.2 Foul Weather Gear

OCGS onsite operation's personnel have on-hand cold weather garments and rain gear, in various sizes, for responders to wear during foul weather conditions. This same foul weather gear will be used to support outside FLEX deployment actions. All operation's foul weather gear is stored in a locker room area adjacent to the MCR.

2.11.3 Heat Tracing

Most of the equipment used to support the FLEX strategies is stored in the FLEX Storage Pads which is designed and protected from seismic events, snow, ice, and extreme cold in accordance with NEI 12-06. Equipment/tools needed to support making the connections are stored in Seavans also located at each FLEX Storage Pad location. Major components for FLEX strategies such as tow vehicles and generators are provided with cold weather protection.

FLEX Pumps once deployed will be monitored for icing conditions with minimum flow lines provided to prevent freezing of hoses when flow is not required for make-up to the RPV, ICs or SFP. The RB 23' FLEX manifold has an additional hose connection to allow water to flow to V-3-936 ESW System Overboard Discharge Valve. This will also provide anti-freeze protection if operating in cold weather.

2.12 Personnel Habitability

Personnel habitability was evaluated as in section 2.11 above and determined to be acceptable.

2.13 Lighting

A walkdown for the adequacy of supplemental lighting and for the adequacy and practicality of using portable lighting to perform FLEX strategy actions was performed. This walkdown included travel paths to various areas necessary to implement the FLEX strategies, making required mechanical and electrical connections, performing instrumentation monitoring, and component manipulations.

Battery Powered (10CFR50 Appendix "R") emergency lights were determined to provide adequate lighting for most Primary FLEX connection points in the FLEX strategies including the illumination of interior travel pathways needed to access the connection points. These emergency lights are designed and periodically tested to insure the battery pack will provide a minimum of eight (8) hours of lighting with no external AC power sources. For the FLEX areas requiring lighting not covered by Appendix "R," those areas will have available lighting using non-appendix "R" DC lighting, and using the portable flashlights carried by station operators. It is an expectation that station plant operators carry with them at all times, as part as their gear, a portable handheld flashlight.

Battery-powered portable hand lights have been provided for use by the Fire Brigade and other operations personnel required to achieve safe plant shutdown. A supply of flashlights, headlights, batteries and other lighting tools are routinely used by operators.

There are no emergency lighting fixtures in the outside areas of the protected area to provide necessary lighting in those areas where portable FLEX equipment is to be deployed. The F750 truck has hand-held flashlights that can be used while deploying FLEX Equipment to further assist the staff responding to a BDB event during low light conditions.

For additional flexibility, at each FLEX Storage Pad location, inside each Seavan, there are 5 LED stanchion lighting units that can be deployed to strategic locations if required. Within each Seavan, there are multiple lengths of extension cords (25,' 50,' 100') that can be used to power the LEDs using station power when reenergized or portable power, such as, the Yanmar portable 5500W diesel generators.

The FLEX generators repower USS 1A2 and USS 1B2 at T=2.5 hours from the initiation of the BDBEE. Therefore, at T≥2.5 hours, vital lighting power is reenergized.

For Phase 3, the NSRC is deploying portable lighting towers per the OCGS SAFER Response Plan. The deployment of three (3), 30 foot high, 440,000 lumens, and diesel-driven lighting towers from SAFER will support OCGS exterior lighting for equipment staging areas and FLEX deployment locations.

2.14 Communications

2.14.1 Onsite

Initial communication announcements to on-site personnel during a BDBEE will be via the OCGS Plant Paging and Announcement systems which are battery backed-up. If the Plant Paging and Announcement system is not available for on-site communications, bullhorns will be used to notify plant personnel of the emergency conditions in accordance with EP-AA-112-100-F-01 "Shift Emergency Director Checklist," which directs plant emergency notifications per EP-AA-112-F-09, "Emergency Public Address Announcements." Bullhorns are stored in the FLEX Communication Cabinet located in the MUX Hallway adjacent to the Main Control

Room. This hallway is part of the Turbine Building envelope and is therefore, seismically robust.

Communication between operators in OCGS Main Control Room (MCR) and FLEX deployment locations will utilize the portable handheld kHz radios in the radio-to-radio or 'talk around' mode, or the installed sound powered phone system.

Radio communications capability during a BDBEE are available to designated on-site and in-plant response team positions outlined in EP BDBEE Communications Strategy and Equipment Readiness (Document ID BDBEECS-1106). The primary strategy for on-site communications is utilization of hand-held portable handheld radios using the radio-to-radio feature also known as 'talk-around' mode. Oyster Creek has twenty seven (27) handheld radios, eighty one (81) radio batteries and nine (9) radio battery chargers. Designated Fukushima radios, batteries and chargers are stored in the 3rd flood MOB Mux hallway communications cabinet which is a protected structure.

In the FLEX Communications Cabinet, there are nine (9) Six Place Radio Chargers with Power Cords, fifty-four (54) Spare Radio Batteries, 10 Radios with Chargers and Cords, five (5) Sound Powered Phone Sets (with 150' Cord with Plugs and 1 Headset). Radio batteries and chargers in the cabinet will be powered from the portable satellite trailer generator staged east of the MOB following a BDBEE.

The backup strategy for on-site communications uses Sound Powered Phones (SPP) between FLEX deployment locations and the Main Control Rooms. Ten (10) SPP kits with headsets and cords to reach the local FLEX deployment location SPP jack and SPP kits for the MCR operators to use have been staged in the FLEX Communications Cabinet, plant storage boxes, and FLEX Storage Pads. Testing was performed to validate communication functionality via SPP system.

FLEX communication equipment is protected from hazards by storage in the FLEX Storage Pads, FLEX Communications Cabinet, or designated in-plant storage boxes in buildings that meet the plant's design bases for the Safe Shutdown Earthquake (SSE). Portable communications equipment is inventoried and functionally checked per the station PM process.

2.14.2 Offsite

A fixed satellite telephone system is available for use from within the Main Control Room. Three (3) fixed satellite telephones are available for use within the MCR if the normally installed telephone systems are not available. The essential components of the MCR satellite system (Satellite phone switch and associated eight (8) hour uninterruptable power supply and phones) are installed within the

Upper Cable Spreading Room which is a protected structure. Below is a description for the back-up MCR portable satellite system that could be tied into the essential portion of the MCR satellite system to reestablish communications.

If the fixed satellite system is not available, Iridium Satellite phones are available for use until the MCR portable satellite communications system is deployed.

Oyster Creek uses two (2) redundant portable satellite communications systems with geographical separation. Each system is designed to accommodate satellite communications to both TSC/OSC ERO staff and a back-up to the MCR satellite phones within the main control room if needed. Each portable satellite communications systems share one (1) Satellite Communications Terminal which is stored within the 3rd floor MOB Mux hallway communications cabinet. Each portable satellite communications system has one (1) portable satellite dish, one (1) satellite control cable, two (2) spools of military grade fiber, One (1) Remote Communications Terminal (RCT) and will utilize extension cords to power the SCT (Satellite Communication Terminal) and the fixed MCR satellite phone switch.

This equipment can be powered from a portable diesel generator staged east of the MOB following a BDBEE.

A detailed user aid (EP Aid OC-74) is provided in the Technical Support Center (TSC), and at the location where each portable satellite trailers are stored. This user aid provides clear instruction, where a typical nuclear worker can deploy this equipment without specific training.

2.15 Water Sources

OCGS has chosen to use Intake/Discharge Canal water from Barnegat Bay as the primary water source throughout the ELAP/LUHS event. This allows the FLEX strategy to position the FLEX Pumps at a source that can provide make-up water to the RPV, Isolation Condensers, and Spent Fuel Pool that is unlimited.

The primary water source is taken from the discharge tunnel of the OCGS Circulating Water system which draws from the Intake/Discharge Canal. The alternate water source is the area between the Intake Traveling Screens and the Circulating Water Pumps (CWPs). AR evaluation A2392457-41 was completed satisfactorily to verify that the necessary FLEX initiative flowrates can be obtained using the OCGS designed configuration (i.e. suction strainer).

At OCGS, there is a single canal drawing water from the Barnegat Bay that has an intake tunnel and a discharge tunnel.

The FLEX Pump's primary suction will be taken from the CWP discharge tunnel chemistry sample point. This suction point is downstream of the Intake Grates, downstream of the Traveling Screens, downstream of the CWPs, and downstream of the Main Condensers, therefore the normal flow process stream will filter FLEX suction water. With no flow occurring from the normal pumps due to the loss of power, the only flow will be from the FLEX Pump suction. The maximum FLEX Pump suction flow rate will be less than 500 gpm as compared to the normal flow rate of approximately 500,000 gpm from the CWPs, Service Water Pumps (SWPs), and other smaller site support intake pumps. This FLEX low flow rate through the large intake flow area results in the intake water flowing at a very low velocities. Low intake velocities will only further assist in reducing the possibility of drawing debris into the suction strainer.

The FLEX Pump 6 inch suction hose utilizes a barrel-shaped strainer submerged below the water surface. This suction strainer with 1 inch holes to prevent larger debris from becoming entrained in the pump suction line. There are up to six sections of 10' suction hose that is used to install the barrel strainer to submergence well below the water's surface and above the bottom of the CWP tunnel. This is performed using FSG-01: Operation of the FLEX Portable Pump. FSG-01 initially stages three lengths of 10' suction hose, but allows the flexibility to stage up to an additional three lengths depending on FLEX pump's positon relative to the suction point and relative to the height of the water level in the CWP discharge tunnel. The portable FLEX Pump suction flow will begin ≤100 minutes after the initial loss of power to the Circulating Water or Service Water pumps. After 100 minutes, heavier debris is not expected in the CWP discharge tunnel. If it were to exist, heavier debris in the tunnel would be expected to settle toward the bottom and lighter debris would be expected to settle toward the surface. With the suction strainer depth location staged in FSG-01, FLEX flow through the 6 inch suction hose is not sufficient to draw debris into the strainer.

An alternate staging area for the FLEX Pump and suction hose is available from the east side of the CWPs. In the event the primary suction point is not accessible, the alternate staging area will be used. In order to access the circulating water system intake tunnel, deck plate access openings can be repositioned in between the Intake Traveling Screens and the CWPs. The 6 inch suction hose can be routed from the FLEX Pump suction through the opening in the deck plate to the water source where water will be drawn through a strainer to further limit solid debris to prevent potential damage to the FLEX Pump. Here to, using FSG-01, the suction end of the barrel strainer will be located at an elevation well below the water surface but well above the floor of the intake canal, thus preventing any debris floating near the surface and preventing debris that may have settled on the bottom of the tunnel to be lifted into the suction hose. Again, due to loss of power to the intake pumps, this FLEX low flow rate through the large intake flow area results in the intake water flowing at very low velocities. Low intake velocities will only further assist in reducing the possibility of drawing debris into the suction strainer.

2.16 Shutdown and Refueling Analysis

OCGS will follow the guidance provided by the Nuclear Energy Institute (NEI) position paper titled "Shutdown/Refueling Modes" (Reference 58) addressing mitigating strategies in shutdown and refueling modes. This position paper is dated September 18, 2013 and has been endorsed by the NRC staff (Reference 59) and incorporated into Exelon procedure OU-AA-103, Shutdown Safety Management Program.

For planned outages and early in an unplanned outage, an outage risk profile is developed per Exelon Shutdown Safety Management Program, OU-AA-103. This risk assessment is updated on a daily bases and as changes are made to the outage schedule. Contingency actions are developed for high risk evolutions and the time needed for such evolutions is minimized. During the outage additional resources are available on site and during the high risk evolutions individuals are assigned specific response actions (e.g. response team assigned to close the containment equipment hatch). The risk assessment accounts for, among other things, environmental conditions and the condition of the grid. In order to effectively manage risk and maintain safety during outages, OCGS develops contingencies to address the conditions and response actions for a loss of cooling. These contingencies not only direct actions to minimize the likelihood for a loss of cooling but also direct the actions to be taken to respond to such an event. OCGS has procedures in place to determine the time to boil for all conditions during shutdown periods.

The FLEX strategies for Cold Shutdown are the same as those for Power Operation, Startup, and Hot Shutdown. If an ELAP/LUHS event occurs during Cold Shutdown with the RPV head installed, water in the Reactor Pressure Vessel (RPV) will heat up. During the heat up, the Isolation Condensers (ICs) are manually initiated as directed by station procedure ABN-36, Loss of Offsite Power & Station Blackout (Plant Control) and ABN-1, Reactor Scram. When reactor coolant temperature reaches 212°F (Hot Shutdown), the ICs will passively maintain the RPV at low values.

When in Refueling mode with the RPV head removed, many variables exist which may impact the ability to cool the core. In the event of an ELAP/LUHS event during this condition, installed plant systems cannot be relied upon to cool the core;

therefore transition to FLEX Phase 2 will ≤ 10 minutes as directed by ABN-36: Loss of Offsite Power & Station Blackout. Required actions will be made to provide core cooling and minimize heat-up. To accommodate the activities of vessel disassembly and refueling, water levels in the reactor vessel and the reactor cavity are often changed. The most limiting condition is the case in which the reactor head is removed and water level in the vessel is at or below the reactor vessel flange. If an ELAP/LUHS event occurs during this condition then (depending on the time after shutdown) boiling in the core may occur quite rapidly. Deployment and implementation of portable FLEX Pumps to supply injection flow will commence ≤ 10 minutes from the time of the event. Execution of FLEX actions will occur expeditiously due to more personnel being on site during outages to provide the necessary resources. Strategies for makeup water may include special FLEX deployment briefings, just in time training or deployment walkthroughs, tabletop discussions of mitigation strategies, or actual deployment of FLEX equipment (pump/generator) to make the strategy ready.

Pre-deployment of FLEX equipment exposes it to the very external hazards that it is intended to be protected from in order to provide prompt response capability for a beyond design basis external event. If pre-deployment is selected as a contingency to mitigate high risk conditions during an outage, this should be done in accordance with OP-OC-108-109-1001, Severe Weather Preparation TRM for Oyster Creek, and understand FLEX separation protection criteria for "N" equipment and "N+1" equipment. In addition, station signage and markings have been installed to ensure travel paths are available for deployment and that deployment areas remain accessible without interference from outage related equipment.

Figure 16:

Hose Deployment Options (Primary - Inside)

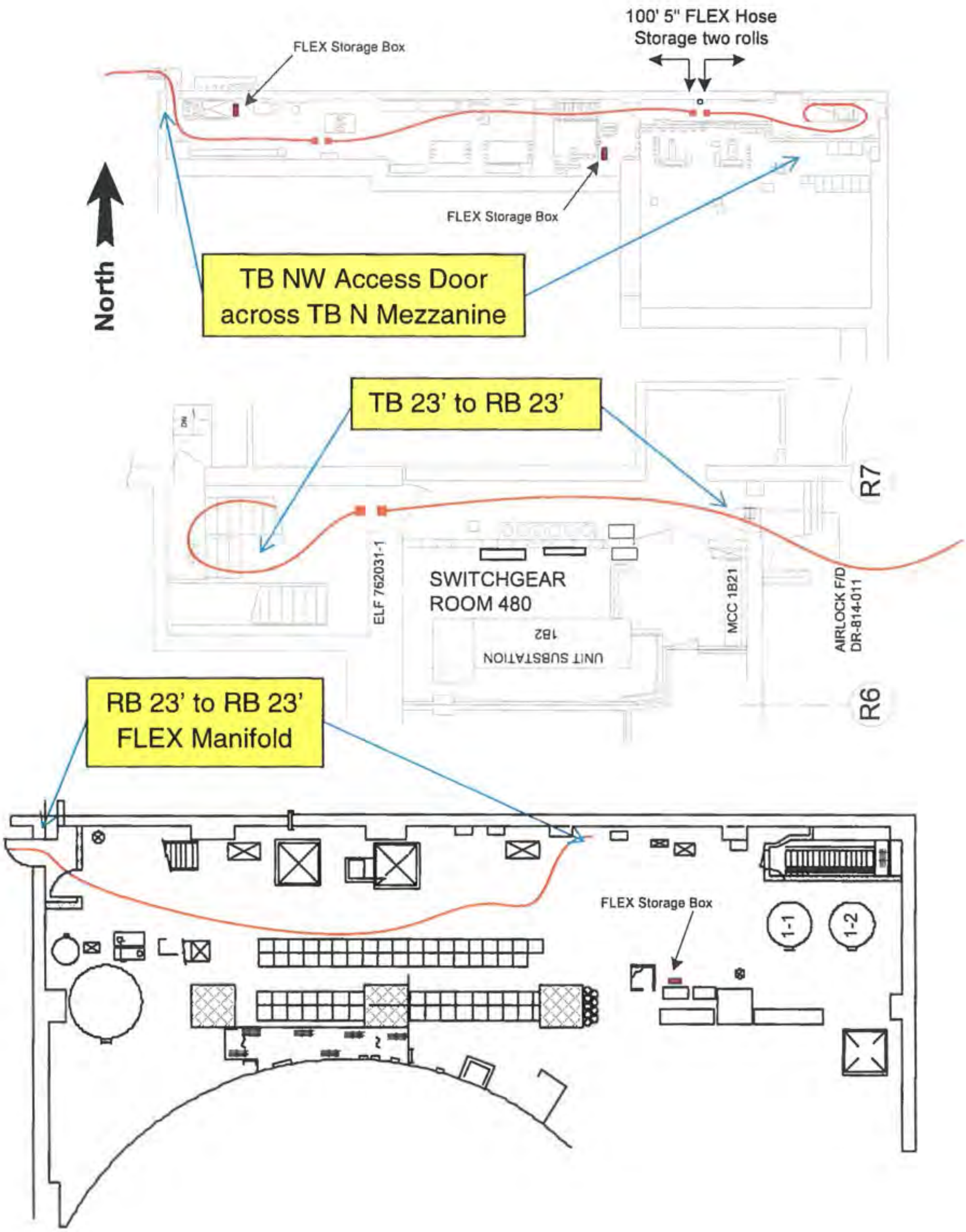


Figure 17:

Hose Deployment Options (Alternate - Inside)

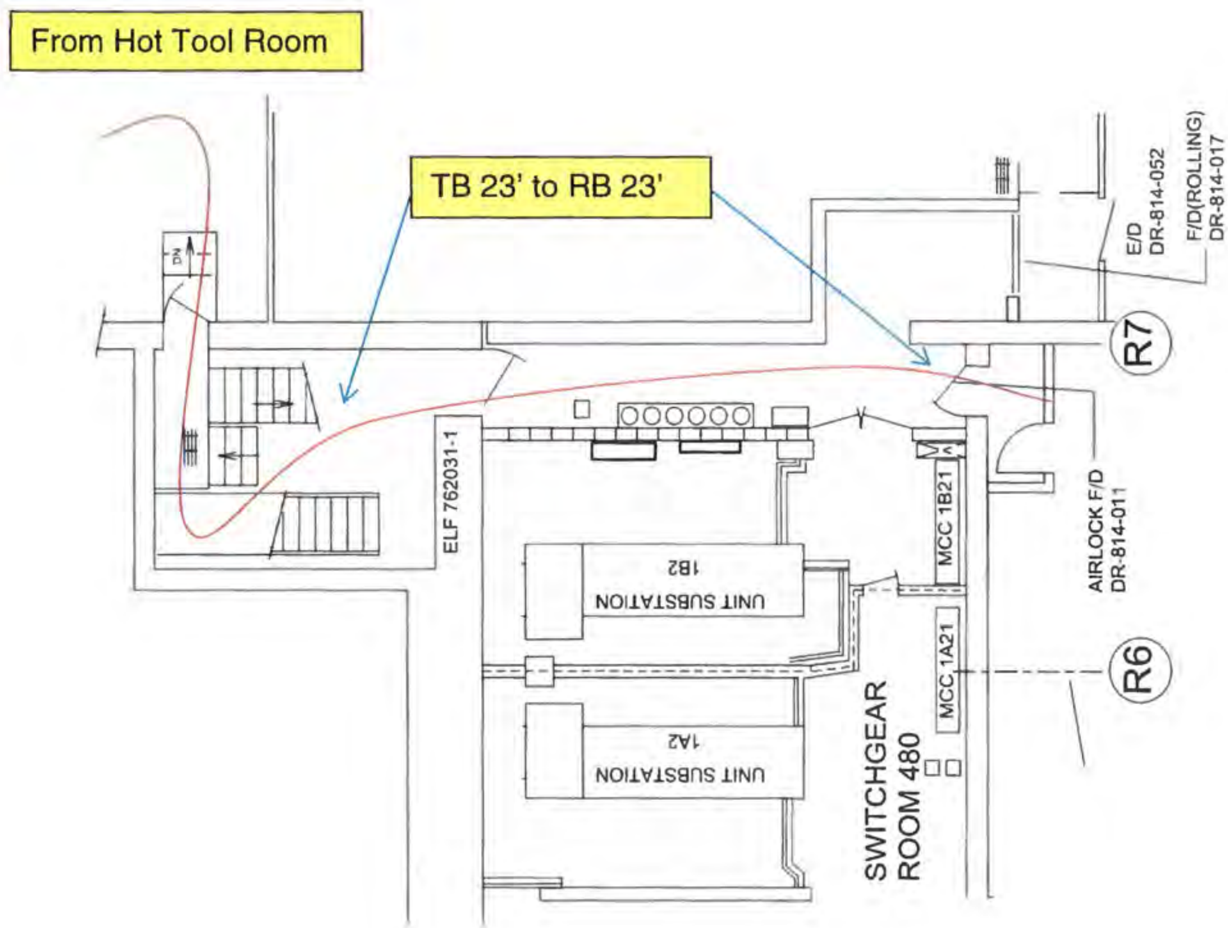


Figure 18:

Hose Deployment Options (Outside)

RED – Primary Deployment; **GREEN** – Alternate Deployment

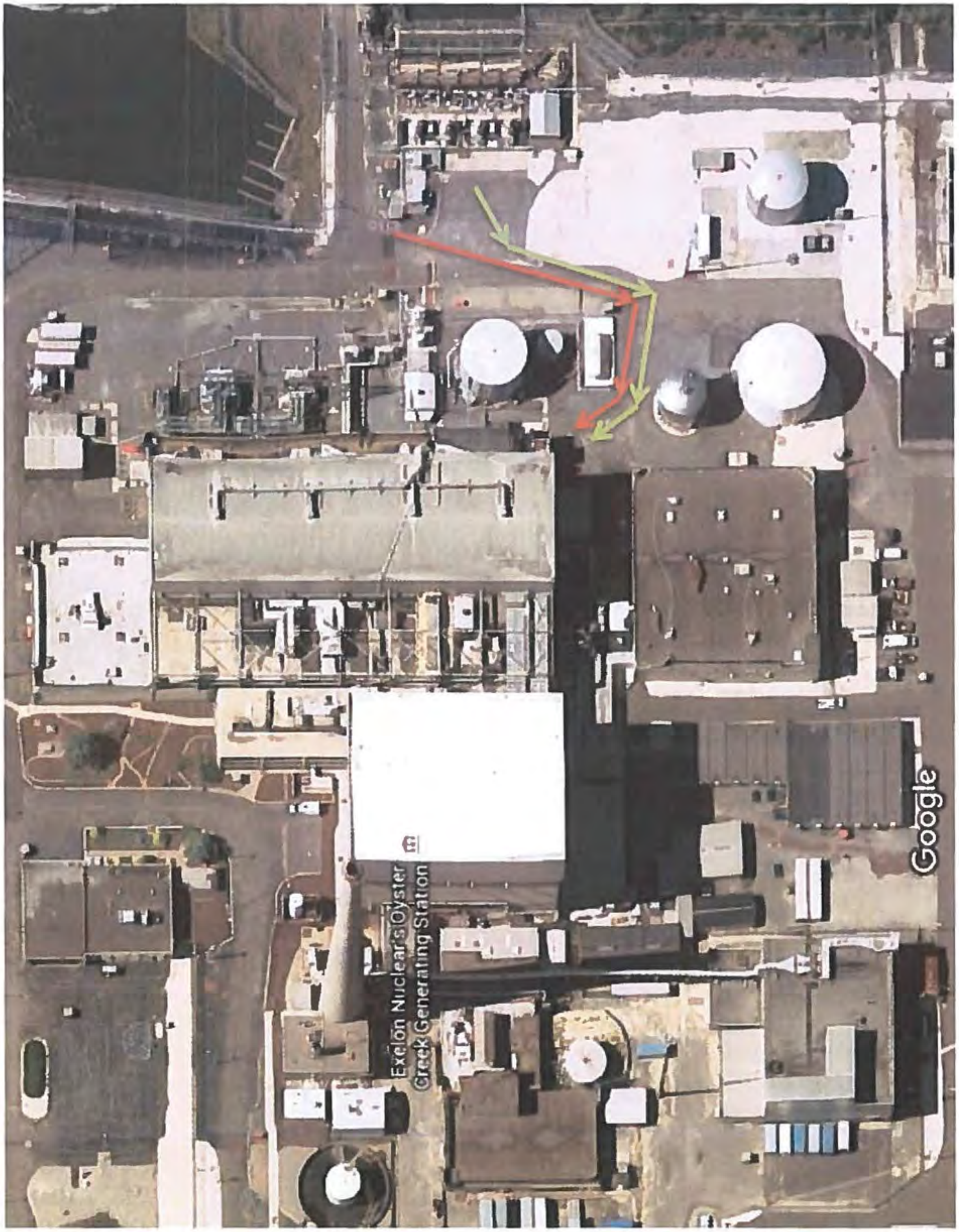


Figure 19:

Cable Connections (Primary Deployment – Inside)

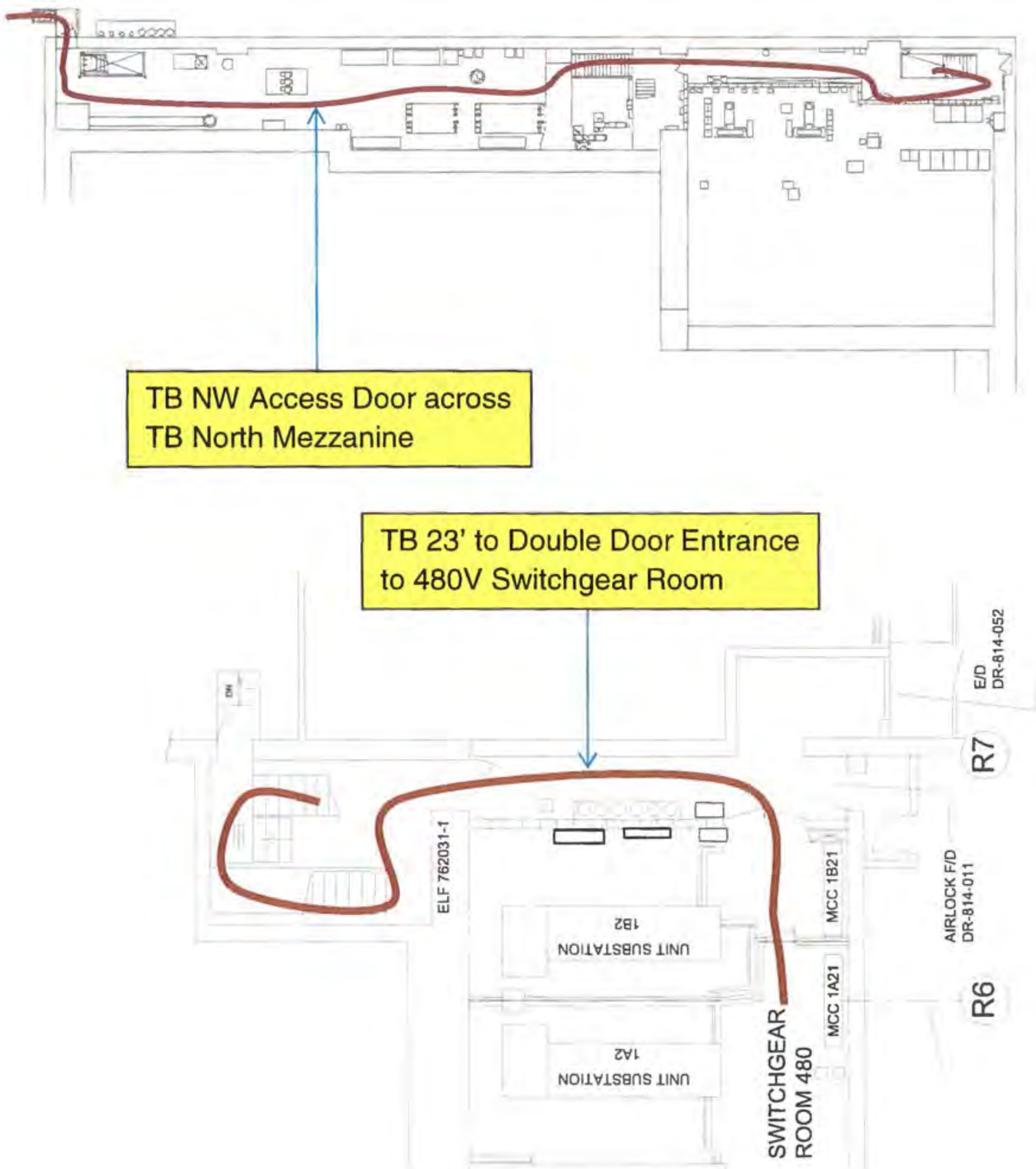


Figure 20:

Cable Connections (Alternate Deployment – Inside)

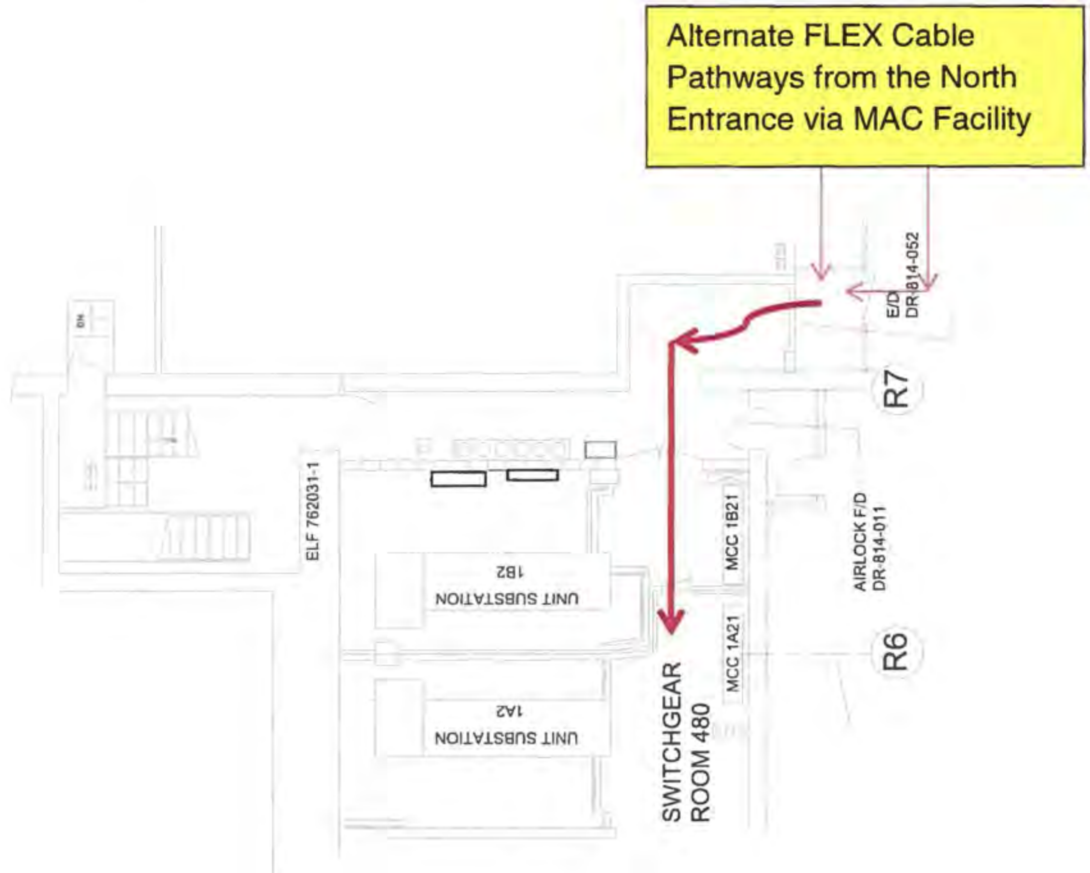


Figure 21: RPV Makeup Connections (Primary: Core Spray 1 – RED; Alternate: Core Spray 2 – GREEN)

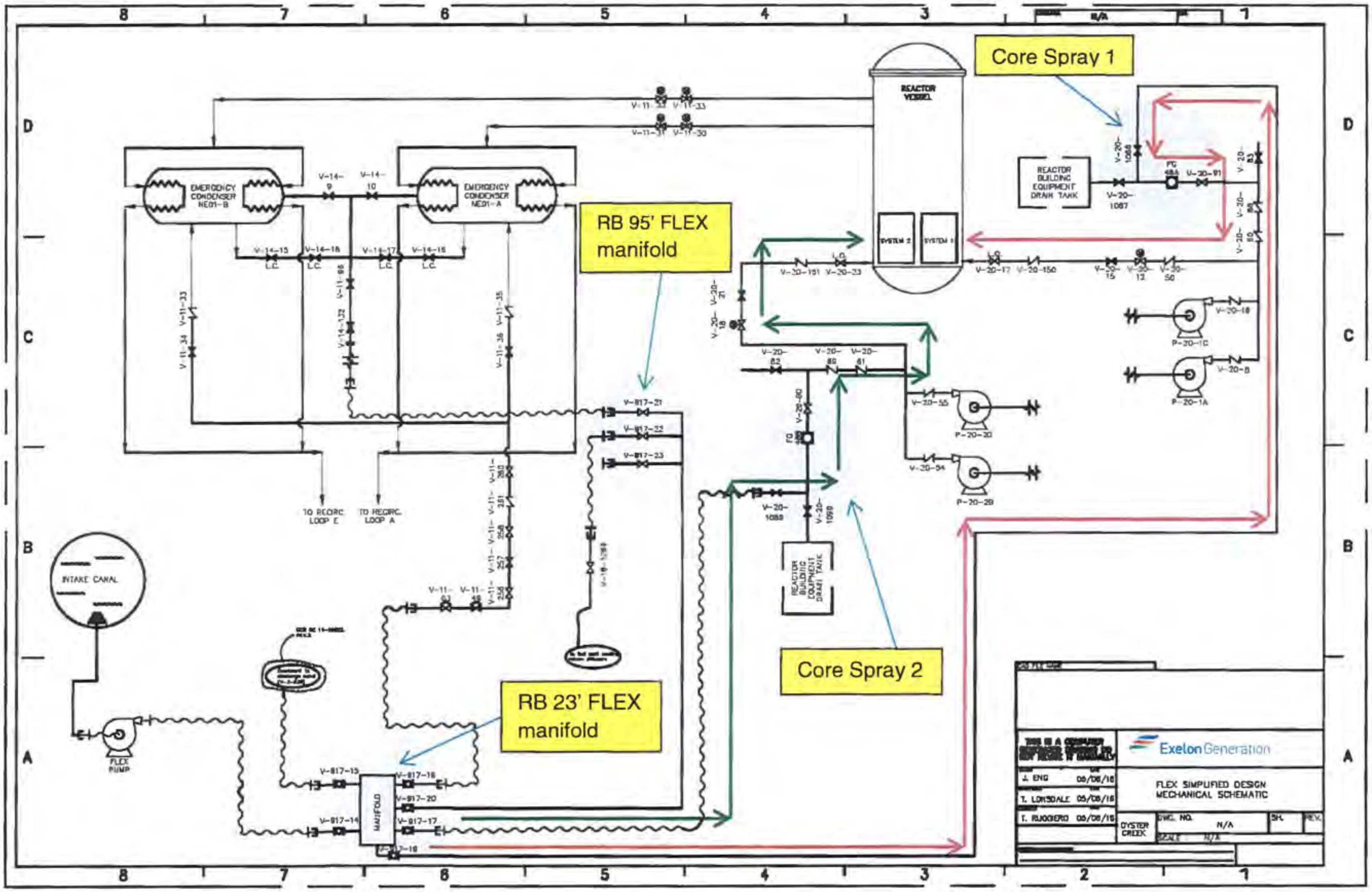


Figure 22: Spent Fuel Pool Make-Up Connections

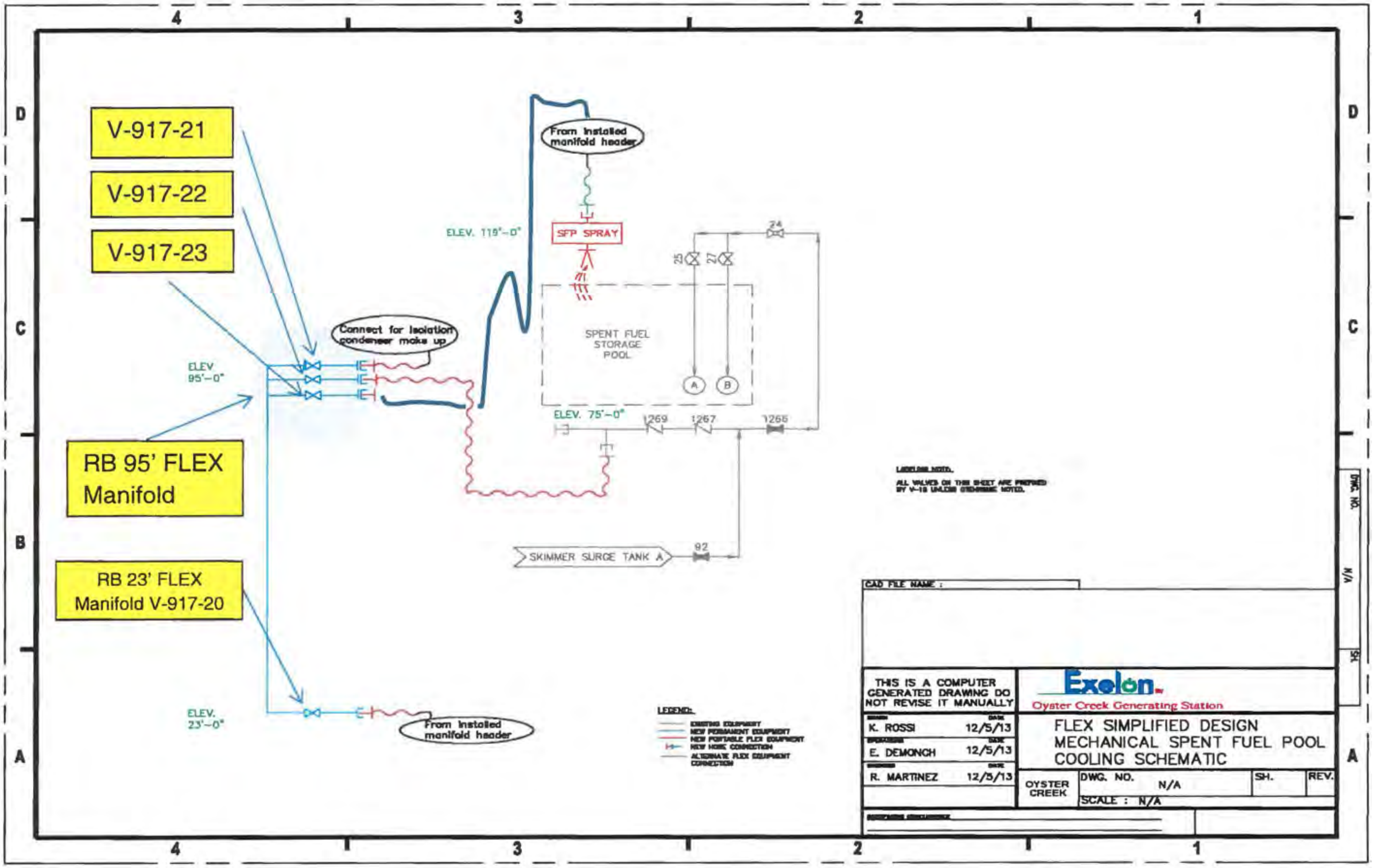


Figure 23: Primary Strategy for Repowering Vital 125 VDC

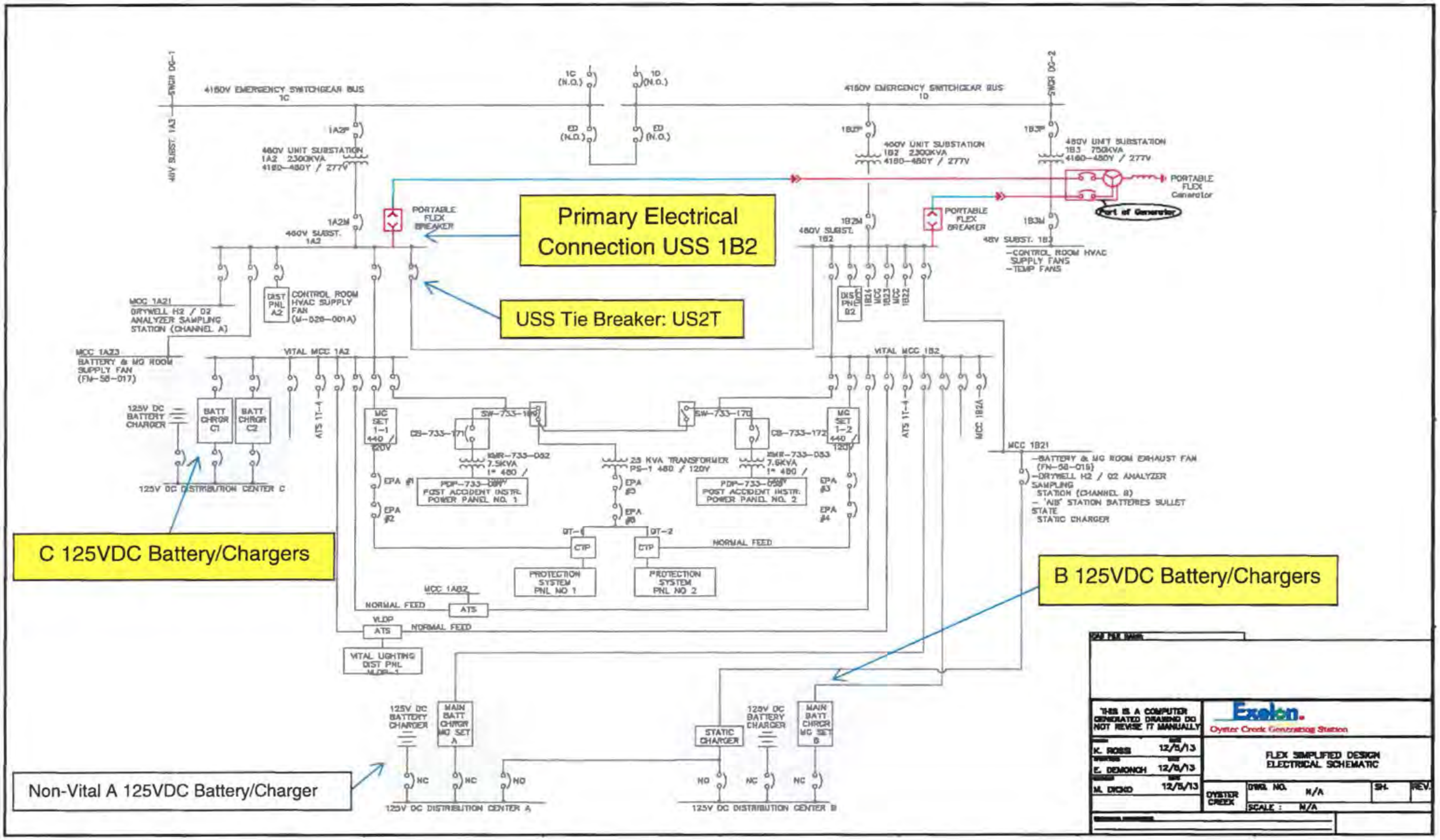
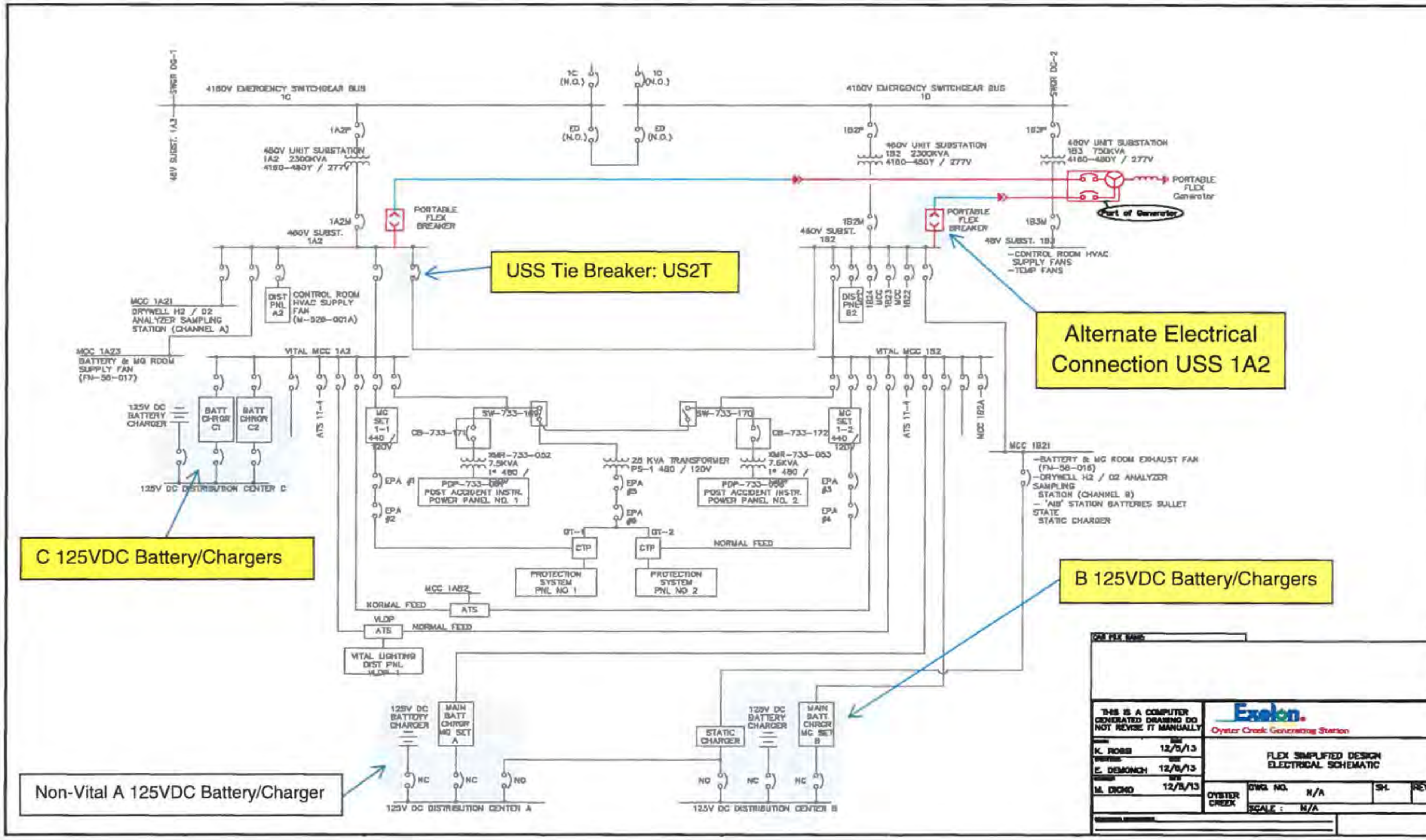


Figure 24: Alternate Strategy for Repowering Vital 125VDC



2.17 Sequence of Events

The Table 1 below presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS event at OCGS. Validation of each of the Flex time constraint actions has been completed in accordance with the Flex Validation Process document issued by NEI and includes consideration for staffing. Time to clear debris will occur coincident with equipment deployment at T≤1.5 hours. This time is considered to be reasonable based on site reviews of the deployment paths, the number/flexibility of deployment pathways, and the location of the FLEX Storage Pads. Small debris removal equipment is stored in the FLEX Storage Pads within the Seavans.

Table 1: Sequence of Events Timeline

Action Item	Elapsed Time	Action	FLEX Time Constraint Y/N	Level of Validation (A,B,C,N/A)	Remarks/Applicability
	0	Event Starts	N/A	N/A	Plant @100% power
	0	Reactor Scram	N/A	N/A	Loss of power to Reactor Protection System results in a reactor scram
1	1 min	Personnel enter EOP – RPV Control	N	N/A	These actions will provide direction for reactor control and options for loss of AC power
2	1 min	Isolation Condenser initiated for pressure control (or verified operating if auto initiation occurs)	N	N/A	EOPs will direct action based on reactor pressure

Action Item	Elapsed Time	Action	FLEX Time Constraint Y/N	Level of Validation (A,B,C,N/A)	Remarks/Applicability
3	2 min	Attempt to start EDGs upon identification of failure to auto start	N	N/A	Per FLEX event initial conditions the EDGs are not available
4	5 min	Personnel dispatched to investigate EDG failure to start.	N	N/A	Per FLEX event initial conditions the EDGs are not available
5	8 min	Per ABN-36, System Operator contacted to assess status of Combustion Turbine for SBO.	N	N/A	Per FLEX event initial conditions the SBO not available
6	10 min	Control Room crew has assessed SBO and plant conditions and declares an Extended Loss of AC Power (ELAP) event. -Personnel dispatched to FLEX strategy for supplying make-up water to the Isolation Condenser shell-side. -Personnel dispatched to FLEX strategy for supplying power to the USS 1A2/1B2 with FLEX Generator	N	N/A	Time is reasonable approximation based on operating crew assessment of plant conditions

Action Item	Elapsed Time	Action	FLEX Time Constraint Y/N	Level of Validation (A,B,C,N/A)	Remarks/Applicability
7	90 min	125VDC Load Shed Complete	Y	A	FSG-04 load shedding to maintain battery availability must be completed if DC chargers are unavailable
8	100 min	FLEX pump connected and supplying Isolation Condenser shell-side makeup.	Y	A	This action requires deployment of FLEX Pump, routing hoses inside and outside building. It is reasonable to expect the FLEX pump can be available within this time period
9	2.5 hours	FLEX strategy for supplying power to a USS 1A2/1B2	Y	A	Involves running temporary cables and connecting to the USS 1A2/1B2. When the busses are energized, power will be available to supply power to battery chargers
10	2.5 hours	Re-Power Battery Chargers	Y	N/A	Battery Chargers will be repowered automatically upon restoration of USS 1A2/1B2
11	3 hours	CLOSE 4 of 5 Recirculation Loops.	Y	A	Will be performed after power is restore to USS 1A2/1B2. Actions performed in the MCR by Reactor Operators. Recirculation loops are isolated to reduce RPV leakage. The sooner this is accomplished the more reactor inventory is conserved
12	3.3 hours	Commence injecting into the reactor using the FLEX pump and restore level to the normal band	Y	A	Will be performed after FLEX pump is running and providing water to manifold

Action Item	Elapsed Time	Action	FLEX Time Constraint Y/N	Level of Validation (A,B,C,N/A)	Remarks/Applicability
13	6 hours	Dispatch personnel to Stage equipment for Fuel Pool Makeup and Spray (FSG-09) prior to the Spent Fuel Pool reaching the boiling point	Y	A	This will minimize personnel having to enter a hazardous area later in the event
14	12 hours	Makeup to the Spent Fuel Pool using FLEX pump strategy is available.	Y	B	Under non-outage conditions, the maximum SFP heat load is 5.04 MBTU/hr. Loss of SFP cooling with this heat load and an initial SFP temperature of 125 0 F (tech spec upper limit) results in a time to boil of 29.26 hours, and 305.3 hours to the top of active fuel. Therefore, completing the equipment line-up for initiating SFP makeup at 12 hours into the event ensures adequate cooling of the spent fuel is maintained.
15	14 hours	Commence Portable Equipment Refueling Operations as required	Y	B	Action is performed to provide makeup of Diesel Fuel to FLEX Equipment when required

Action Item	Elapsed Time	Action	FLEX Time Constraint Y/N	Level of Validation (A,B,C,N/A)	Remarks/Applicability
16	24 hours	Restore A/B Battery Room Ventilation	N	B	Restore A/B Battery Room ventilation if required due to high outside temperatures. This action is temperature dependent and required to be performed at 14 hours only if outside temperature was greater than 106F at start of event. If temperature is lower, then time frame is extended
17	24 hours	Initial equipment from Regional Response Center becomes available	N	N/A	NEI 12-06 Assumption
18	30 hours	Personnel dispatched to establish temporary ventilation to the MCR (portable fans and associated generators)	N	N/A	FSG-15 provides direction. This is a continued effort to support Main Control Room personnel and is temperature dependent
19	30 hours	Personnel dispatched to establish C Battery Room Ventilation due to H2 Buildup	Y	N/A	Action to re-start C Battery Room Ventilation per FSG-15. FSG-15 direction is not complex and no validation is required since it's performed greater than 24 hours.
20	24-72 hours	Continue to maintain critical functions of core cooling (via IC and makeup water injection), containment (via hardened vent opening) and SFP cooling (FLEX pump injection to SFP). Utilize initial RRC equipment in spare capacity.	N	N/A	None

2.18 Programmatic Elements

2.18.1 Overall Program Document

OCGS procedure CC-OC-118 (Reference 12) provides a description of the Diverse and Flexible Coping Strategies (FLEX) Program for Oyster Creek Generating Station. This procedure implements Exelon fleet program document CC-AA-118 which contains governing criteria and detailed requirements. The key elements of the program include:

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

The instructions required to implement the various elements of the FLEX Program at OCGS and thereby ensure readiness in the event of a Beyond Design Basis External Event are contained in Exelon fleet program document CC-AA-118, Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program Document.

Procedure CC-AA-102, Design Input and Configuration Change Impact Screening, has been revised to ensure that configuration changes to the plant structures, systems, and components will not adversely impact the approved FLEX strategies.

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

2.18.2 Procedural Guidance

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

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

Procedural interfaces have been incorporated into ABN-36, Loss of Offsite Power & Station Blackout (Plant Control) and EOPs, to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP.

Changes to FSGs are controlled by Exelon fleet procedure AD-AA-101, Processing of Procedures and T&RMs (Reference 53). FSG changes will be reviewed and validated by the involved groups to the extent necessary to ensure the strategy remains feasible. Validation for existing FSGs has been accomplished in accordance OP-OC-118-1001 (Oyster Creek FLEX VALIDATION Plan: Reference 26).

2.18.3 Staffing

Using the methodology of NEI 12-01, *Guideline for Assessing beyond Design Basis Accident Response Staffing and Communications Capabilities*, an assessment of the capability of OCGS on-shift staff and augmented Emergency Response Organization (ERO) to respond to a Beyond Design Basis External Event (BDBEE) was performed. The results were provided to the NRC in a letter dated May 11, 2016 (Reference 57).

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

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

OCGS Operations personnel conducted a table-top review of the on-shift response to the postulated BDBEE and extended loss of AC power for the Initial and Transition Phases using the FLEX mitigating strategies. Resources needed to perform initial event response actions were identified from the Emergency Operating Procedures (EOPs), Support Procedures, and FLEX Support Guidelines (FSGs). Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and time motion analyses of NEI 10-05, *Assessment of On-Shift Emergency Response Organization Staffing and Capabilities.*

This Phase 2 Staffing Assessment concluded that the current minimum on-shift staffing as defined in the Emergency Response Plan for OCGS, as augmented by site auxiliary personnel, is sufficient to support the implementation of the FLEX strategies at OCGS, as well as the required Emergency Plan actions, with no unacceptable collateral duties.

2.18.4 Training

OCGS's Nuclear Training Program has been revised to assure personnel proficiency in the mitigation of BDBEEs is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training (SAT) Process (References 22, 23).

Using the SAT process, Job and Task analyses were completed for the new tasks identified as applicable to the FLEX Mitigation Strategies. Based on the analysis, training for Operations was designed, developed and implemented for Operations continuing training. "ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training" certification of simulator fidelity is considered to be sufficient for the initial stages of the BDBEE scenario training. Full scope simulator models have not been explicitly upgraded to accommodate FLEX training or drills. Overview training on FLEX Phase 3 and associated equipment from the SAFER NSRCs was also provided to OCGS Operators. Upon SAFER equipment deployment and connection in an event, turnover and familiarization training on each piece of SAFER equipment will be provided to station operators by the SAFER deployment/operating staff.

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

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

2.18.5 Equipment List

The equipment stored and maintained at the OCGS FLEX Storage Pads and various pre-staged locations at OCGS necessary for the implementation of the FLEX strategies in response to a BDBEE at OCGS are listed in Table 2. Table 3 identifies the quantity, applicable strategy, and capacity/rating for the major BDB/FLEX equipment components only, as well as, various clarifying notes.

2.18.6 Equipment Maintenance and Testing

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

EPRI has completed and has issued "Preventive Maintenance Basis for FLEX Equipment – Project Overview Report" (Reference 25). Preventative Maintenance Templates for the major FLEX equipment including the portable diesel pumps and generators have also been issued.

The PM Templates include activities such as:

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

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

Table 2: OCGS FLEX Equipment Test and Maintenance Overview

Equipment[1]	Quantity	Weekly	Quarterly	6 Month	Annual	3 Year	Notes
Diesel Pump GODWIN HL130	2 (one at each FLEX Storage Pad)	Walk down		Functional Test and Inspection (Dry Run)		Battery replacement and diesel fuel maintenance and inspections	
Diesel Generator (Cummins 500 KW)	2 (one at each FLEX Storage Pad)	Walk down		Functional Test and Inspection (Unloaded Run)	Performance Test, Annual Maintenance Inspection and PM (100% Loaded Run)		
Hoses for GODWIN pumps (suction and discharge)	6- 6" hard suction hoses for each pump 5"-discharge hoses in plant	Walk down			Performance Test, Inspection and PM (with diesel generator)	Hydrostatic test of all hoses	Replace every 10 years
Cables (for both 500 KW generators)	2 sets of six cables (Stored in Plant and FLEX Storage Pads)	Walk down			Visual Inspection and assessment		Replace every 10 years or test and justify extension/life

Table 2: OCGS FLEX Equipment Test and Maintenance Overview

Equipment[1]	Quantity	Weekly	Quarterly	6 Month	Annual	3 Year	Notes
Portable 120/240v diesel generators, portable diesel trash pumps	6- generators 3- trash pumps (stored in sea vans at FLEX Storage Pads)	Walk down		Functional check of generators and dry run of pumps			
Hoses (for trash pumps suction and discharge)	2 hard suction with strainers 4- discharge hoses (Stored in Sea van at FLEX Storage Pads)	Walk down		Inventory Check	Visual Inspection and assessment		Replace every 10 years
Communications Cabinet (hand-held radios, Sound powered phones, bullhorns)	5 – SPP 9 – 6 place battery chargers 10 – radios 54-spare batteries 2-bullhorns	Walk down		Inventory check, battery checks and Functional test and inspection (Radios),	Functional test and inspection (Radios), Functional test including associated FLEX circuits (sound powered phones)		

Table 2: OCGS FLEX Equipment Test and Maintenance Overview							
Equipment[1]	**Quantity**	**Weekly**	**Quarterly**	**6 Month**	**Annual**	**3 Year**	**Notes**
Portable Satellite Trailers (includes communication equipment and portable generators)	2 (one in each Seavan at FLEX Storage Pads)	Walk down		Semi-annual satellite updates and checks of phones and inventory check of trainer equipment			

The unavailability of FLEX equipment and applicable connections that directly perform a FLEX mitigation strategy for core, containment, and SFP is controlled and managed per Oyster Creek Generating Station procedure CC-OC-118, such that risk to mitigating strategy capability is minimized. The guidance in this procedure conforms to the guidance of NEI 12-06 as follows:

- Portable FLEX equipment may be unavailable for 45 days provided that the site FLEX capability (N) is available
- If portable equipment becomes 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

FLEX support equipment is defined as equipment not required to directly support maintenance of the key safety functions. There are no requirements specified in NEI 12-06 for unavailability time for any of the FLEX support equipment. This equipment is important to the successful Implementation of the OCGS FLEX strategy and Exelon Generation Company (EGC) requires establishment of an unavailability time (Reference 24).

- One or more pieces of FLEX support equipment available but not in its evaluated configuration for protection restore protection within 90 days

- One or more pieces of FLEX support equipment is unavailable, restore the equipment to available within 45 days AND implement compensatory measures for the lost function within 72 hours

When FLEX equipment deficiencies are identified the following action will be taken:

1. Identified equipment deficiencies shall be entered into the corrective action program.
2. Equipment deficiencies that would prevent FLEX equipment from performing the intended function shall be worked under the station priority list in accordance with the work management process.
3. Equipment that cannot perform its intended functions shall be declared unavailable. Unavailability shall be tracked per CC-OC-118.

Table 3 – Water Sources								
Water sources and associated piping that fully meet ALL BDB hazards, i.e., are FLEX qualified								
Water Sources	Usable Volume (Gallons)	Applicable Hazard					Time Based on Decay Heat	Cumulative Time Based on Decay Heat
		Satisfies Seismic	Satisfies Flooding	Satisfies High Winds	Satisfies Low Temp	Satisfies High Temp		
Water from Barnegat Bay (Phase 1, 2, & 3)	Unlimited – >1,000,000 gpm	Y	Y	Y	Y	Y	Indef.	Indef.

Table 4 – BWR Portable Equipment Stored On-Site

Use and (Potential / Flexibility) Diverse Uses						
List Portable Equipment	Core	Containment	SFP	Instrumentation	Accessibility	**Performance Criteria**
FLEX diesel-driven pumps (2) and associated hoses and fittings	X	X	X			Supports makeup to core, containment and SFP cooling
FLEX generators (2) and associated cables, connectors	X	X		X		500KW, 480VAC, Supports instrumentation and controls
Hose Trailers (2)	X	X	X			Supports FLEX hose connections from FLEX pump to RB 23' FLEX manifold
Towing vehicles (2): -F750 -Kubota Tractor	X	X	X		X	Supports large FLEX equipment deployment

Table 4 – BWR Portable Equipment Stored On-Site						
Use and (Potential / Flexibility) Diverse Uses						**Performance Criteria**
List Portable Equipment	Core	Containment	SFP	Instrumentation	Accessibility	
Debris Removal Equipment (2): -F750 -Kubota Trailer					X	Debris Removal of deployment paths
Fuel Tank with 100 gal. tank and DC pump (1)	X	X	X	X	X	Support adding fuel to diesel engine driven FLEX equipment
Fuel transfer pumps (2)	X	X	X	X	X	Support adding fuel to diesel engine driven FLEX equipment
Communications equipment (SPP, spare radio batteries and chargers, handheld satellite phones)	X	X	X	X	X	Support on-site and off-site communications

Table 4 – BWR Portable Equipment Stored On-Site						
Use and (Potential / Flexibility) Diverse Uses						
List Portable Equipment	Core	Containment	SFP	Instrumentation	Accessibility	**Performance Criteria**
Communications small portable generators (6) and associated and associated extension cords and power strips	X	X	X	X	X	5.5KW, 120VAC, Support communication equipment
Misc. debris removal equipment (demolition saw, chain saw, axe, tow chains)					X	Support FLEX deployment
Misc. Support Equipment (hand tools, flashlights & batteries, jumper cables, foul weather gear, battle lanterns, TruFuel gasoline, extension cords, power strips, spill kits, rope)					X	Support FLEX deployment

Table 4 – BWR Portable Equipment Stored On-Site
NOTES: • Large FLEX portable equipment stored in NW and SE FLEX Storage Pads • Small FLEX portable equipment stored in NW and SE FLEX Storage Pad Seavans • Support equipment. Not required to meet N+1.

Table 5 – BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses									Performance Criteria		Notes
List Portable Equipment	Quantity Req'd /Unit	Quantity Provided / Unit	Power	Core Cooling	Cont. Cooling/ Integrity	Access	Instrumentation.	RCS Inventory			
Medium Voltage Generators	0	2	Diesel	X	X		X		4160VAC	1 MW	(1)
Medium Voltage Generators Cables	0	7 reels of 350 ft. each		X	X		X		4/0 AWG		(1)
Low Voltage Generators	1	1	Diesel	X	X		X		480VAC	1 MW	(1)
Low Voltage Generators Cables	1	8 reels of 100 ft. each		X	X		X		4/0 AWG		(1)
High Pressure Injection Pump	0	1	Diesel					X	2000psi	60 GPM	(1)
High Pressure Injection Pump Suction hose	0	2 lengths of 100' hose						X	150 PSI		(1)

Table 5 – BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses									Performance Criteria		Notes
List Portable Equipment	Quantity Req'd /Unit	Quantity Provided / Unit	Power	Core Cooling	Cont. Cooling/ Integrity	Access	Instrumentation.	RCS Inventory			
High Pressure Injection Pump Discharge hose	0	4 lengths of 50' and 4 lengths of 100'						X	2500 PSI		(1)
SG / RPV Makeup Pump	0	1	Diesel	X	X			X	500 psi	500 GPM	(1)
SG / RPV Makeup Pump Suction hose	0	4 lengths of 10'		X	X			X	150 PSI		(1)
SG / RPV Makeup Pump Discharge hose	0	9 lengths of 100'		X	X			X	500 PSI		(1)
Low Pressure / Medium Flow Pump	1	1	Diesel	X	X			X	300 psi	2500 GPM	(1)

Table 5 – BWR Portable Equipment From NSRC

List Portable Equipment	Quantity Req'd /Unit	Quantity Provided / Unit	Power	Core Cooling	Cont. Cooling/ Integrity	Access	Instrumentation.	RCS Inventory	Performance Criteria		Notes
	Use and (Potential / Flexibility) Diverse Uses										
Low Pressure / Medium Flow Pump Suction hose	1	8 lengths of 10'		X	X			X	150 PSI		(1)
Low Pressure / Medium Flow Pump Discharge hose	1	18 lengths of 50'		X	X			X	300 PSI		(1)
Low Pressure / High Flow Pump (Dewatering)	0	1	Diesel						150 PSI	5000 GPM	(1)
Low Pressure / High Flow Pump Suction hose (Dewatering)	0	12 lengths of 10'							150 PSI		(1)
Low Pressure / High Flow Pump Discharge (Dewatering)	0	30 lengths of 50'							300 PSI		(1)
Lighting Towers	3	3	Diesel			X				440,000 Lumens	(1)

Table 5 – BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses											
List Portable Equipment	**Quantity Req'd /Unit**	**Quantity Provided / Unit**	**Power**	**Core Cooling**	**Cont. Cooling/ Integrity**	**Access**	**Instrumentation.**	**RCS Inventory**	**Performance Criteria**		**Notes**
Diesel Fuel Transfer	1	1	AC/DC	X	X	X	X	X	35 GPM AC, 25 GPM DC		(1)
Fuel Air-Lift Containers	1	1		X	X	X	X	X		500 Gal	(1)
On-Site Diesel transfer	1	1	Diesel	X	X	X	X	X	60 GPM		(1)
Portable Diesel Fuel Tank and Attached Pumps	1	1	AC/DC	X	X	X	X	X	30 GPM AC, 25 GPM DC		(1)
Suction Booster Lift Pump	0	2	Diesel	X	X			X	26 Feet Lift	5000 GPM	(1)
4160VAC Distribution System	0	1	N/A	X	X		X		4160VAC	1200 Amps	(1)

Table 5 – BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses									Performance Criteria	Notes
List Portable Equipment	Quantity Req'd /Unit	Quantity Provided / Unit	Power	Core Cooling	Cont. Cooling/ Integrity	Access	Instrumentation.	RCS Inventory		

Note (1) NSRC Generic Equipment – Not required for Phase 2 FLEX Strategy – Provided as Defense-in-Depth.

2.18.7 <u>List of Figures</u>

References

1) NRC Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, March 12, 2012
2) NRC Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, March 12, 2012
3) NRC Interim Staff Guidance (ISG) JLD-ISG-2012-01 R1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, January 2016
4) NRC JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, Revision 0, August 29, 2012
5) NEI 12-06 R2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, , December, 2015
6) NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation", Revision 1, August 2012
7) NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, Revision 0, April 2012
8) 10 CFR Section 50.63, Loss of all alternating current power
9) OCGS UFSAR (Oyster Creek Generating Station Updated Final Safety Analysis Report)
10) ABN-1, Reactor Scram, Revision 13
11) ABN-36, Loss of Offsite Power & Station Blackout (Plant Control) Rev 29
12) CC-OC-118, Oyster Creek Implementation of Diverse and Flexible Coping Strategies (FLEX) and Spent Fuel Pool Instrumentation Program
13) Task Interface Agreement (TIA) 2004-04, "Acceptability of Proceduralized Departures from Technical Specification (TSs) Requirements at the Surry Power Station", (TAC Nos. MC42331 and MC4332), dated September 12, 2006, ADAMS Accession No. ML060590273
14) Oyster Creek Generating Station Technical Specifications
15) OC FLEX Equipment Protection Matrix per NEI 12-06: ATI 2656138-07
16) IPEEE OC-IPE-03 (Individual Plant Examination For External Events)
17) LIP-OYS-001, Rev 7, Oyster Creek Local Intense Precipitation Evaluation
18) Wikipedia, the Free Encyclopedia: (https://en.wikipedia.org/wiki/)
19) FAQ 2013-01 Tornado Missile Separation (NEI 12-06: section 7.3.1)
20) FAQ 2013-07 Reasonable Protection (NEI 12-06: sections 7, 10.1, 11.3.3)

21) NOAA National Weather Service (http://www.spc.noaa.gov/wcm/) for New Jersey from 1950 to 2013
22) TQ-AA-1, Systematic Approach to Training Process Description, Revision 002, July 2014
23) TQ-AA-150, Operator Training Programs, Revision 011, March 2015
24) Exelon Position Paper EXC-WP-12, Required Actions for FLEX Support Equipment, Revision 0, January 2015
25) EPRI Preventive Maintenance Basis for FLEX Equipment – Project Overview Report, Report #3002000623, September 2013
26) OP-OC-118-1001 (Oyster Creek FLEX VALIDATION Plan)
27) FSG-00: ELAP FLEX Strategy Implementation Flowchart Rev 0
28) FSG-01: Operation of the FLEX Portable Pump
29) FSG-02: FLEX Generator Operation
30) FSG-03: Deployment of FLEX Hoses
31) FSG-04: DC Load Shed
32) FSG-05: Debris Removal and FLEX Equipment Deployment
33) FSG-06: Deployment of FLEX 480V Cables and Connection to USS 1A2/1B2
34) FSG-07: Line up of USS 1A2/1B2 for Repowering from the FLEX Generator
35) FSG-08: Makeup to Isolation Condenser
36) FSG-09: Makeup to SFP
37) FSG-10: Makeup to RPV
38) FSG-11: Operation of HCVS for FLEX
39) FSG-12: Restoration of Plant Equipment with FLEX Generator
40) FSG-13: Alternate SFP Level Indication
41) FSG-14: Determining HCVS Position Indication following Loss of AC & DC Power – Post BDBEE
42) FSG-15: Establishing MCR and Battery Room Ventilation
43) FSG-16: Venting Main Generator H2
44) FSG-17: Establish Main Stack Natural Draft Flow and Install Stack Diverter Plate
45) FSG-18: Lower RB Temperature – Post BDBEE
46) FSG-19: Diesel FO Transfer – FLEX
47) FSG-20: *EOP Key Parameter–Alternate Instrumentation Reading*
48) FSG-21: Communications
49) FSG-22: Operation of Portable Equipment
50) FSG-23: Transfer of FLEX Strategy to SAFER
51) OP-OC-108-109-1001, Severe Weather Preparation TRM for Oyster Creek

52) C-1302-735-E320-050, Rev 0, 20040225, Oyster Creek Batteries A, B, and C, Hydrogen Calculation
53) AD-AA-101, Processing of Procedures and T&RMs, Revision 026, December 2014
54) MAAP Analysis Oyster Creek Generating Station Document Number OC-MISC-010 R1
55) NMP Nuclear Station Unit 1: FIP Document – Mitigating Strategies NRC Order EA-12-049: June 2015
56) ACEL Research Report ET-S-426, 1997
57) 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, NRC Docket Number 50-219, May 11, 2016
58) NEI Position Paper Shutdown and Refueling: ADAMS Accession No. ML13273A514
59) NRC Endorsement of NEI Shutdown and Refueling paper: ADAMS Accession No. ML13267A382
60) OCGS Flood Hazard Reevaluation Report (FHRR), FHRR-OYS-001 Rev. 0
61) SAFER Response Plan for OCGS: CC-OC-118-1002 Rev. 001
62) Special Congested Area Plan for OCGS: CC-OC-118-1003, Rev 000
63) Calculation Number – C-1302-917-E310-002, Hydraulic Analysis for FLEX Implementation
64) Calculation Number – C-1302-424-5360-001, Rev. 2, Condensate Transfer Pump Min Recirc Flow
65) Gothic Calculation: EXOC049-CALC-001: Control Room Flex Heat Up
66) Gothic Calculation: EXOC049-CALC-002: A_B Battery Room Flex Heat Up
67) Gothic Calculation: EXOC049-CALC-003: 480V Switchgear Room Flex Heat Up
68) Gothic Calculation: EXOC049-CALC-004: 4160V and Battery Room C Heat Up for BDBEE with Extended Loss of AC Power
69) Evaluation: A2386806 E01, Attachment 7: Station 480V FLEX Generator Load List Evaluation
70) Evaluation: A2386806-E05, Calculation of voltage drop across Portable FLEX Cables
71) Nexus Report 12-4159.OCGS, Rev. 0: Exelon Corporation Oyster Creek Generating Station (OCGS) Battery Coping Evaluation Report

72) Evaluation A2326264 E15: SFP Area Evaluation For Steam/Condensation And Habitability
73) Evaluation A2392457-E41: Assess Reactor Flowrate Using Present FLEX Strainer Design
74) SA-AA-111 R16: Heat Stress Control
75) Engineering Change Request (ECR) ECR-OC-14-00389, Reliable SFP Level Instrumentation
76) Engineering Change Request (ECR) ECR-OC-14-00025, Riser/IC/FP Return Diffusers
77) Engineering Change Request (ECR) ECR-OC-14-00026, RX & Cont. Spray M/U Strategies
78) Engineering Change Request (ECR) ECR-OC-14-00027, Outdoor Storage Structures for Portable FLEX Equipment
79) Engineering Change Request (ECR) ECR-OC-14-00028, Diesel Fuel Oil Transfer Connection
80) Engineering Change Request (ECR) ECR-OC-14-00164, "A" Isolation Condenser Instrumentation Modification
81) Engineering Change Request (ECR) ECR-OC-16-00289, Issue ELAP Heat Up Calcs
82) Engineering Change Request (ECR) ECR-OC-14-00291, FLEX System Comp Project N+1
83) A2386806: Fukushima FLEX Electrical Mitigation Strategy Installation
84) Exelon Generation Company, LLC Seventh Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 26, 2016 (RS-16-148)
85) BWROG EPG/SG Revision 3, BWR Owner's Group Emergency Procedure and Severe Accident Guidelines Rev 3, February 2013
86) Procedure AD-OC-103, EOP/SAQM Program Control
87) Evaluation A2392457 E16: SFP Area Evaluation For Steam/Condensation And Habitability (additional evaluation from A2326264 E15)