Exelon Generation

Order No. EA-12-049

RS-15-025
TMI-15-011

February 27, 2015

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

Three Mile Island Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-50
NRC Docket No. 50-289

Subject: 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)

References:

1. NRC Order Number EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012
2. NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0, dated August 29, 2012
3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 2012
4. Exelon Generation Company, LLC's Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated October 25, 2012
5. Exelon Generation Company, LLC Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2013 (RS-13-026)
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-13-131)
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-14-016)

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-14-214)
9. NRC letter to Exelon Generation Company, LLC, Three Mile Island Nuclear Station, Unit 1 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC No. MF0803), dated December 17, 2013

On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued an order (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directs 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 pursuant to Section IV, Condition C. Reference 2 endorses industry guidance document NEI 12-06, Revision 0 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the EGC initial status report regarding mitigation strategies. Reference 5 provided the Three Mile Island Nuclear Station, Unit 1 overall integrated plan.

Reference 1 requires submission of a status report at six-month intervals following submittal of the overall integrated plan. Reference 3 provides direction regarding the content of the status reports. References 6, 7, and 8 provided the first, second, and third six-month status reports, respectively, pursuant to Section IV, Condition C.2, of Reference 1 for Three Mile Island Nuclear Station, Unit 1. The purpose of this letter is to provide the fourth six-month status report pursuant to Section IV, Condition C.2, of Reference 1, that delineates progress made in implementing the requirements of Reference 1. The enclosed report provides an update of milestone accomplishments since the last status report, including any changes to the compliance method, schedule, or need for relief and the basis, if any. The enclosed report also addresses the NRC Interim Staff Evaluation Open and Confirmatory Items contained in Reference 9.

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 27th day of February 2015.

Respectfully submitted,

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

Enclosure:

1. Three Mile Island Nuclear Station, Unit 1 Fourth Six-Month Status Report for the Implementation of Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region I
NRC Senior Resident Inspector – Three Mile Island Nuclear Station, Unit 1
NRC Project Manager, NRR – Three Mile Island Nuclear Station, Unit 1
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Director, Bureau of Radiation Protection – Pennsylvania Department of Environmental Resources
Chairman, Board of County Commissioners of Dauphin County, PA
Chairman, Board of Supervisors of Londonderry Township, PA
R. R. Janati, Chief, Division of Nuclear Safety, Pennsylvania Department of Environmental Protection, Bureau of Radiation Protection

Enclosure

Three Mile Island Nuclear Station, Unit 1

Fourth Six-Month Status Report for the Implementation of Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events

(29 pages)

Three Mile Island Station, Unit 1

Fourth Six-Month Status Report for the Implementation of Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events

1 Introduction

Three Mile Island Nuclear Station, Unit 1 (TMI) developed an Overall Integrated Plan (Reference 1 in Section 8), documenting the diverse and flexible strategies (FLEX), in response to NRC Order EA-12-049 (Reference 2). This enclosure provides an update of milestone accomplishments since submittal of the last status report (August 2014), including any changes to the compliance method, schedule, or need for relief/relaxation and the basis, if any.

2 Milestone Accomplishments

The following milestone(s) have been completed since August 28, 2014 and are current as of February 27, 2015:

- Engineering for FLEX Platform Modification

3 Milestone Schedule Status

The following provides an update to Attachment 2 of the Overall Integrated Plan. It provides the activity status of each item, and whether the expected completion date has changed. The dates are planning dates subject to change as design and implementation details are developed.

The revised milestone target completion dates do not impact the order implementation date.

Original Target Completion Date	Activity	Status
	Submit 60 Day Status Report	Complete
	Submit Overall Integrated Implementation Plan	Complete
	Contract with NSRC	Complete
	6 Month Updates	
Update 1	Aug., 2013	Complete
Update 2	Feb., 2014	Complete
Update 3	Aug., 2014	Complete
Update 4	Feb., 2015	Complete with this submittal

Original Target Completion Date	Activity	Status
Update 5	Aug., 2015	Not Started
Update 6	Feb., 2016	Not Started
	Modification Development	
Oct 2014	Phase 1 modifications (1) RCP Seal Upgrade	(1) Complete
Oct 2014	Phase 2 modifications (1) FLEX Electrical Power Supply (2) FLEX RCS & SFP Makeup (3) FLEX Feedwater System (4) FLEX Storage Facility (5) Turbine Bldg Structure (6) Turbine Bldg FLEX platform (7) FLEX fuel oil supply (8) Spent Fuel Pool Level (9) On Site Communications modification (10) Reactor Building Vent (11) Satellite phone storage	(1) Started (2) Complete (3) Complete (4) Started (5) Started (6) Complete (7) Started (8) Started (9) Started (10) Started (11) Complete
Oct 2014	Phase 3 modifications	None
	Modification Implementation	
Nov 2015	Phase 1 modifications (1) RCP Seal Upgrade	Not Started
Nov 2015	Phase 2 modifications (1) FLEX Electrical Power Supply (2) FLEX RCS & SFP Makeup (3) FLEX Feedwater System (4) FLEX Storage Facility (5) Turbine Bldg Structural (6) Turbine Bldg FLEX platform (7) FLEX fuel oil supply (8) Spent Fuel Pool Level (9) On Site Communications modification (10) Reactor Building Vent (11) Satellite phone storage	Not Started Complete
Nov 2015	Phase 3 modifications	None

Original Target Completion Date	Activity	Status
	Procedure development	
Jun 2015	• Create Site-Specific Procedures	Started
Jul 2015	• Validate Procedures (NEI 12-06, Sect. 11.4.3)	Started
Jun 2015	• Create Maintenance Procedures	Started
Jul 2015	Staffing analysis	Started
Nov 2015	Storage Plan	Started
Nov 2015	FLEX equipment acquisition	Started
Nov 2015	Training	Started
Jun 2015	Regional Response Center Operational	Started
Nov 2015	Unit 1 Implementation date	

4 Changes to Compliance Method

The following changes are the most significant changes made to the FLEX implementation strategy since the last update (August 2014):

(1) FLEX Diesel Generator and Fuel Oil Supply (Reference Attachment 2A)

- The vent piping from FX-T-2 and FX-T-3 will be routed outside the TB independently and the Diesel Generator muffler will be located in the Turbine Building.

(2) FLEX RCS and SFP Makeup System (Reference Attachment 2D)

- Procedures will be prepared to provide additional borated water source, WDL-T-1C, for RCS makeup if it is available. This method provides defense in depth in addition to the credited capability to obtain borated water with phase 3 capabilities. WDL-T-1 normally contains greater than 20,000 gallons of water borated to > 2000 ppmB. This is a seismic Class I tank located within a Class I tornado protected structure.

The following are the most significant changes made to the FLEX Sequence of Events and Timelines (Reference Attachments 1A, B. C) since the last update (August 2014):

- Condensate valves CO-V-8, 24 and 108 will be closed if the Earthquake or Tornado AOP is entered, rather than based on diagnosis of a loss of condensate.
- Long term condensate supply pumps FX-P-3A or B will be moved from the FLEX storage facility to higher ground offsite, if the Flood AOP is initiated.

5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

TMI expects to comply with the order implementation date and no relief/relaxation is required at this time.

6 Open Items from Overall Integrated Plan and Interim Staff Evaluation

Section Reference (Refer to OIP Update from Aug 2013)	Overall Integrated Plan Open Item (Refer to OIP Update from Feb 2014)	Status (As of February 27, 2015)

None

Interim Staff Evaluation Open Item or Confirmatory Items

Item #	NRC ref no.	Description	Status FEB 2015 UPDATE
6	3.1.1.2.A	The licensee did not specifically address deployment considerations with respect to the deployment of FLEX equipment through areas subject to liquefaction, routing only through seismically robust buildings, power required to deploy or move equipment, and protection of the means to move equipment.	(1) The potential for earthquake induced liquefaction has been evaluated. Deployment of TMI1 FLEX equipment will not be adversely impacted. (Reference 990-2179 "Assessment of earthquake-induced liquefaction potential and associated ground failure hazards for Three Mile Island Unit 1", Geomatrix Consultants). (2) Evaluation of all actions performed within non-seismic structures is in progress (August 2015 Update). (3) A vehicle stored in the FLEX storage facility will be used to deploy or move FLEX equipment. No additional power is required.
7	3.1.1.3.A	The licensee did not address the determination of necessary instrument local readings per consideration 1 of NEI 12-06 Section 5.3.2, to support the implementation of the mitigating strategies in the event that seismically qualified electrical equipment is affected by a BDBEE.	A procedure is being prepared which will provide operators with the direction on how to obtain any measured parameters critical to implementing the FLEX mitigation strategy without reliance on functional electrical equipment outside the reactor building after a seismic event.
8	3.1.1.4.A	The licensee did not identify the local assembly area or describe the methods to be used to deliver the equipment to the site for all hazards. In the audit process the licensee stated that the TMI NSRC playbook will be made available when approved to address this.	The local assembly area (Staging area "C") is the Lancaster Airport. The site staging area is the south parking lot (staging area "B"). The primary delivery method will be by truck, but airlift capability via helicopter will be available to address delivery after any hazard. The TMI NSRC playbook has not been approved. (August 2015 Update)
11	3.1.5.3.A	The licensee provided no information regarding the heat up of various rooms and enclosures in the Integrated Plan, and there was no discussion of the potential effects of high temperatures at the location where portable (or permanently installed FLEX) equipment would actually operate in the event of high temperatures in these plant locations.	An evaluation has been completed which establishes a plan where portable ventilation will be used to ensure the capability to successfully implement the FLEX strategy. Reference 8.

Item #	NRC ref no.	Description	Status FEB 2015 UPDATE
22	3.2.1.6.A	During the ELAP and LUHS [Loss of Ultimate Heat Sink] beyond-design-basis external event, the licensee has identified that times to complete actions in the Events Timeline are based on operating judgment, the conceptual designs, and the current supporting analyses. The TMI mitigation strategy is not based upon the PWROG WCAP-17601-P ELAP mitigation strategy. In the audit process, the licensee stated that the current SOE is for the seismic event only and that another SOE would be developed for the flood event. Based on the information provided by the licensee, it is not possible to determine the validity of the time constraints provided in the preliminary sequence of events timeline for all hazards. The final timelines will be validated once detailed designs are completed and procedures are developed. The results will be provided in a future 6-month update.	A SOE timeline for flooding is provided as Attachment 1B. The capability to perform the actions within the period identified in analysis will be validated when the procedures are written, through table top, simulator and field simulation exercises. August 2015 Update
31	3.2.4.1.A	The licensee did not specify if the FLEX diesel generators on the Turbine Building were of sufficient capacity to supply any additional cooling need such as the system that provides for the steam driven emergency feedwater (EFW) pump bearing cooling, or any other plant components or cooling systems needed to support the FLEX strategies. Additional formal analysis is required to determine the acceptability of the licensee's plans to provide supplemental cooling to the subject areas, e.g., Main Control Room (MCR), EFW room, Atmospheric Dump Valve (ADV) room, battery rooms.	An evaluation has been completed which establishes a plan where portable ventilation will be used to ensure the capability to successfully implement the FLEX strategy. Each FLEX diesel generator has the capacity for all FLEX functions including ventilation or cooling. Reference 8.

Item #	NRC ref no.	Description	Status FEB 2015 UPDATE
32	3.2.4.2.A	Habitability conditions in the MCR will be evaluated and a strategy will be developed to maintain MCR habitability. The strategy and associated support analyses will be provided in a future 6-month update.	Portable ventilation will be utilized to improve CR habitability and provide cooling for key FLEX equipment. Reference 8
33	3.2.4.2.B	The analysis of battery room conditions was not complete, and the licensee noted that additional formal analysis to determine the acceptability of their actions regarding the battery room's accessibility is needed. Also additional discussion on the hydrogen gas exhaust path for each strategy is needed, and a discussion of the accumulation of hydrogen to ensure that the hydrogen gas level is below combustible level when the batteries are being recharged during Phase 2 and 3.	Portable ventilation will be utilized to prevent an excessive hydrogen concentration in the battery rooms. Reference 8
34	3.2.4.2.C	The licensee did not provide any information regarding temporary cooling/ventilation for areas such as the steam driven emergency feedwater pump room, ADV rooms or cable spreading rooms. The licensee's current strategies are based on preliminary analysis. The current strategy for providing cooling or ventilation for these areas is to connect a permanently staged 480V AC diesel generator and fuel tanks to be located in the Turbine Building elevation 322. The strategy is to repower 1A and 1B ES MCCs in four hours and hence supply power for cooling these areas. The licensee did not provide any details regarding what ventilation systems would be repowered for these areas of the plant, or the capacity of the FLEX emergency diesel generators to meet these needs, or how this would be accomplished.	Portable ventilation will be utilized to provide cooling for key FLEX equipment. Reference 8.

Item #	NRC ref no.	Description	Status FEB 2015 UPDATE
38	3.2.4.4.8	The NRC staff reviewed the licensee communications assessment and has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by Exelon will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. Confirmation that upgrades to the site's communications systems have been completed will be accomplished.	Essential communications capability will be maintained such that operators can implement the actions necessary to satisfy the EA 12-049 required functions, i.e. core cooling, spent fuel cooling and containment.
39	3.2.4.5.A	The licensee provided no information in the Integrated Plan regarding local access to the protected areas under ELAP.	A response plan which coordinates Operations and Security response will be developed which will ensure the security staff can support access to the protected area within the time frame required for successful implementation.
40	3.2.4.6.A	The licensee's analysis regarding access to the MCR, and battery rooms, is preliminary and additional formal analysis is required. In the audit process the licensee specified that temporary ventilation (fans and flexible ducts) will be used to maintain control room habitability, to control the ambient temperature in control building areas with credited FLEX electrical equipment and to limit the accumulation of hydrogen during battery charging. This approach uses a "once through" air flow path. The licensee stated that the technical basis to demonstrate that this temporary capability is sufficient and that supporting documentation, ECR [engineering change Request] 13-00310, will be made available to NRC when it is completed.	An evaluation has been completed which establishes a plan where portable ventilation will be used to ensure the capability to successfully implement the FLEX strategy. Reference 8.

Item #	NRC ref no.	Description	Status FEB 2015 UPDATE
45	3.3.3.A	The specific procedures for training, new or revised, have not yet been completed. The requirements from the analysis will be used to develop and to validate the new and revised procedures. This includes the existing design and licensing basis requirements and the new FLEX requirements. Validation of time response is performed using a composite of field simulation and performance/simulator exercises.	August 2015 Update
46	3.4.A	The licensee's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies, item 1. The licensee did not address the remaining items, 2 through 10 of Section 12.2.	All licensees, including Exelon Generation Company, relying on SAFER and the National SAFER Response Centers (NSRC), have executed contractual agreements with Pooled Equipment Inventory Company (PEICo) which allows for the capabilities (considerations) in Section 12.2 of NEI 12-06. The NRC staff evaluated the NSRCs and the SAFER program, plans, and procedures against these 10 capabilities (considerations) from NEI 12-06, Section 12.2. The NRC audit results concluded that the NSRCs and the SAFER plans and procedures conform to the guidance described by the 10 capabilities (considerations) of NEI 12-06, Section 12.2. The NRC findings are documented in a letter from the NRC (Jack R. Davis) to the Nuclear Energy Institute (Joseph E. Pollock), Staff Assessment of National SAFER Response Centers Established in Response to Order EA-12-049, dated September 26, 2014 (ML14265A107).

7 Potential Draft Safety Evaluation Impacts

No potential impact to the Draft Safety Evaluation was identified.

8 References

The following references support the updates to the Overall Integrated Plan described in this 6-month update.

1. Three Mile Island Nuclear Station, Unit 1, 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.
2. NRC Order Number EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012.
3. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, dated August 2012.
4. TM-FLEX-002, *Reactor Building Pressure Analysis for FLEX,* Rev. 0.
5. TMI Station's First Six Month Status Report for the Implementation of FLEX, dated August 28, 2013.
6. C-1101-734-E420-009 "Extending Battery Life to 6 hours during an ELAP".
7. TMI Station's Second Six Month Status Report for the Implementation of FLEX, dated February 28, 2014.
8. Technical Evaluation ECR 13-00310, "FLEX Ventilation Plan".
9. TMI Station's Third Six Month Status Report for the Implementation of FLEX, dated August 28, 2014.

9 Attachments

1A Sequence of Events Timeline Earthquake or Tornado @ 100% power

1B Sequence of Events Timeline External Flood @ 100% power

1C Sequence of Events Timeline Extreme Cold, Snow and Ice @ 100% power

2A 1E-919-21-001, draft, FLEX Diesel Generator and Fuel Oil System

2B 1E-919-21-002, draft, FLEX Electrical Distribution

2C 1E-919-21-003, draft, FLEX Feedwater System

2D 1E-919-21-004, draft, FLEX RCS & SFP Makeup System

2E 1E-919-21-005, draft, Long Term Water Supply

Attachment 1A - Sequence of Events Timeline
Earthquake or Tornado @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
1	0	Earthquake or tornado Causes LOOP and damages unprotected equipment. All control rods are inserted and the reactor is shutdown.	NA	
2	0	Emergency Diesel Generators fail to energize ES buses.	NA	Failures per NEI 12-06
3	< .01	EFW actuated: Steam driven pump (EF-P-1) and EFW Control valves (EF-V-30A & B) supply feedwater. MSSV & ADV control OTSG pressure.	N	Automatic plant response.
4	< .02	EOP initiated.	NA	
5	< 0.05	RCS Letdown is automatically isolated on high temperature (MU-V-3 closes).	N	Automatic plant response.
6	< 0.08	Control Room operators throttle ADV to stabilize OTSG pressure and RCS temperature. Adequate core cooling is provided through RCS natural circulation and heat removal through the OTSG.	N	
7	< 0.08	Control Room operators attempt to start and load SBO Diesel Generator.	N	
8	< 0.10	Control Room operator closes RCP Controlled Bleed Off Isolation Valve (MU-V-26).	N	Contains RCS losses within the Reactor Bldg.
9	< 0.17	SBO Diesel generator is not functional.	N	Failure per NEI 12-06.
10	0.25	Operator initiates E-plan. If needed, satellite phones are used for offsite notifications & communication.	N	
11	0.25	Operators open main condenser vacuum breaker (VA-V-8) and valves to vent Main Generator H2 to atmosphere.	N	This is a pre-condition to reduce DC loads.
12	0.25	Control Room operator secures DC powered FW pump turbine lube oil pumps (LO-P-9A & B).	N	DC Load shedding
13	0.5	Operator opens doors to inverter and battery rooms.	Y	Maintain acceptable temperature for FLEX equipment.

Attachment 1A - Sequence of Events Timeline
Earthquake or Tornado @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
14	0.5	Operator de-energizes instrument systems not required for FLEX.	N	DC Load shedding.
15	< 0.75	Operator lines up CO2 purge for main generator.	N	Minimize risk of main generator fire.
16	< 0.75	If earthquake or tornado occurs, then operator closes CO-V-8, CO-V-108 and CO-V-24. If both CO-T-1A and CO-T-1B are damaged, then operator closes CO-V-10B and opens DW-V-35 to line up DW-T-2 to EF-P-1.	Y	Minimize loss of condensate.
17	< 1.0	Operators have ensured fire service pumps (FS-P-1 and FS-P-3) have been secured, if required..	N	Mitigates the effects of non seismic piping failures in Class I buildings.
18	1.0	Control room operator secures Main Turbine Lube Oil Pump LO-P-6.	N	DC load shedding.
19	1.5	Operator lines up FLEX Diesel Generator.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
20	< 2.0	If battery chargers have not been re-energized, then Control room operator secures Main Generator Seal Oil Pump (GN-P-2).	Y	DC load shedding is complete.
21	2.0	Operator props open doors for initial intermediate building ventilation.	N	
22	2.0	Operator lines up FLEX RCS Makeup Pump from BWST or Spent Fuel Pool to RCS.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
23	2.0	Operator takes local control of MS-V-6 (EF-P-1 steam supply), EF-V-30A & EF-V-30B (EFW Flow Control Valves) and MS-V-4A & MS-V-4B (Atmospheric Dump Valves).	Y	Bottled air system will last at least 3 hours, and then local manual control is required.
24	2.25	Operator strips loads from 1P & 1S 480V Buses, and 1A & 1B ES MCC to prepare to load FLEX diesel generator.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
25	2.5	Operator starts FLEX Diesel Generator, energizes FLEX MCC and closes breakers to energize 1P-1S 480V cross tie bus.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.

Attachment 1A - Sequence of Events Timeline
Earthquake or Tornado @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
26	2.58	Operator closes breakers to energize 1P 480V Bus, 1S 480V Bus, 1A ES MCC and 1B ES MCC.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
27	2.75	Operator closes breakers for selected loads on 1A and 1B ES MCC: Battery Chargers AC Power to Inverters & Vital Instruments FLEX RCS Makeup Pumps Emergency Lighting	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
28	3.0	Operator starts FLEX RCS Makeup Pump (A or B) to restore RCS inventory and increase RCS boron concentration.	Y	Restore makeup within 4 hours to prevent interruption of core cooling.
29	3.5	Operator opens service bldg and turbine bldg machine shop roll up doors and aux boiler roll up door.	N	
30	4.0	Operator connects hose from DF-V-41 to pipe in DGB, connects hose to fuel oil pipe in TB, routes hose to FLEX DG Fuel Oil Tank (FX-T-3), and routes hose from FX-P-7 discharge to FX-T-2.	N	Required for continued operation of FX-Y-1A or B.
31	4.0	Operator strips loads on 1A ESV MCC & 1A Radwaste MCC and installs jumper between 1A ESV MCC and 1A Radwaste MCC.	N	Pre-condition to isolate RCP controlled bleed off flow.
32	4.0	Operator starts DF-P-1C or DF-P-1D, as needed, to maintain level in FX-T-3.	Y	Required for continued operation of FX-Y-1A or B. Pre-staged fuel supply will last 3 hours at full load.
33	4.5	Operator energizes1A ESV MCC and 1A Radwaste MCC, and Closes CBO Isolation Valves MU-V-33A, MU-V-33B, MU-V-33C and MU-V-33D.	N	Isolate RCP controlled bleed off flow to minimize RCS loss rate.
34	5.0	When pressurizer level reaches 100 inches, operator throttles open MS-V-4A & B to initiate a cooldown and controls pressurizer level at 100 inches. Cooldown rate will be approximately 30 F/HR.	N	

Attachment 1A - Sequence of Events Timeline
Earthquake or Tornado @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
35	5.0	Operator initiates temporary ventilation in Control Bldg, IB and Turbine Bldg.	N	
36	7.0	Operator strips loads on 1C ESV MCC, energizes 1C ESV MCC, and closes breakers for CF-V-1A and CF-V-1B. When a reliable Pressurizer steam bubble is established or If RCS pressure drops below 300 psig, then CLOSE CF-V-1A & CF-V-1B.	N	Contingency action.
37	7 to 8	Operator transfers a pressurizer heater group (RC-HTR-GRP- 8 or 9) to the emergency power supply and energizes heaters.	N	Hydraulic control of RCS pressure can be used if required.
38	8.0	Operator connects hose from FX-P-2A & B pump discharge to FLEX feedwater header, connects power cable to FX-P-2A or B starter, opens FX-V-203, FX-V-205, EF-V-67A and EF-V-67B.	N	This is a pre-condition to use backup feedwater capability.
39	8 to 11	Transfer portable diesel-driven pump (FX-P-3A or FX-P-3B) from FLEX storage facility (FSF) to road next to the river, route suction hose into river, and route discharge hose to CO-T-1B or hotwell.	Y	For a tornado, minimum condensate supply would last greater than 24 hours. The minimum supply is greater for an earthquake.
40	< 10.0	OTSG Pressure is now less than 200 psig. Backup feedwater capability is enabled. If backup feedwater is required, operator starts FX-P-2A or B and throttles opens FX-V-206A and FX-V-206B to control OTSG level (all action TB 322 north).	N	Design objective is to be able to establish a backup with 12 hours.
41	10.0	RCS cooldown is complete. • Incore temperature 400F • OTSG A & B Pressure 150 psig • RCS Pressure 400 psig Operator begins raising pressurizer level to > 300 inches	N	
42	12.0	Operator opens SF-V-88, connects hose from FLEX feedwater header to the FLEX primary low pressure header, monitors SF pool level and throttles FX-V-101 open as needed to maintain SFP level.	N	Spent fuel pool boiling occurs after 40 hours.

Attachment 1A - Sequence of Events Timeline
Earthquake or Tornado @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
43	15.0	Operator lines up spent fuel pool vent path (opening doors through U2 fuel pool to atmosphere).	N	Spent fuel pool boiling occurs after 40 hours.
44	24.0	SNRC (Regional Response Center) resources begin arriving on site. SNRC Equipment will be used to maintain a reliable condensate supply and to address longer term needs for fuel oil or borated water.	N	On site fuel supply is sufficient for greater than 2 weeks. If BWST is damaged by tornado, then a borated water supply will be required.

Attachment 1B - Sequence of Events Timeline
External Flood @ 100% power

#	ELAP Time (HR)	Action (only selected actions in AOP-002 listed)	Time Constraint Y/N	Remarks / Applicability
1	-36	Forecast indicates river level could exceed the height of the dike within the next 36 hours. Emergency procedure OP-TM-AOP-002 "Flood" initiated.	NA	Plant @100% power.
2	-35 to -12	Operators maximize condensate tank (CO-T-1A & CO-T-1B) and demineralized water tank (DW-T-2) inventory.	Note 1	
3	-30	Operators install drain plugs, close drain valves and inflate seals for AB & FHB Missile shield doors.	Note 1	
4	- 30 to - 16	Operator connects hose from DF-V-41 to pipe in DGB, connects hose to fuel oil pipe in TB, and routes hose to FLEX DG Fuel Oil Tank (FX-T-2). Operator starts DF-P-1C and initiates fill of FX-T-2.	Note 1	DF-P-1C can fill FX-T-2 in approx. 14 hours.
5	- 30 to - 12	Maintenance installs flood barriers and stages, consumables within the flood protected area.	Note 1	
6	- 22 to - 2	Maintenance installs U2 flood barriers and stages, consumables within the flood protected area.	Note 1	
7	- 20	Plant shutdown and cool-down initiated.	Y	
8	- 19 to - 12	Vent the main generator hydrogen and purge with CO2.	N	
9	-18	Reactor is shutdown.	Y	
10	-16	RC-P-1C and RC-P-1D shutdown and cooldown initiated	N	
11	-13	RCS cooldown terminated - RCS temperature at 375F - RCS pressure 400 psig - Pressurizer level 200 to 220 inches - CF-V-1A & B closed - MU-V-33C & D closed - OTSG pressure A & B at 165 psig - OTSG Level A & B at 97 to 99 % op range	N	
12	-10	RCS boron concentration exceeds cold shutdown boron concentration requirement.	N	
13	-9 to -8	Operator transfers a pressurizer heater group (RC-HTR-GRP- 8 or 9) to the ES power supply.	Note 1	
14	-6	Operator connects hose from FX-P-2A & B pump discharge to FLEX feedwater header, connects power cable to FX-P-2A or B starter, opens FX-V-203, FX-V-205, EF-V-67A and EF-V-67B.	Note 1	

Attachment 1B - Sequence of Events Timeline
External Flood @ 100% power

#	ELAP Time (HR)	Action (only selected actions in AOP-002 listed)	Time Constraint Y/N	Remarks / Applicability
15	-4	Operator lines up FX-P-1A & B path from BWST to RCS. Operator connects hose from FLEX feedwater header to the FLEX primary low pressure header, and lines up FLEX makeup to the SF pool.	Note 1	
16	-3	Operator connects power cable to FX-P-5A or B, hose from FX-P-5A & B discharge to FX-T-3 and FX-P-7 discharge to FX-T-2.	Note 1	
17	-2	Operator opens breakers for BWST tunnel sump pumps and closes WDL-V-612	Note 1	
18	-1	Operator strips unprotected DC circuits from DC system (OP-TM-734-903 & 904).	Note 1	Prevents loss of battery capacity.
19	0	River level exceeds the height of the dike. LOOP occurs and Emergency Diesel Generators fail to energize ES buses.	NA	Failures per NEI 12-06.
20	0	EFW actuated: Steam driven pump (EF-P-1) starts and EFW Control valves (EF-V-30A & B) are available to supply feedwater. RCS hot leg and cold leg temperatures diverge. OTSG pressure is dropping slowly.	NA	Automatic plant response.
21	< .02	EOP initiated.	NA	
22	< 0.05	Letdown isolates (MU-V-3) automatically on high temperature.	NA	Automatic plant response.
23	< 0.08	Control Room operators throttle ADV to reduce OTSG pressure, maintain OTSG level with EFW control valves, and stabilize RCS temperature. Adequate core cooling is provided through RCS natural circulation and heat removal through the OTSG. RCS conditions follow: - RCS temperature at 400F - RCS pressure 425 psig - Pressurizer level 200 to 220 inches - OTSG pressure A & B at 150 psig - OTSG Level A & B is at "flooded nozzle" (97 to 99 % operating range)	N	
24	< 0.08	Control Room operators attempt to start and load SBO Diesel Generator.	N	
25	< 0.10	Control Room operator closes RCP Controlled Bleed Off Isolation Valve (MU-V-26).	N	Contain RCS losses within Reactor Bldg.

Attachment 1B - Sequence of Events Timeline
External Flood @ 100% power

#	ELAP Time (HR)	Action (only selected actions in AOP-002 listed)	Time Constraint Y/N	Remarks / Applicability
26	< 0.17	Control room operators recognize SBO Diesel generator is not functional.	N	Failure per NEI 12-06.
27	0.25	Operator performs E-plan offsite notifications & communication using satellite phones.	N	
28	< 0.25	Operator close FS-V-256 & FS-V-257 to terminate IA-P-1A & B cooling water flow into IB sump.	N	
29	< 0.5	Operator lines up FLEX Diesel Generator.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
30	0.5	Operator opens doors to inverter and battery rooms for ventilation.	N	Maintain acceptable FLEX equipment cooling.
31	.75	Operator strips loads from 1P & 1S 480V Buses, and 1A & 1B ES MCC to prepare to load FLEX diesel generator.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
32	< 1.0	Operator starts FLEX Diesel Generator, energizes FLEX Distribution Panel and closes breakers to energize 1P-1S 480V cross tie bus.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
33	1.0	Operator closes breakers to energize 1P 480V Bus, 1S 480V Bus, 1A ES MCC and 1B ES MCC.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
34	1.25	Operator closes breakers for selected loads on A and B 480V ES Bus: - Battery Chargers - AC Power to Inverters & Vital Instruments - FLEX RCS Makeup Pumps - Emergency Lighting - Pressurizer heater group	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
35	1.5	Operator starts FLEX RCS Makeup Pump (A or B) and throttles FX-V-103A (B) and slowly raises pressurizer level above 300 inches.	Y	Objective to restore makeup with 4 hours is conservative.
36	2.0	If backup feedwater is required, then operator starts FX-P-2A or B and throttles open FX-V-206A and FX-V-206B to control OTSG level.	N	
37	2.0	Operator takes local control of MS-V-6 (EF-P-1 steam supply), EF-V-30A & EF-V-30B (EFW Flow Control Valves) and MS-V-4A & MS-V-4B (Atmospheric Dump Valves).	Y	Bottled air system will last at least 3 hours, and then manual control is required.

Attachment 1B - Sequence of Events Timeline
External Flood @ 100% power

#	ELAP Time (HR)	Action (only selected actions in AOP-002 listed)	Time Constraint Y/N	Remarks / Applicability
38	2.5	Operator strips loads on 1A ESV MCC and installs jumper between 1A ESV MCC and 1A Radwaste MCC.	N	
39	3.0	Operator energizes1A ESV MCC and 1A Radwaste MCC, and Closes CBO Isolation Valves MU-V-33A and MU-V-33B.	N	
40	3.5	Operator use FX-V-8 to gravity drain fuel oil from FX-T-2 to maintain level in FX-T-3.	Y	Required for continued operation of FX-Y-1A or B. Pre-staged fuel supply will last 3 hours at full load.
41	4.0	Operator sets up and starts temporary ventilation in CB, IB and TB.	N	
42	15.0	Operator lines up spent fuel pool vent path (opening doors through U2 fuel pool to atmosphere).	N	Spent fuel pool boiling occurs after 40 hours.
43	24.0	SNRC (Regional Response Center) resources available …limited capability to transport any resources until 72 hours due to water level on site.	N	
44	> 24	Operator throttles open FX-V-101 as needed to maintain SFP level.	N	Spent fuel pool boiling occurs after 40 hours.
45	96	Transfer portable diesel-driven pump (FX-P-3A or FX-P-3B) from temporary offsite storage to road next to the river, route suction hose into river, and route discharge hose to CO-T-1B.	N	Minimum condensate supply would last greater than 48 hours after water recedes (at 72 hrs).

NOTE 1: In the event of a flood, additional resources are applied to ensure the proactive actions can be completed within the described timeline.

Attachment 1C - Sequence of Events Timeline
Extreme Cold, Snow and Ice @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
	-8	Weather predicts extreme cold conditions. Staff augmentation is initiated.	NA	
	-4	Staff augmentation is complete.	NA	
1	0	Extreme cold, snow or ice causes LOOP. All control rods are inserted and the reactor is shutdown.	NA	
2	0	Emergency Diesel Generators fail to energize ES buses.	NA	Failures per NEI 12-06.
3	< .01	EFW actuated: Steam driven pump (EF-P-1) and EFW Control valves (EF-V-30A & B) supply feedwater. MSSV & ADV control OTSG pressure.	N	Automatic plant response.
4	< .02	EOP initiated.	NA	
5	< 0.05	RCS Letdown is automatically isolated on high temperature (MU-V-3 closes).	N	Automatic plant response.
6	< 0.08	Control Room operators throttle ADV to stabilize OTSG pressure and RCS temperature. Adequate core cooling is provided through RCS natural circulation and heat removal through the OTSG.	N	
7	< 0.08	Control Room operators attempt to start and load SBO Diesel Generator.	N	
8	< 0.10	Control Room operator closes RCP Controlled Bleed Off Isolation Valve (MU-V-26).	N	Contains RCS losses within the Reactor Bldg.
9	< 0.17	SBO Diesel generator is not functional.	N	Failure per NEI 12-06.
10	0.25	Operator initiates E-plan. If needed, satellite phones are used for offsite notifications & communication.	N	
11	0.25	Operators open main condenser vacuum breaker (VA-V-8) and valves to vent Main Generator H2 to atmosphere.	N	This is a pre-condition to reduce DC loads.
12	0.25	Control Room operator secures DC powered FW pump lube oil pumps (LO-P-9A and LO-P-9B).	N	DC Load shedding.

Attachment 1C - Sequence of Events Timeline
Extreme Cold, Snow and Ice @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
13	0.5	Operator opens doors to inverter and battery rooms.	Y	
14	0.5	Operator de-energizes instrument systems not required for FLEX.	N	DC Load shedding.
15	< 0.75	Operator lines up CO2 purge for main generator.	N	Minimize risk of main generator fire.
16	1.0	Control room operator secures Main Turbine Lube Oil Pump LO-P-6.	N	DC load shedding
17	1.5	Operator lines up FLEX Diesel Generator.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
18	< 2.0	Control room operator secures Main Generator Seal Oil Pump (GN-P-2).	Y	DC load shedding is complete.
19	2.0	Operator lines up FLEX RCS Makeup Pump from BWST to RCS.	Y	Pre-condition to restore RCS makeup.
20	2.0	Operator takes local control of MS-V-6 (EF-P-1 steam supply), EF-V-30A & EF-V-30B (EFW Flow Control Valves) and MS-V-4A & MS-V-4B (Atmospheric Dump Valves).	Y	Bottled air system will last at least 3 hours, and then manual control is required.
21	2.25	Operator strips loads from 1P & 1S 480V Buses, and 1A & 1B ES MCC to prepare to load FLEX diesel generator.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
22	2.5	Operator starts FLEX Diesel Generator, energizes FLEX MCC and closes breakers to energize 1P-1S 480V cross tie bus.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
23	2.58	Operator closes breakers to energize 1P 480V Bus, 1S 480V Bus, 1A ES MCC and 1B ES MCC.	Y	Pre-condition to maintain vital AC power and restore RCS makeup.
24	2.75	Operator closes breakers for selected loads on 1A and 1B ES MCC: Battery Chargers AC Power to Inverters & Vital Instruments FLEX RCS Makeup Pumps Emergency Lighting	Y	Pre-condition to maintain vital AC power and restore RCS makeup.

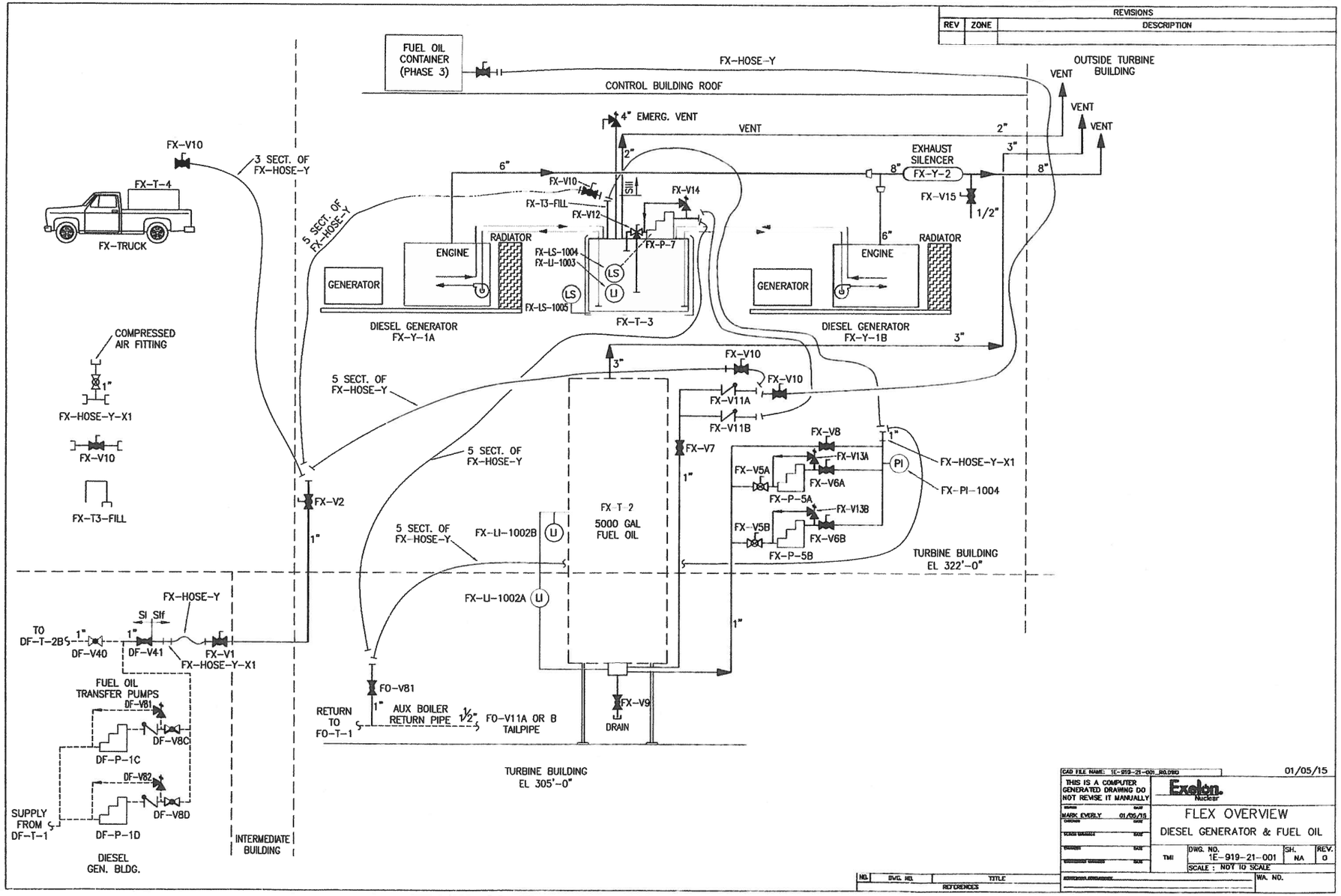
Attachment 1C - Sequence of Events Timeline
Extreme Cold, Snow and Ice @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
25	3.0	Operator starts FLEX RCS Makeup Pump (A or B) to restore RCS inventory and increase RCS boron concentration.	Y	Restore makeup within 4 hours to prevent interruption of core cooling.
26	4.0	Operator connects hose from DF-V-41 to pipe in DGB, connects hose to fuel oil pipe in TB, routes hose to FLEX DG Fuel Oil Tank (FX-T-3) and connects hose from FX-P-7 to FX-T-2.	N	Pre-condition to maintain fuel supply to FX-Y-1A or B.
27	4.0	Operator strips loads on 1A ESV MCC & 1A Radwaste MCC and installs jumper between 1A ESV MCC and 1A Radwaste MCC. Operator ensures BWST heat trace is energized.	N	
28	4.0	Operator starts DF-P-1C or DF-P-1D, as needed, to maintain level in FX-T-3.	Y	Required for continued operation of FX-Y-1A or B. Pre-staged fuel supply will last 3 hours at full load.
29	4.5	Operator energizes1A ESV MCC and 1A Radwaste MCC, and Closes CBO Isolation Valves MU-V-33A, MU-V-33B, MU-V-33C and MU-V-33D.	N	Isolate RCP controlled bleed off flow to minimize RCS loss rate.
30	5.0	When pressurizer level reaches 100 inches, then operator throttles open MS-V-4A & B to initiate a cooldown and controls pressurizer level at 100 inches. Cooldown rate will be less than 30 F/HR.	N	Pre-condition to enable back-op feedwater capability.
31	7.0	Operator strips loads on 1C ESV MCC, energizes 1C ESV MCC, and closes breakers for CF-V-1A and CF-V-1B. When a reliable steam bubble is established or if RCS pressure drops below 300 psig, then CLOSE CF-V-1A & CF-V-1B .	N	Contingency actions.
32	7 to 8	Operator transfers a pressurizer heater group (RC-HTR-GRP- 8 or 9) to the emergency power supply and energizes heaters.	N	Hydraulic control of RCS pressure can be used if required.
33	8.0	Operator connects hose from FX-P-2A & B pump discharge to FLEX feedwater header, connects power cable to FX-P-2A or B starter, opens FX-V-203, FX-V-205, EF-V-67A and EF-V-67B.	N	Pre-condition to enable back-op feedwater capability.

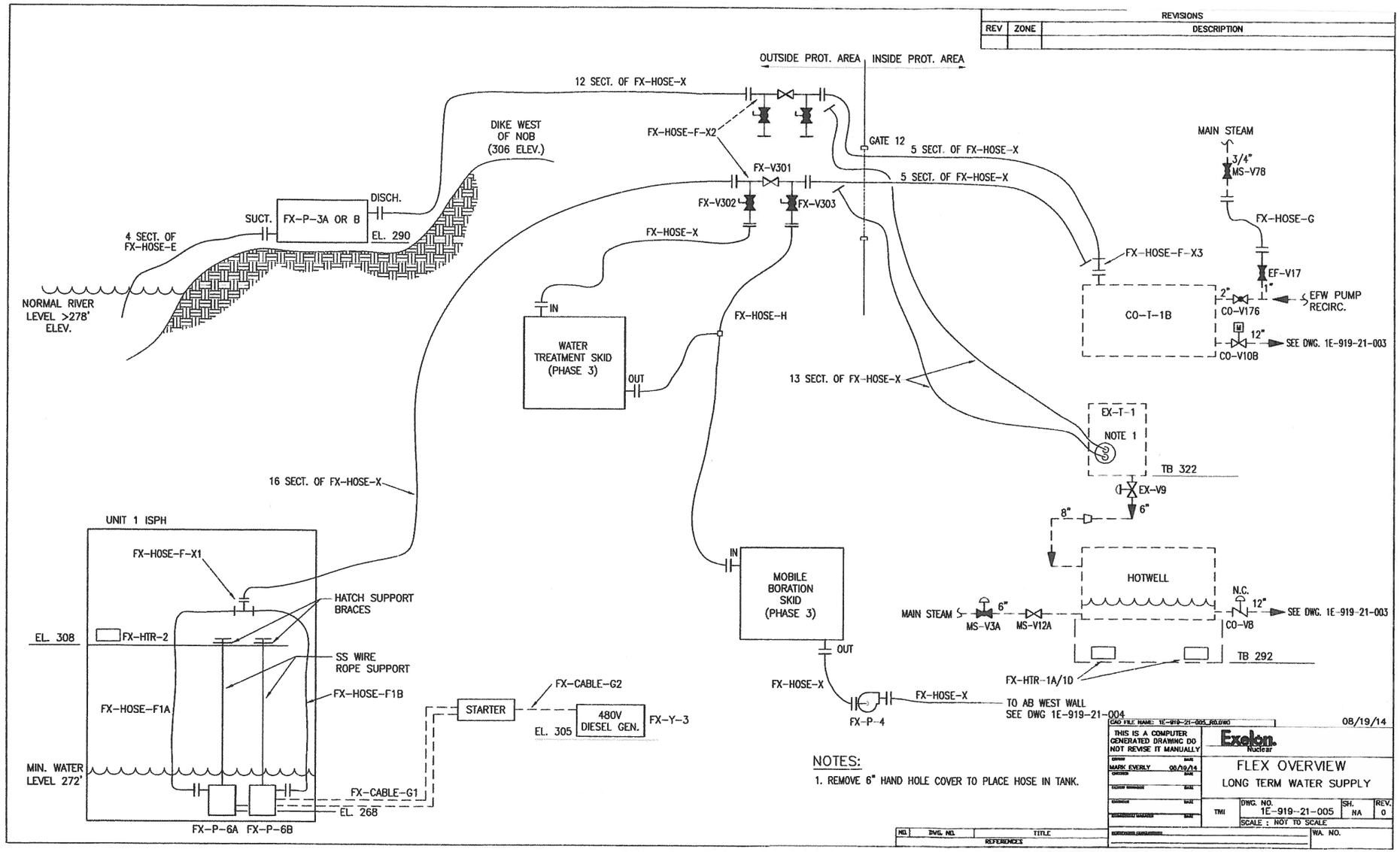
Attachment 1C - Sequence of Events Timeline
Extreme Cold, Snow and Ice @ 100% power

#	ELAP Time (HR)	Action	Time Constraint Y/N	Remarks / Applicability
34	< 10.0	OTSG Pressure is now less than 200 psig. Backup feedwater capability is enabled. If backup feedwater is required, operator starts FX-P-2A or B and throttles opens FX-V-206A and FX-V-206B to control OTSG level (all action TB 322 north).	N	The design objective is to enable back-op feedwater capability within 12 hours.
35	10.0	RCS cooldown is complete. • Incore temperature 400F • OTSG A & B Pressure 150 psig • RCS Pressure 400 psig Operator begins slowly raising pressurizer level to above 300 inches.	N	
36	12.0	Operator connects a hose from main steam drain line to piping connected to condensate tank B and initiates tank heating.	N	
37	12.0	BWST immersion heater 1A is energized from 1A ESF MCC.	N	
38	12.0	Operator opens SF-V-88, connects hose from FLEX feedwater header to the FLEX primary low pressure header, monitors SF pool level and throttles FX-V-101 open as needed to maintain SFP level.	N	Spent fuel pool boiling occurs after 40 hours.
39	15.0	Operator lines up spent fuel pool vent path (opening doors through U2 fuel pool to atmosphere).	N	Spent fuel pool boiling occurs after 40 hours.
40	24.0	SNRC (Regional Response Center) resources begin arriving on site. SNRC Equipment will be used to maintain a reliable condensate supply and to address longer term needs for fuel oil or borated water.	N	
41	48	Transfer hose and portable diesel-driven pump (FX-P-3A or FX-P-3B) from FLEX storage facility (FSF) to road next to the river, route suction hose into river, and route discharge hose to CO-T-1B.	N	Minimum condensate supply would last greater than 72 hours.

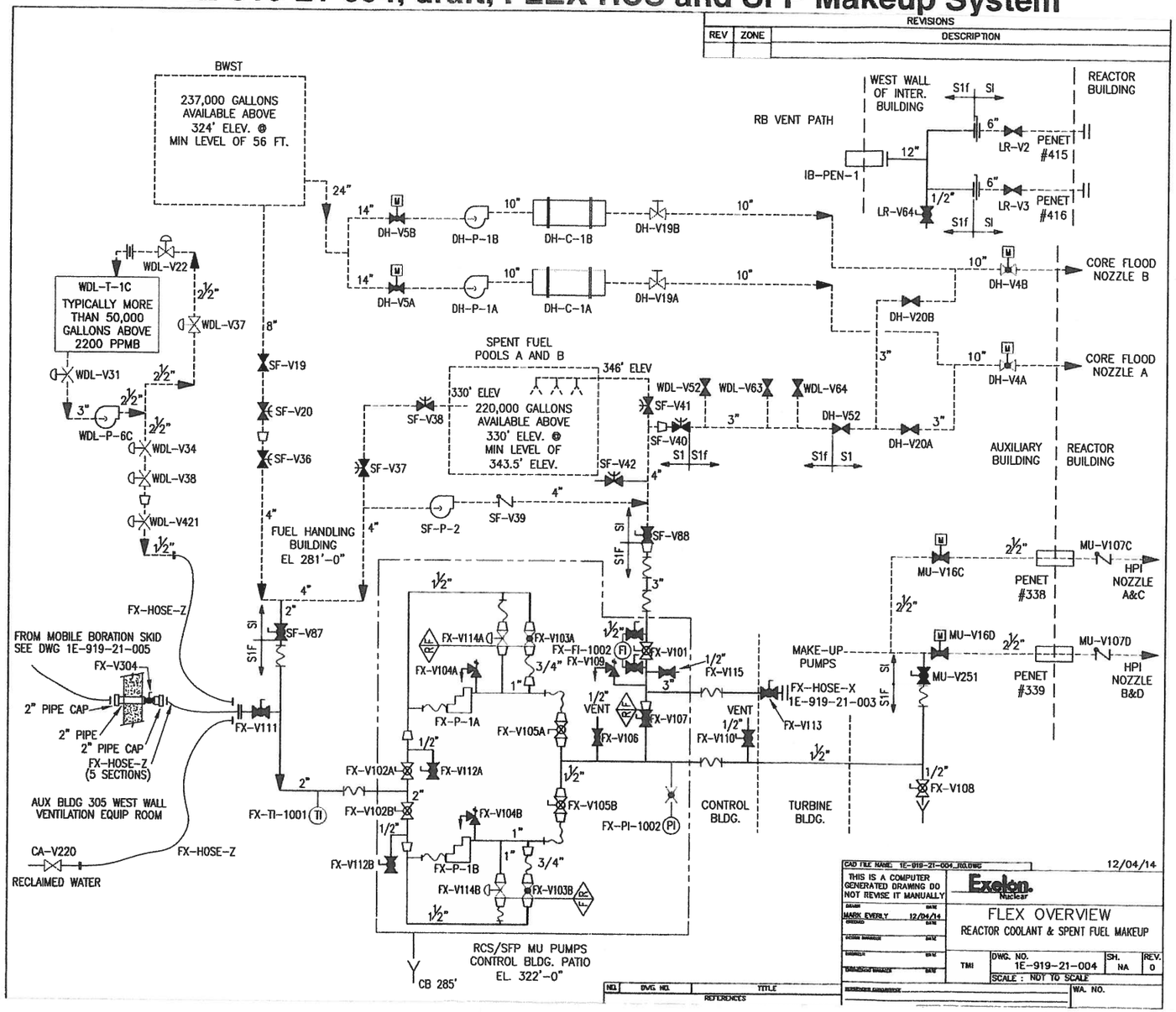
Attachment 2A
1E-919-21-001, draft, FLEX Diesel Generator and Fuel Oil System



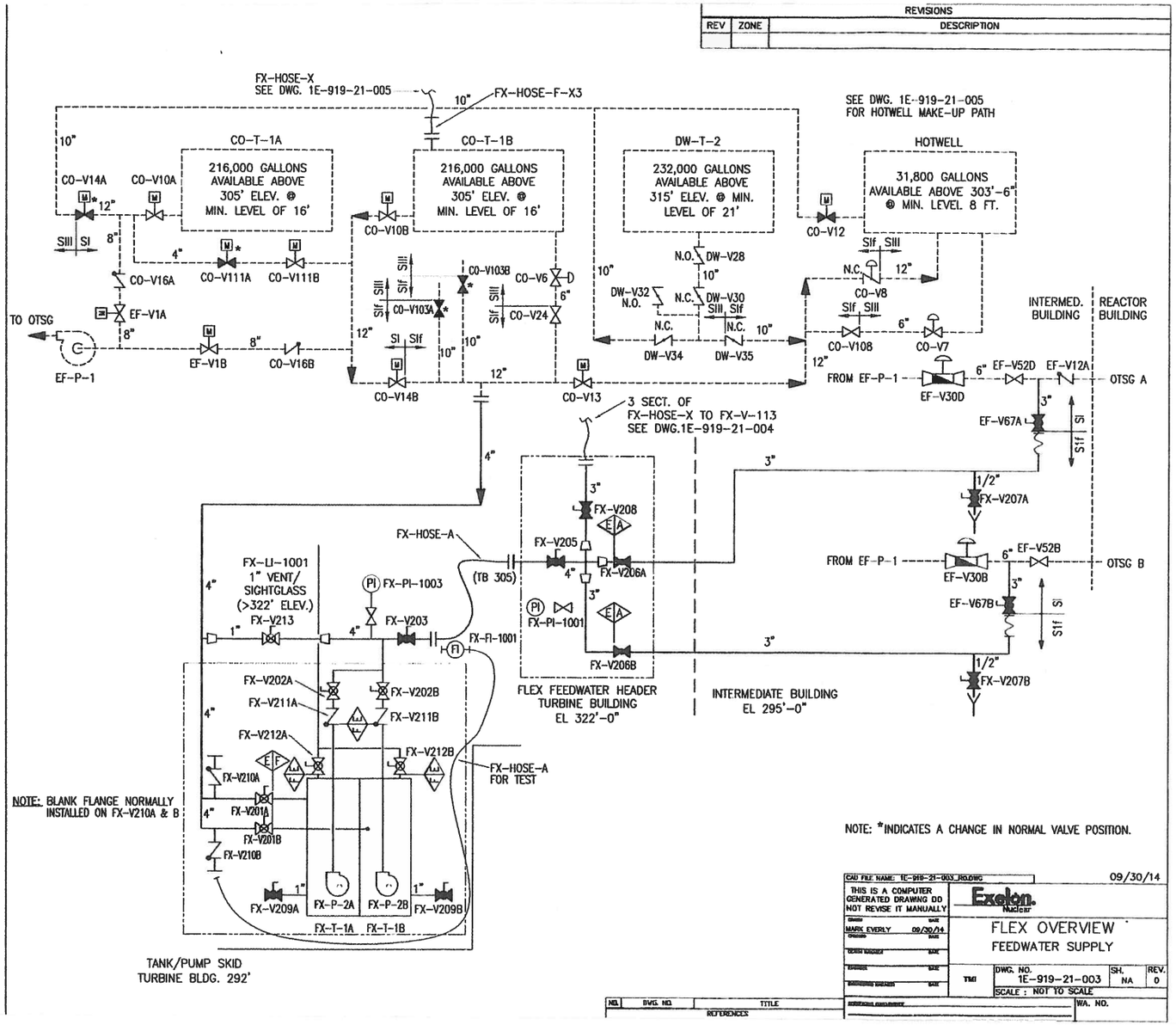
Attachment 2E
1E-919-21-005, draft, Long term water supply



Attachment 2D
1E-919-21-004, draft, FLEX RCS and SFP Makeup System



Attachment 2C
1E-919-21-003, draft, FLEX Feedwater System



Attachment 2B
1E-919-21-002, draft, FLEX Electrical Distribution