Keith J. Polson
Site Vice President

DTE Energy Company
6400 N. Dixie Highway, Newport, MI 48166
Tel: 734.586.6515 Fax: 734.586.4172
Email: polsonk@dteenergy.com

DTE Energy

10 CFR 2.202

January 20, 2016
NRC-16-0005

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

References:
1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

2) NRC Order 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 (ADAMS Accession No. ML12054A735)

3) NRC Letter, "Fermi, Unit 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC No. MF0770)," dated November 25, 2013 (ADAMS Accession No. ML13220A133)

Subject: Fermi 2 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)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued an order (Reference 2) to DTE Electric Company (DTE). Reference 2 was immediately effective and directed DTE 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 were provided in Attachment 2 of Reference 2. Enclosure 1 of this letter provides a summary of DTE's compliance with the requirements in Attachment 2 of Reference 2.

Enclosure 2 of this letter provides DTE's response to NRC audit questions, including NRC Interim Staff Evaluation (Reference 3) open and confirmatory items. The response in Enclosure 2 includes information previously provided to the NRC staff as part of the diverse and flexible coping strategy (FLEX) audit process, with updated information consistent with implementation of NRC Order EA-12-049 at Fermi 2.

Enclosure 3 provides the Final Integrated Plan for FLEX implementation at Fermi 2.

This letter, along with the enclosures, provides the notification required by Section IV.C.3 of the Order that full compliance has been achieved for Fermi 2.

This letter contains no new regulatory commitments.

Should you have any questions or require additional information, please contact Mr. Kevin Burke, Manager, Industry Interface at (734) 586-5148.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on January 20, 2016

Keith J. Polson
Site Vice President

Enclosures:
1. Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events
2. Response to Audit Questions
3. Final Integrated Plan

cc: Director, Office of Nuclear Reactor Regulation
NRC Project Manager
NRC Resident Office
Reactor Projects Chief, Branch 5, Region III
Regional Administrator, Region III
Michigan Public Service Commission
Regulated Energy Division (kindschl@michigan.gov)

Enclosure 1 to
NRC-16-0005

Fermi 2 NRC Docket No. 50-341
Operating License No. NPF-43

Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events

Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events

1 Background

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Reference 4.1) to DTE Electric Company (DTE). This Order was effective immediately and directed DTE 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-bases external event as outlined in Attachment 2 of the Order. The information provided herein documents full compliance for Fermi 2 in response to the Order.

DTE submitted the Fermi 2 Overall Integrated Plan (OIP) by letter dated February 28, 2013 (Reference 4.2). By letter dated November 21, 2013 (Reference 4.3), the NRC provided its interim staff evaluation (ISE) and requested additional information necessary for completion of the review. The information requested by NRC is included in Enclosure 2 of this letter.

2 Compliance Elements Summary

A summary of DTE compliance with Reference 4.1 is provided as follows:

Strategies – Complete
Fermi 2 strategies are in compliance with Order EA-12-049. DTE has provided responses to strategy-related Open Items, Confirmatory Items, and Audit Questions/Audit Report Open Items through the audit process, as documented in Enclosure 2 of this letter. Responses to audit items 12-A, 12-B, and E-7 are pending final NRC approval. The remaining audit items have been closed.

Modifications – Complete
The modifications required to support the diverse and flexible coping strategies (FLEX) at Fermi 2 are complete. The buildings and equipment have been turned over to Operations.

Equipment – Procured and Maintenance & Testing
The equipment required to implement the FLEX strategies for Fermi 2 has been procured in accordance with NEI 12-06, Sections 11.1 and 11.2 (Reference 4.4). The required FLEX equipment has been received at Fermi 2.

Equipment has been initially tested and 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 Fermi 2 Preventative Maintenance (PM) program such that equipment reliability is sustained. FLEX PM instructions have been approved and will be issued in accordance with the site PM control process. Site PMs will be scheduled for implementation in the appropriate work weeks based on their frequency as scheduled in the PM program.

Protected Storage – Complete
The Fermi 2 protected storage facilities, FLEX Storage Facility 1 (FSF1) and FLEX Storage Facility 2 (FSF2), that support implementation of the FLEX strategies for Fermi 2 are complete. FSF1 and FSF2 provide protection from applicable site hazards as required.

Procedures – Complete
FLEX Support Guidelines (FSGs) for Fermi 2 have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been validated.

Training – Complete
Training for Fermi 2 FLEX strategies has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6 (Reference 4.4).

Staffing – Complete
The staffing study for Fermi 2 has been completed, as required by NRC's request for information, dated March 12, 2012 (Reference 4.5). DTE submitted the staffing study results to the NRC on April 17, 2015 (Reference 4.6).

National SAFER Response Centers – Complete
DTE contracted 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. DTE confirmed that PEICo is ready to support Fermi 2 with Phase 3 equipment stored in the National SAFER Response Centers, in accordance with the site-specific SAFER Response Plan.

Validation – Complete
In accordance with industry guidance, DTE has validated required tasks, manual actions, and decisions for FLEX strategies to ensure they are feasible and may be executed within the constraints of the Final Integrated Plan.

FLEX Program Document – Complete
The Fermi 2 FLEX Program Document has been developed in accordance with the requirements of NEI 12-06 (Reference 4.4).

3 Milestone Schedule – Items Complete

Milestone	Activity Status
Submit 60 Day Status Report	Complete
Submit Overall Integrated Plan	Complete
Submit 6 Month Updates:	
Update 1	Complete
Update 2	Complete
Update 3	Complete
Update 4	Complete
Update 5	Complete
FLEX Strategy Evaluation	
Validation Walk-through or Demonstrations	Complete
Perform Staffing Analysis	Complete
Modifications:	
Design Engineering	Complete
Implementation	Complete
Storage	
Storage Design Engineering	Complete
Storage Implementation	Complete
FLEX Equipment	
Procure On-Site Equipment	Complete
Develop Strategies with RRC	Complete
Procure Staging Location	Complete
Procedures:	
Create Procedures	Complete
Training:	
Develop Training Plan	Complete
Training Complete	Complete
FLEX Implementation	Complete
Submit Completion Report	This document

4 References

4.1 NRC Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A735)

4.2 DTE letter, NRC-13-0009, "DTE Electric 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 (ADAMS Accession No. ML13063A262)

4.3 NRC letter, “Fermi 2 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies),” dated November 25, 2013 (ADAMS Accession No. ML13220A133)

4.4 Nuclear Energy Institute, NEI 12-06, Revision 0, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,” dated August 2012 (ADAMS Accession No. ML12242A378)

4.5 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 (ADAMS Accession No. ML12053A340)

4.6 DTE letter, NRC-15-0040, “Emergency Preparedness Phase 2 Staffing Assessment,” dated April 17, 2015 (ADAMS Accession No. ML15107A399)

Enclosure 2 to
NRC-16-0005

Fermi 2 NRC Docket No. 50-341
Operating License No. NPF-43

Response to Audit Questions

Response to Audit Questions

NRC Reference
1-A – ISE OI 3.1.1.1.A

NRC Audit Item
Each section of the Integrated Plan describing storage protection from hazards makes reference to Section 11 rather than to the specific protection requirements described in Nuclear Energy Institute (NEI) 12-06 for the applicable hazard; that is Section 6.2.3.1 for floods, Section 7.3.1 for wind, etc.

DTE Response
DTE revised the Overall Integrated Plan (OIP) to refer to the specific protection requirements described in NEI 12-06 for the applicable hazard. This revised OIP was sent to the NRC in the second six month update on progress in implementing Order EA-12-049 (DTE Letter NRC-14-0002, ADAMS Accession No. ML14059A350). The revised OIP included adding the following NEI 12-06 section references in DTE Letter NRC-14-0002, Enclosure 2, Page 15:

- 5.3.1 Protection of FLEX Equipment - Seismic Hazard,
- 6.2.3.1 Protection of FLEX; Equipment - Flood Hazard,
- 7.3.1 Protection of FLEX Equipment - High Wind Hazard,
- 8.3.1 Protection of FLEX Equipment - Snow, Ice and Extreme Cold,
- 9.3.1 Protection of FLEX Equipment - High Temperatures, and
- 11.3 Equipment Storage.

NRC Reference
2-A – ISE CI 3.1.1.2A

NRC Audit Item
Plans for the deployment of portable equipment following a seismic event require a liquefaction study for the proposed route.

DTE Response
Results from the calculations below show no susceptibility to liquefaction that impacts the Circulating Water pond, Phase 2 equipment deployment, or Strategic Alliance for FLEX Emergency Response (SAFER) Phase 3 travel paths inside the Owner Controlled Area. Cyclic softening in areas with clay fill is predicted to result in settlements of a maximum of 2 inches, which does not impact deployment capability.

- DC-6601 Vol. I, Rev. 0, “Robustness & Stability Evaluations of Circ Water Pond During & After Safe Shutdown Earthquake”
- DC-6603 Vol. I, Rev. 0, “Evaluation of Liquefaction of Soil in the FLEX Deployment Path”

NRC Reference
3-A – ISE CI 3.1.1.2.A

NRC Audit Item
Plans for strategies have insufficient information to demonstrate alternate sources of instrument readings and adequate tolerances/accuracies if there is seismic impact to primary sources.

DTE Response
Alternate instrumentation to the Main Control Room is identified in FLEX Support Guideline (FSG) 29.FSG.100, "FLEX Supplemental Information," Enclosure C, with expected accuracies to vary depending on the method selected for obtaining the reading. The expected accuracy is adequate to implement the FLEX strategy.

NRC Reference
4-A – ISE CI 3.1.1.3.B

NRC Audit Item
Internal flooding, reliance on Alternating Current (AC) power for pumping, and impact of downstream dam failure from a seismic event are still being evaluated.

DTE Response
Internal Flooding – NEI 12-06, Revision 0, Section 5.3.3.2 states:

> Consideration should be given to the impacts from large internal flooding sources that are not seismically robust and do not require ac power (e.g., gravity drainage from lake or cooling basins for non-safety-related cooling water systems).

All major piping systems within the Reactor Building and Auxiliary Building are seismic category I or II/I. Similarly, all large volume tanks, such as the Standby Liquid Control tank, Reactor Building Closed Cooling Water surge tank, and Emergency Equipment Cooling Water surge tank, are seismic category I or category II/I. Therefore, the Reactor and Auxiliary Buildings are not susceptible to large internal flooding from non-seismically robust sources (Updated Final Safety Analysis Report (UFSAR) Section 3.7).

Postulated breaks in the Turbine Building are bounded by the worst case flooding scenario, which results from the failure of the expansion joints between the circulating water piping and the main condenser water boxes. The basement area may be flooded in this event. Operation of the High Pressure Core Injection (HPCI)/General Service Water (GSW) crosstie valve may be precluded by this flooding, which would prevent containment heat rejection to the circulating water pond. In this case, containment heat rejection will occur by venting through the torus hardened vent.

Reliance on AC Power for Pumping – NEI 12-06, Revision 0, Section 5.3.3.3 states:

> For sites that use ac power to mitigate ground water in critical locations, a strategy to remove this water will be required.

Reactor/ Auxiliary Building
Fermi does not rely on AC power to mitigate ground water in critical locations since Category I structures are design to protect against/keep out ground water leakage (UFSAR Section 3.4).

Turbine Building
Similar to the discussion of internal flooding above, should ground water in-leakage prevent access to the HPCI/GSW crosstie valve operator, containment heat rejection will occur by venting through the torus hardened vent.

Impact of Downstream Dam Failure from a Seismic Event – NEI 12-06, Revision 0, Section 5.3.3.4 states:

> Additional guidance may be required to address the deployment of FLEX for those plants that could be impacted by failure of a not seismically robust downstream dam.

Fermi does not rely on a dam to maintain its water inventory required for FLEX injection and is not susceptible to dam failures (UFSAR Section 2.4.4).

NRC Reference
5A – ISE CI 3.1.1.4.A

NRC Audit Item
Utilization of offsite resources. In its integrated plan, DTE has provided information regarding its use of the offsite resources through the industry Strategic Alliance for FLEX Emergency Response (SAFER) program, but has not yet provided sufficient details, including method of transportation, to conclude that they conform to the guidance of NEI 12-06, Section 5.3.4, consideration 1, Section 6.2.3.4, considerations 1 and 2, Section 7.3.4, considerations 1 and 2, and Section 8.3.4. DTE is requested to provide additional information to address these issues.

DTE Response
The industry has contracted with the Strategic Alliance for FLEX Emergency Response (SAFER) organization through Pooled Equipment Inventory Company (PEICo) to establish and operate the National SAFER Response Centers (NSRC) as part of PEICo's existing Pooled Inventory Management (PIM) Program. The SAFER approach and its subsequent acceptance and implementation by the industry, is based on the Phase 3 requirements of NEI 12-06.

The Fermi 2 SAFER Response Plan (SRP) contains information on the specifics of generic and site specific equipment obtained from the NSRC. The Fermi 2 SRP also contains the logistics for transportation of the equipment, staging area set up, and other needs for ensuring the equipment and commodities sustain the site's coping strategies. The Fermi 2 SRP includes both air and land modes of transportation, as well as alternative routes for each. The Fermi 2 SRP provides the details necessary to show conformance to NEI 12-06, Section 5.3.4, consideration 1, Section 6.2.3.4, considerations 1 and 2, Section 7.3.4, considerations 1 and 2, and Section 8.3.4.

NRC Reference
6A – ISE CI 3.1.3.2.A

NRC Audit Item
Validate Key Parametric Values versus time using Fermi Station Time Critical Operator Action validation\verification process once all procedures, training, and equipment have been implemented.

Licensee Input Needed from NRC Audit Report
Licensee to complete its verification and validation analyses.

DTE Response
NEI 12-06, Revision 0, states:

> The purpose of this guide is to outline a process that may be used by licensees to reasonably 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. The process defined in this guidance is sufficient for a licensee to demonstrate the ability to execute the strategies associated with Order EA-12-049.

The Fermi 2 FLEX Validation Process (FVP) confirms that the staffing assumptions and the ability to perform time-sensitive actions are consistent with analytical assumptions, including consideration for performance attributes that could influence the outcome. The results of the validation are summarized in the attachments, and are based on the following documents:

- Final Integrated FVP Review Results (TMII-15-0012)
- NEI (Phase 2) Staffing Assessment Validation (NARP-15-0294)

The FVP determined that the tasks reviewed had sufficient margin between the validated task completion time and the required task completion time. TMII-15-0012 provides a consolidation of the results, which show that margin exists to successfully complete procedure actions in the time required by the strategy and supporting analyses, including consideration for performance attributes.

The Fermi 2 Phase 2 Staffing Study was reviewed to determine if the FLEX Validation Process results would require changes to the staffing study conclusions, as submitted. NARP-15-0294 documents the results of this review and determined that no changes were necessary.

To perform the validation, DTE parsed the identified Time Sensitive Actions (TSA) from the FSGs and Abnormal Operating Procedures (AOPs) into subtasks. Validation Plans were developed based on task groupings best suited to conduct the validation activities in accordance with the procedures.

These tasks were performed or simulated at the field locations. The validations were conducted under normal working or simulated post-event conditions, in segments.

Based on equipment and facility availability, the validation plans were performed in three cycles, followed by a fourth (and final) integrated review cycle. The final cycle reviewed the validation plan documentation for appropriate resources and consistency with the procedures and strategy sequence of events.

The data and results are summarized in TMII-15-0012, Enclosure B. The report presents:

- the available time margin for the performance of each validation plan,
- the assigned resource, the time determined for that resource to perform the tasks, and
- the total implementation time assigned to each resource allocated to the validation plan.

As shown in Enclosure A to TMII-15-0012, each validation plan was determined to have an acceptable margin.

To assess resource utilization during the overall time period of the event, activities were modelled in Primavera P6 using the resources, logic ties, and durations from the applicable validation plans. The output report is presented in TMII-15-0012, Enclosure C.

In the period of time since the validation activities were conducted, Operations and other site personnel have completed all training activities associated with FLEX strategies and response.

Additionally, Operations has issued the FSG procedures. Operations personnel conducted a review and provided documentation (NPOP 15-0063) that the issued FSG procedures contain no substantive changes from the draft procedures used in the validation that would affect the ability to implement the FLEX strategy in the times as validated.

No resource utilization factors >1.0 exist, which indicates the strategy can be successfully accomplished using the available resources defined in the Fermi Phase 2 Staffing Study.

NRC Reference
7A – ISE CI 3.1.4.2.A

NRC Audit Item
Equipment to clear ice and snow from haul pathways not identified in plan or during the audit process to date.

DTE Response
Snow and ice is routinely cleared from haul pathways by a contractor in accordance with FBP-90, “Enrico Fermi Energy Center Snow Removal Plan.” In addition, a Ford 550 truck with a plow blade is stored in each FLEX Storage Facility (FSF). A Caterpillar bulldozer is also stored in FSF1. This equipment is available for use if needed during an event.

NRC Reference
8A – ISE CI 3.2.1.1.A

NRC Audit Item
From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that Modular Accident Analysis Program 4 (MAAP4) is an appropriate code for the simulation of an Extended Loss of AC Power (ELAP) event at your facility.

DTE Response
Benchmarks that demonstrate that MAAP4 is an appropriate ELAP simulation code for use with a Fermi 2 ELAP are identified and discussed in the following:

- EPRI Technical Report 3002001785, Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications. (Commonly Referred to as the June 2013 Position Paper)
- EPRI Technical Report 3002002749, Technical Basis for Establishing Success Timelines in Extended Loss of AC Power Scenarios in Boiling Water Reactors Using MAAP4 – A Guide to MAAP Thermal-Hydraulic Models. (Commonly Referred to as the Roadmap)
- LTR-BWR-ENG-15-029 Rev. 0, DTE Fermi 2 MAAP FLEX Analysis Quality Assurance Documentation
- NEI Letter dated December 19, 2013, Subject: Revised BWR Template for Use of MAAP
- P0142150004-1587, Fermi 2 MAAP Thermal Hydraulic Calculations to Support Extended Loss of AC Power Mitigating Strategies

NRC Reference
9A – ISE 3.2.1.1.B

NRC Audit Item
The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits.

DTE Response
MAAP4 evaluation of a Fermi 2 ELAP under a FLEX scenario shows that the collapsed level remains above TAF. The results are documented in:

- LTR-BWR-ENG-15-029 Rev. 0, DTE Fermi 2 MAAP FLEX Analysis Quality Assurance Documentation
- CN-BWR-ENG-14-009 Rev. 0, DTE Fermi 2 MAAP Analysis for Updated FLEX Submittal
- P0142150004-1587, Fermi 2 MAAP Thermal Hydraulic Calculations to Support Extended Loss of AC Power Mitigating Strategies

As recognized in the ISE, the cool down rate will not necessarily be within the limit posed by Technical Specifications (TS) because plant response will be governed by the Emergency Operating Procedures (EOPs).

NRC Reference
10A – ISE CI 3.2.1.1.C

NRC Audit Item
MAAP4 must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper.

DTE Response
The use of MAAP4 in accordance with the June 2013 position paper is address in the following documents:

- LTR-BWR-ENG-15-029 Rev. 0, DTE Fermi 2 MAAP FLEX Analysis Quality Assurance Documentation
- CN-BWR-ENG-14-009 Rev. 0, DTE Fermi 2 MAAP Analysis for Updated FLEX Submittal
- P0142150004-1587, Fermi 2 MAAP Thermal Hydraulic Calculations to Support Extended Loss of AC Power Mitigating Strategies

NRC Reference
11A – ISE CI 3.2.1.1.D

NRC Audit Item
In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1 020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included:

a. Nodalization
b. General two-phase flow modeling
c. Modeling of heat transfer and losses
d. Choked flow
e. Vent line pressure losses
f. Decay heat (fission products / actinides / etc.)

DTE Response
The following documents identify, discuss and justify the key modeling parameters used in Fermi 2's MAAP analysis:

- LTR-BWR-ENG-15-029 Rev. 0, DTE Fermi 2 MAAP FLEX Analysis Quality Assurance Documentation
- P0142150004-1587, Fermi 2 MAAP Thermal Hydraulic Calculations to Support Extended Loss of AC Power Mitigating Strategies

NRC Reference
12A – ISE CI 3.2.1.1.E

NRC Audit Item
The specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the integrated plan must be identified and should be available for the NRC staff to review. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that Top of Active Fuel (TAF) is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within tech spec limits.

Licensee Input Needed from NRC Audit Report
Licensee to demonstrate that Reactor Core Isolation Cooling (RCIC) (and HPCI, if credited) can continue to operate when the reactor vessel water level exceeds the main steam line elevation, as assumed in a credited MAAP calculation. Alternately, a different control strategy should be used that does not result in the vessel level exceeding the main steam line elevation during the time that operation of steam-driven systems is credited.

The licensee should further provide on the e-portal its procedure for using the condenser hotwell as a suppression volume during the flooding event.

DTE Response
Cases B1 and C1 of CN-BWR-ENG-14-009 Rev. 0, "DTE Fermi 2 MAAP Analysis for Updated FLEX Submittal" are the key cases that validate the instantaneous scenario. The flooding scenario is validated in P0142150004-1587, "Fermi 2 MAAP Thermal Hydraulic Calculations to Support Extended Loss of AC Power Mitigating Strategies."

As recognized in the ISE, the cool down rate will not necessarily be within the limit posed by Technical Specifications because plant response will be governed by the EOPs.

Fermi 2 re-analyzed the FLEX flooding scenario, after correcting modeling discrepancies, in P0142150004-1587. The re-analysis evaluated a FLEX-Flood scenario for three cases: (1) RCIC operating to "bleed" Torus inventory, (2) HPCI operating to "bleed" Torus inventory, and (3) utilizing the containment vent. All three cases demonstrate that Reactor Pressure Vessel (RPV) water level remains above TAF for the event duration and that RPV water level does not reach the main steam lines.

The condenser hotwell is credited as a heat sink to minimize suppression pool temperature rise during the event. Procedure 29.400.02, "FLEX Flood," provides the procedural guidance for use of the condenser hotwell as a heat sink.

NRC Reference
13A – ISE CI 3.2.1.2.A

NRC Audit Item
Include a discussion of the assumed pressure-dependence of the leakage rate, and clarify whether the leakage was determined or assumed to be single-phase liquid, two-phase mixture, or steam at the donor cell and discuss how mixing of the leakage flow with the drywell atmosphere is modeled.

DTE Response
Flow from the recirculation pump seal will be single-phase liquid due to the location of the break flow in the RPV with RPV level maintained above TAF. Upon exiting the RPV, the seal leakage will flash a portion of the flow to steam based on saturated conditions in the drywell, creating a steam source and a liquid water source to the drywell.

Drywell atmosphere modelling is discussed in:

- EPRI Technical Report 3002002749, Technical Basis for Establishing Success Timelines in Extended Loss of AC Power Scenarios in Boiling Water Reactors Using MAAP4 – A Guide to MAAP Thermal-Hydraulic Models (Commonly Referred to as the BWROG Roadmap),
- MAAP4 Application Guidance, EPRI TP 1020236. July 2010, and
- MAAP4 – Modular Accident Analysis Program for LWR Power Plants, Computer Code Manual.

The BWROG roadmap addresses many generic MAAP questions including those documented in an NRC Letter to NEI dated October 3, 2013 (ADAMS Accession No. ML13275A318).

Fermi’s model of leakage into containment from the primary system is based on a specific break size. The break size was modeled to match the assumed leakage under pressurized conditions. As the break geometry is assumed unchanged for the event duration (unless isolated), primary system leakage to containment decreases with pressure as modeled in MAAP. Results are found in CN-BWR-ENG-14-009 Rev. 0, “DTE Fermi 2 MAAP Analysis for Updated FLEX Submittal.”

NRC Reference
14A – ISE CI 3.2.1.3.A

NRC Audit Item
Final Verification and Validation of the time required to implement these strategies has not been completed and because the licensee has not reviewed these strategies using NEDC-33771 P "GEH Evaluation of FLEX Implementation Guidelines," there is insufficient information to determine if the action time constraints can be met for all strategies.

DTE Response
Validation of time required to implement the strategies is addressed in the response to Audit Item 6A.

NRC Reference
15A – ISE 3.2.1.5.A

NRC Audit Item
Insufficient information that instrumentation for suppression pool conditions will be available to support the reactor level control coping strategies.

DTE Response
This audit item is addressed in the response to item 3A.

NRC Reference
16A – ISE CI 3.2.1.6.A

NRC Audit Item
Fermi is currently preparing modifications to provide bottled gas for operation of valves required for torus and drywell instrumentation which will include proper sizing of the bottles to allow operation until off-site equipment arrives to supplement the air supply.

DTE Response
Fermi credits Division 2 monitoring of Wetwell Level (T50N406B) and Drywell Pressure (T50N415B).

Engineering Design Package (EDP) 37114 provided the means for maintaining FLEX indication of Wetwell Level and Drywell Pressure in Division 2 by providing a pneumatic supply to instrument isolation valves T5000F420B and T5000F421B. Key containment parameters are monitored by T50N406B / T50R804B (Wetwell Level) and T50R802B / T50N415B (Drywell Pressure). Isolation valves T5000F421B (Wetwell Level) and T5000F420B (Drywell Pressure) fail close due to a loss of power in an ELAP event. EDP 37114 provided Operations with a remote means of re-opening these valves from the H21P101 Hardened Containment Vent System (HCVS) Panel by utilizing installed Nitrogen bottles. The Nitrogen bottles are sized for a 24-hour supply for HCVS and will fulfill the FLEX timeline.

NRC Reference
17A –ISE CI 3.2.1.8.A

NRC Audit Item
Development of a technical basis for demonstrating RCIC operability and confirmation that loss of CST will not cause a loss of suction.

DTE Response to NRC Audit Item
This audit item is addressed in the response to audit item 28B.

NRC Reference
18A – ISE OI 3.2.2.A

NRC Audit Item
Until the issue of relying on blow-away panels to prevent [over] pressurization of the Reactor Building 5^{th} Floor (RB-5) is provided, there is no reasonable assurance that the plan will conform with NEI 12-06, Table C-3.

DTE Response to NRC Audit Item
Provisions to vent the fifth floor of the Reactor Building have been included in procedure 29.FSG.20, "FLEX Ventilation and Building Heat Control."

NRC Reference
19A – ISE CI 3.2.3.A

NRC Audit Item
Demonstrate that there is sufficient minimum free volume available in the locations that are postulated to survive each applicable Beyond-Design-Basis External Event (BDBEE) such that the "bleed" volume of water can be properly contained to support this strategy for the duration of the coping time which is required.

DTE Response
Fermi 2 utilizes the Circulating Water (CW) pond in its Feed and Bleed Strategy as water supply (feed) for the FLEX pumps as well as a rejection (bleed) location for hot water. As the CW pond is the supply and rejection location, the overall inventory of the 5.5 acre CW pond (33×10^6 gallons normal inventory) will not significantly change. The CW pond and CW piping have been evaluated as seismically robust in the following calculations:

- DC-6601 Vol. I, "Robustness & Stability Evaluation of Circ Water Pond During & After Safe Shutdown Earthquake" and
- Vendor Calculation 141313 CA 01, "Seismic Analysis of 144 In. Circulating Water System Supply Lines."

NRC Reference
20A – ISE OI 3.2.3.B

NRC Audit Item
Revision 3 to the Boiling Water Reactor Owners' Group (BWROG) Emergency Procedure Guidelines (EPG)/Severe Accident Guidelines (SAG) is a Generic Concern because the BWROG has not addressed the potential for the revised venting strategy to increase the likelihood of detrimental effects on containment response for events in which the venting

strategy is invoked. (Note: For Fermi, containment venting is a backup plan to the torus feed and bleed strategy, discussed in response to Audit Item 19A.)

DTE Response
The NRC generic concerns with the revised venting strategy contained in Revision 3 to the BWROG EPG/SAG have been resolved as documented in an NRC letter to NEI, dated January 9, 2014 (ADAMS Accession No. ML13358A206).
Revision 3 to the BWROG EPG/SAG has been implemented at Fermi 2. Venting is required by EOPs to maintain containment pressure below the Pressure Suppression Pressure/ Pressure Control Pressure Limit (PSP/ PCPL). Steps to restore containment pressure instrumentation and perform torus venting are contained in 29.FSG.13, "FLEX Containment Venting." Venting is directed if necessary as a contingency in the event Feed and Bleed operation cannot be established or is not effective in controlling Containment pressure. This action is directed by 29.400, "FLEX Flowchart." The use of the 29.400 chart is governed by 29.400.01, "FLEX."

NRC Reference
21-A – ISE CI 3.2.4.2.A

NRC Audit Item
Completion of the licensee's evaluation of the hydrogen gas buildup and strategy, including exhaust path for the battery room.

DTE Response
Hydrogen concentration, as evaluated under DC-6586 Vol. I, Rev. A, "Loss of HVAC – Room Environment Analysis in Support of FLEX: Battery Room Temperature and Hydrogen Concern," remains below 2% by volume for 39 hours for the Division II Battery Room and 36 hours for the Division I Battery Room. At 72 hours both compartments maintain hydrogen concentrations less than 4%.

While hydrogen concentration remains below 2%, Fermi's present design basis allowable limit (UFSAR Section A.1.128), mitigating actions are not required for the first 36 hours. Within 36 hours, Operations will restore Reactor Building Heating, Ventilation, and Air Conditioning (RBHVAC) using 29.FSG.19, "FLEX Toolbox – RBHVAC Restoration."

Fermi 2 will not employ the use of portable fans for hydrogen mitigation.

NRC Reference
22-A – ISE CI 3.2.4.2.B

NRC Audit Item
Complete post ELAP/BDBEE extended environmental response analysis for Support System Ventilation and equipment operation in RCIC and HPCI pump rooms

DTE Response
An environmental evaluation of post-ELAP RCIC room temperature generated temperature, relative humidity and room pressure timelines. The maximum temperature over the 72 hour period evaluated was 153.0 degrees Fahrenheit (ºF). The maximum relative humidity is 70.2% and the maximum room pressure is 0.5 pounds per square inch gauge (psig).

The environmental evaluation assumed that the door between the Torus Room and the RCIC Room would be opened at 9 hours to mitigate flooding. This causes a slight rise in RCIC Room temperature. Before opening of the Torus to RCIC door, RCIC Room temperature was approximately 145 ºF. Operations will be monitoring RCIC Room water level, and power to the RCIC Room sump pump is available at approximately 4 hours. This will allow operations to mitigate RCIC Room flooding and opening the Torus to RCIC door will not be necessary. Additional cooling, not modelled in the environmental evaluation, may occur at about 8 hours into the ELAP when RBHVAC ventilation can be provided the RCIC Room. Based on the above, RCIC Room temperature is not expected to rise significantly above 150 ºF. The environmental evaluation also demonstrates that RCIC/HPCI temperatures will be reduced to below 140 ºF if the Reactor Building doors are opened to the environment. The Electronic Governor Module (EGM) for the RCIC controls is located in the Relay Room (a mild environment) and is not affected be RCIC Room conditions. RCIC was previously evaluated under Station Blackout (SBO) for maximum temperatures of 158 ºF. As the RCIC Room temperatures are anticipated to be below 158 ºF for at least 9 hours post ELAP initiation, simple actions (such as opening external reactor building doors) can maintain temperatures below the design maximum temperature for RCIC.

The environmental evaluation results for RCIC Room pressure shows an increase to about 0.5 psig until the Torus room door is assumed to open at 9 hours. As discussed above, Operator actions to mitigate RCIC Room flooding will allow the Torus Room door to remain closed throughout the event. In addition, RBHVAC ventilation restoration will reduce the room pressure.

For the Fermi 2 Environmental Qualification program, the harsh environment threshold outside primary containment is a combination of 100% relative humidity with room pressure greater than 2.5 psig. Since the RCIC room peak humidity is well below 100%, the area is considered mild in regards to humidity and room pressure; therefore, humidity and room pressure are not of concern for RCIC operation during an ELAP.

Based on the above, there is reasonable assurance of RCIC operation during an ELAP.

An environmental evaluation of post-ELAP HPCI Room conditions generated temperature and relative humidity timelines. The maximum temperature over the 72 hour period evaluated was 163.4 ºF. The maximum relative humidity was 66.3% and the maximum room pressure was 0.3 psig. During the 8 hours before RBHVAC can be restored, the temperature increases during the first hour to 150 ºF, quickly reduces to approximately 140 ºF, and then gradually rises to the peak value of 163.4 ºF. Similar to the RCIC discussion, if Reactor Building doors are opened to the environment, a continuous HPCI Room temperature of approximately 150 ºF is anticipated.

For an SBO event, the HPCI system has been evaluated to successfully operate at a temperature of 180 ºF. The SBO coping time at Fermi 2 is 4 hours and AC power restoration begins after 1 hour. In addition, HPCI has been environmentally qualified to respond to design basis high energy line break (HELB) events where peak room temperatures reach greater than 170 ºF.

Based on the evaluations of HPCI at greater temperatures than the temperatures of concern for FLEX, and associated component-based evaluations, it is reasonable to expect HPCI to function for the 8 hour period that room cooling is unavailable during a FLEX event. This assessment takes into account the inherent margin in the SBO and design basis event evaluations as well as the consideration that containment venting is a contingency strategy for any potential loss of HPCI. Containment venting is directed by 29.400, "FLEX Flowchart." The use of the 29.400 chart is governed by Procedure 29.400.01 "FLEX." Note that the EGM for HPCI control is located in the Relay Room (a mild environment) and is not affected by HPCI room conditions.

During the initial 8 hours HPCI room pressure remains below 0.5 psig. After that, RBHVAC ventilation restoration will act to reduce the room pressure.

For the Fermi 2 Environmental Qualification program, the harsh environment threshold outside primary containment is a combination of 100% relative humidity with room pressure greater than 0.5 psig. Since the HPCI room peak humidity is well below 100%, the area is considered mild in regards to humidity and room pressure; therefore, humidity and room pressure are not of concern for HPCI operation during an ELAP.

Based on the above, there is reasonable assurance of HPCI operation during an ELAP.

NRC Reference
23A – ISE CI 3.2.4.2.C

NRC Audit Item
A discussion is needed on the effects of extreme high and low temperatures (i.e., temperatures above/below those assumed in the sizing calculation for each battery) on each battery's capability to perform its function for the duration of the ELAP event.

DTE Response
DC-6586 Vol. I Rev A, "Loss of HVAC – Room Environment Analysis in Support of FLEX: Battery Room Temperature and Hydrogen Concern," establishes plant environmental profiles for areas where required FLEX equipment/system exists and where personnel may require access. The Division I and Division II Battery Rooms are in the scope of the calculation, as shown in Table 1.1. Per Section 2.1, "The maximum calculated temperatures and hydrogen concentrations in the worst summer conditions (scenarios 1 and 2) and the minimum calculated temperatures and hydrogen concentrations in the worst winter conditions (scenarios 3 and 4) are summarized

in Table 2.1." From Table 2.1, the maximum temperatures for the Division I and Division II Battery Rooms for scenario 1 (scenario 2) are 103.2 ºF (113.5 ºF) and 105.8 ºF (116.3 ºF), respectively. From Table 2.1, the minimum temperatures for the Division I and Division II Battery Rooms for scenario 3 (scenario 4) are 65.4 ºF (64.5 ºF) and 65.4 ºF (64.4 ºF), respectively.

From Section 3.1 of DC-6584 Vol. I, Rev 0, "The duration that each battery can maintain sufficient voltage to support all connected loads is provided below. The aging factor, corresponding battery capacity and minimum required battery temperature required to support these results are included in Tables 3.1.1 and 3.1.2. This calculation conservatively uses a lower temperature of 60 ºF compared to DC-6480." Therefore, the analysis of battery performance at 60 ºF in DC-6584 bounds the analyzed minimum temperature of 64.4 ºF for the Division I and Division II Battery Rooms calculated in DC-6586.

Per Institute of Electrical and Electronics Engineers (IEEE) Standard 450-2002, elevated temperatures will reduce battery life; however, they will not adversely affect battery capacity. Although not evaluated in DC-6584, the effect of the maximum temperatures during the ELAP scenarios is a long term consideration in regards to battery life and would not be an imminent concern for the available coping capacity. Additionally, the analysis in DC-6586 assumes a 72 hour time frame from ELAP event initiation. After 72 hours, the temperatures would be expected to improve following restoration of selected systems during Phase 2 of the FLEX strategy. Therefore, the coping times that each battery can maintain sufficient voltage to support all connected loads (DC-6584 Tables 3.1.1 and 3.1.2) are valid for the duration of the ELAP event.

NRC Reference
24A – ISE CI 3.2.4.2.A

NRC Audit Item
Confirm whether or not freezing of piping or instrument lines have been addressed (heat tracing).

DTE Response
NEI 12-06, Rev. 0, Section 3.2.2 (12) states:

> Plant procedures/guidance should consider loss of heat tracing effects for equipment required to cope with an ELAP. Alternate steps, if needed, should be identified to supplement planned action…Procedures/guidance should be reviewed to identify if any heat traced systems are relied upon to cope with an ELAP.

Procedures/guidance relied on to cope with an ELAP at Fermi 2 have been reviewed and do not rely on any systems that are heat-traced. Therefore, loss of heat tracing is not a consideration in the Fermi 2 ELAP response.

The Fermi 2 ELAP response relies on installed plant equipment and instruments installed within the Reactor and Auxiliary Buildings. The Reactor and Auxiliary Building ventilation system is designed to maintain temperatures greater than 65 ºF. Portable equipment for the FLEX response is stored in two FLEX Support Facilities (FSF). The FSF heating and ventilation system is designed to maintain the interior temperature of the buildings above 40 ºF.

NRC Reference
25A – ISE CI 3.2.4.4.A

NRC Audit Item
Specific evaluation of paths and emergency lights is on-going as part of the Operator action evaluation process. Changes to emergency light placement/aiming may be made as a result of this review. The licensee's completion of their evaluation of paths and emergency lights as part of the Operator action evaluation process is sufficient to provide reasonable assurance that coping strategies for portable and emergency lighting will conform to the guidance of NEI 12-06, Section 3.2.2, consideration (8).

DTE Response
DTE's evaluation of paths and required lighting was conducted as part of Fermi's FLEX Validation Process and provides reasonable assurance that coping strategies for portable and emergency lighting conform to the guidance of NEI 12-06, Section 3.2.2 (8).

NRC Reference
26A – ISE CI 3.2.4.4.B

NRC Audit Item
Confirm guidance and strategies for communications strategies will conform to the guidance of NEI 12-06, Section 3.2.2 (8).

DTE Response
Fermi 2 communication strategies conform to the guidance of NEI 12-06, Section 3.2.2 (8). The Fermi 2 Staffing Assessment Report included a summary of an evaluation performed on Fermi's communications capabilities to implement the Fermi FLEX strategy. The Staffing Assessment Report was submitted to NRC by DTE letter, NRC-15-0040, "Emergency Preparedness Staffing Assessment," dated April 17, 2015 (ADAMS Accession No. ML15107A399).

NRC Reference
27A – ISE CI 3.2.4.5.A

NRC Audit Item
Verification that the security system and security Uninterruptable Power Supply (UPS) will remain available and that backup use of security keys will be adequate to ensure required access to implement FLEX strategies, and that guidance is provided in appropriate procedures, is identified as Confirmatory Item 3.2.4.5.A in Section 4.2.

DTE Response to NRC Audit Item
At Fermi 2 loss of offsite power to the security system will result in the security UPS maintaining power until its associated batteries are depleted, unless the site is flooded, in which case the security UPS is lost. The operators access the security areas by normal keycard use and have contingency Abloy keys for when the power fails. An Abloy key locker is in the Control Room for this purpose and is referenced in procedure 29.400.01, "FLEX."

Normal security access operation is returned when the FLEX AC generators power up the security loads per procedures 29.FSG.01 "FLEX DC" and 29.FSG.04, "FLEX AC."

NRC Reference
28A – ISE CI 3.2.4.6.A

NRC Audit Item
Address protective clothing or other equipment or accessibility of equipment, tooling, connection points, and plant components or the use of appropriate human performance aids.

DTE Response
The Fermi 2 Safety Handbook, Section 7, "Personal Protective Equipment," provides requirements for protective clothing and equipment. Personal Protective Equipment and tooling required to operate the FLEX equipment, to deploy hoses, to make the necessary connections, and to fuel the equipment are stored in the FLEX Support Facilities.

FLEX dedicated components have purple nameplates with white lettering affixed to the component. "Hard Cards" have been created to assist in the operation of the FLEX dedicated components. These "Hard Cards" were developed using the Institute of Nuclear Power Operations (INPO) Guidance for Operating Aids.

NRC Reference
29A – ISE CI 3.2.4.8.A

NRC Audit Item
Insufficient information provided regarding isolation of busses and regarding minimum bus voltages.

DTE Response
EDP 37122 describes the electrical distribution equipment associated with 480 Volt (V) FLEX backup power. This equipment consists of a local distribution panel at each FLEX 480V generator (N and N+1) in FSF1 with cabling routed through permanent BDBEE protected vaults and conduit to the Switchgear rooms. (See the response to Audit Item E-13 for further discussion of the cable vaults.) These are installed per EDP 37122 to allow connection into plant panels to provide 480 Volts AC (VAC) to Engineered Safety Feature (ESF) Battery Chargers (Motor Control Center (MCC) 72B-2A/MCC 72F-2A) and to ESF 480 VAC buses for critical and optional loads (72B and 72E for connection to 72C and 72F).

Connections are made per procedures 29.FSG.01, “FLEX DC,” for ESF Battery Charger restoration and 29.FSG.04, “FLEX AC,” for ESF 480 VAC bus restoration for critical and optional loads.

Isolation from normal 4160 VAC sources is described in procedures 29.FSG.01 and 29.FSG.04. This isolation consists of opening the 4160 VAC feed to the 480 VAC buses at the 4160 VAC buses and opening the incoming 480 VAC bus feed breaker from the 4160/480 VAC transformer.

Additionally, as part of the Direct Current (DC) load shedding per procedure 29.FSG.01, control power for Emergency Diesel Generator (EDG) 4160 VAC breakers to the plant as well as EDG starting logic and controls are de-energized to prevent unexpected start, load, and paralleling of EDGs.

DC-6583 Vol. I Rev 0, “FLEX AC Calculations” provides the analysis for minimum bus voltage with discussion in Section 3.2.3 which states “ bus voltages remain at levels sufficient to maintain hold-in of 120V relay elements.” The maximum voltage drops to modular power units (MPUs) 1 and 2 are 13.26V and 13.31V, respectively. These values are below the 19.1% and 15.0% maximums and are acceptable.”

DC-6583 Vol. I Rev 0, Section 10.2.4, Motor Starting Analysis, shows that minimum bus voltage hold-in requirements are maintained during motor start. Required Motor Ride through Voltages are analyzed for acceptance.

DC-6583 Vol. I Rev 0 Acceptance Criteria ensures:

- The steady-state voltages and currents must be within equipment ratings to ensure equipment reliability.
- The steady-state voltages must be sufficient for 120V control power relay pickup which will ensure equipment operates when required.
- During successful motor starting, motor terminal voltage must be sufficient to accelerate the motor before protective devices trip so that equipment operation and availability is maintained.
- During motor starting, the motor terminal voltages of concurrently running motors must not dip to a level which threatens motor stalls, which would threaten equipment and system reliability.
- During motor starting, the bus voltages must remain at a level sufficient to guarantee 120V control power relay hold-in, ensuring the running loads continue to perform their functions.

DC-6584 Vol. I, Rev 0, “FLEX DC Calculations” provides the analysis for battery coping duration and 260 Volts Direct Current (VDC) MCC Bus voltage results.

Per Section 3.1, the duration that each battery can maintain sufficient voltage to support all connected loads is provided in Tables 3.1.1 and 3.1.2 for the instantaneous scenario and flood scenario, respectively. The aging factor, corresponding battery capacity and minimum required battery temperature required to support these results are included in Tables 3.1.1 and 3.1.2. This calculation conservatively uses a lower temperature of 60 ºF compared to 70 ºF in DC-6480 Vol. I, Rev. B, "130V/260V DC System Analysis." Aging factor and design margin values are consistent with the requirements necessary to support the SBO profile in DC-6480. For the instantaneous case, the coping time of battery 1A is limited by string 1A-2 and is 13 hours, while the coping time of battery 2B is limited by string 2B-1 and is 14 hours. For the flood case, the coping time for batteries 1A and 2B is 24 hours.

Per Section 3.2, the 260 VDC MCC Bus voltage results are shown in Tables 3.2.1 and 3.2.2, and the methodology is further described in Section 4.3. Attachment DA of DC-6480 evaluated all the circuits on the 2PA and 2PB DC battery system, and the sizing voltage (minimum required voltage) was calculated for each battery. DC-6584 used Attachment DA and modified it to show only the required FLEX devices. For both instantaneous and flood cases, minimum required voltage was determined for each battery which ensures that all FLEX components necessary to mitigate the event have adequate voltage to perform their safety function. The battery discharge runs from DC-6480 were used to determine the limiting FLEX load on each battery system. DC-6584 added the new FLEX loads to the load profile. Similar to the methodology of DC-6480, each half of the 260V string is evaluated independently. One set of voltages is calculated in each of the individual 130 VDC battery strings (each half of the 260 VDC battery). These two sets of MCC voltage results represent the two halves of the total MCC voltage and must be summed together for each coincident time interval during the battery load profile in order to determine the actual MCC voltages on the correct 260 VDC voltage base. Therefore, maximum coping time of each 260V battery is based on summing together each battery string (Tables 3.2.1 and 3.2.2).

NRC Reference
30A-ISE CI 3.2.4.8.B

NRC Audit Item
The licensee did not provide sufficient information regarding loading/sizing calculations of portable diesel generator(s).

DTE Response
Phase 2 Portable Diesel Generators – Two 550 KW Diesel Generators
DC-6583 Vol. I, Rev 0, "Fukushima FLEX AC Calculations" provides FLEX 480 VAC generator sizing and an evaluation of the FLEX equipment and circuits used in conjunction with existing Fermi electrical distribution system equipment and circuits as part of the FLEX strategy in response to an ELAP during a BDBEE. The results of this calculation confirm the adequacy of the Fermi 2 AC system and FLEX 480 VAC equipment and circuits, with respect to the identified Phase 1 and Phase 2 FLEX strategy.

Loading Requirements: AC Load List (DC-6583, Attachment H, Pages H4-H5)
Sizing Requirements: Project Sizing Report (DC-6583, Attachment E, Page E7)

Phase 3 Portable Diesel Generators – Two 1 MW Generators
TE-K11-14-007, Revision A, "FLEX Phase 3 Emergency Response (SAFER) Evaluation" analyzes the means and methods by which the generic 2 MegaWatt (MW) 4160 VAC turbine generator system can be connected to the plant 4160 VAC bus(s).

Loading Requirements: The FLEX Phase-3, 2 MW generator system can provide backup to the FLEX Phase 2 N+1 generator system intended to serve equipment on Division 1 buses 72A, 72B, 72C and on Division 2 buses 72E, 72F, 72L and has considerable excess capacity. (TE-K11-14-007, Page 5)
Sizing Requirements: Design Input/Specification (TE-K11-14-007, Page 5)

TE-K11-14-015, "FLEX Phase 3 Emergency Response (SAFER), 480 VAC Generator for Communications Bldg," connects and evaluates the 1000 kiloWatt (KW), 480 VAC generators, which will be brought to the site by SAFER to support the electrical load at the Communications Building.

Loading Requirements: Computation and Results (TE-K11-14-015, Pages 8 and 15-18/ Attachments 7, 8, 9 and 10)
Sizing Requirements: Design Input/Specification (TE-K11-14-015, Page 5)

NRC Reference
31A – ISE CI 3.2.4.9.A

NRC Audit Item
Develop a diesel fuel oil management plan to include control of fuel inventory and fuel quality.

DTE Response
Fermi's diesel fuel oil management plan for refueling FLEX equipment and validation includes 29.FSG.17, "FLEX Fuel Management," and DC-6540 Vol. I Rev A, "FLEX Phase 2 Diesel Consumption Calculation."

Fuel inventory of individual components will be replenished per procedure 29.FSG.17. The diesel supply may be from various sources including the Fermi 2 EDG diesel storage tanks. Fuel quality for the tanks is monitored by chemistry surveillances 74.000.18 (for new fuel inventory) and 74.000.19 (for monitoring fuel inventory within the EDG fuel storage tanks). Additional, alternative supplies of the Auxiliary Boiler fuel oil and Combustion Turbine Generator fuel oil are monitored by Fermi's Preventative Maintenance program under events AA44 and AA46.

DC-6540 assumes a 7 day coping time for FLEX phase 2 equipment and evaluates onsite fuel storage to support the following equipment: Source (lift) pump, Neptune pump, Dominator pump, two (2) 550 kW generators, portable air compressors, and a bulldozer. A total of approximately 23,700 gallons of diesel fuel will be required for 7 days of continuous operation of the equipment. The maximum allowed time to refuel each of the items is nominally: 17 hours for the source pump, 8 hours for the Neptune pump, 11 hours for the Dominator pump, 11 hours for each backup generator, 6 hours for the air compressor, and 13 hours for the bulldozer.

Inventory of the EDG storage tanks is maintained by Technical Specification Surveillance Requirement 3.8.3.1. A single tank maintains a total inventory of 35,280 gallons per Technical Specifications. This provides sufficient inventory for maintaining fuel for FLEX equipment for a minimum of seven days.

Equipment utilized in refueling operations is provided in 29.FSG.17 and includes a refueling vehicle equipped with a fuel transfer pump.

NRC Reference
32A – ISE CI 3.2.4.10.A

NRC Audit Item
Complete detailed review of functions associated with DC load shedding being performed in conjunction with the development of modifications associated with the FLEX AC and DC strategies. This includes the review of resulting component states and defense in depth following a loss of AC or DC power or load shed actions to isolate power.

DTE Response
DC functions shed are listed in 29.FSG.01, "FLEX DC," attachments 1-4 (instantaneous event in attachments 1 and 2, flooding event in attachments 3 and 4).

Components listed in these attachments are all de-energized. These logics are not used for defense in depth since no AC power exists to power the systems' pumps using the de-energized logic.

The remaining DC power supports all Phase 2 FLEX loads (HPCI, RCIC, safety relief valves (SRVs), and instrumentation). The two injection systems, RCIC and HPCI, and both divisions of SRVs and instrumentation provide defense in depth for critical functions. For the flooding case, the SRVs and HPCI are not relied upon since decay heat is much lower.

EDP 37122 modifications allow restoration of the battery chargers to maintain credited FLEX Phase 2 equipment and support directed actions to protect the primary containment and the fuel from damage.

NRC Reference
33A – ISE CI 3.2.4.10.B

NRC Audit Item
Evaluation of minimum required dc bus voltages are to be finalized in conjunction with FLEX AC and DC modifications

DTE Response
This audit item is addressed in the response to item 29A

NRC Reference
34A – ISE CI 3.3.2.A

NRC Audit Item
Establish Configuration Control program

DTE Response
The overall program document (discussed in NEI 12-06 Section 11.8) at Fermi 2 is MOP25, Revision 1, "Beyond-Design-Bases Event Coping Strategies Program Document." Fermi 2 conformance to NEI 12-06 Section 11.8 consists of two elements: (1) MOP25 and (2) the changes required to be made to the plant existing configuration control procedures.

MOP25, Section 10.0 contains requirements for control of changes to documents containing the supporting analytical bases, calculations, and assumptions used to develop FLEX strategies and procedures.

MOP25, Section 5.5 states: "Proposed changes to the plant design, physical plant layout, buildings and miscellaneous structures will be evaluated using plant configuration control procedures to ensure that FLEX strategies are not adversely impacted."

Plant configuration control procedures have been revised to control changes to plant configuration consistent with these requirements.

NRC Reference
15B – AQ 15

NRC Audit Item
On page 10 of the overall integrated plan (OIP), DTE indicates that RCIC will be used to maintain core cooling by injecting into the RPV. The RCIC pump will take suction from either the condensate storage tank (CST), or the torus. The licensee is requested to provide adequate technical basis demonstrating RCIC pump operability with a suction temperature of 240 ºF. The NRC staff is aware of two BWROG reports on the subject, GE Task Report 0000-0143-0382-R0, "RCIC System Operation in Prolonged Station Blackout - Feasibility Study," dated January 2012, and 0000-0155-0154-R0, "RCIC Pump and Turbine Durability Evaluation - Pinch Point Study," dated February 2013, neither of which has been submitted for NRC review. The licensee is requested to address the applicability of the BWROG analyses on the subject and any procedural or plant modifications planned to facilitate the continued operation of RCIC. If the CST becomes unavailable, the possibility of loss of suction from the CST could exist. The licensee is requested to provide information showing that the loss of the CST will not cause a loss of suction source such that the RCIC would ingest gas before the switch over to the torus occurs.

Licensee Input Needed from NRC Audit Report
The licensee to provide analyses demonstrating that the RCIC system can tolerate temperatures up to 250 °F. Alternately, the licensee may demonstrate that FLEX pumps would be ready to provide the required flow at the time the suppression pool heats up to a temperature that could jeopardize operation of RCIC.

DTE Response
Fermi 2 does not credit RCIC operation above 215 °F.

In a FLEX scenario, Fermi may elect to use a venting or "Feed and Bleed" strategy. Both strategies involve RCIC operation to maintain core cooling through direct injection to the vessel. For a vent strategy, RCIC suction temperatures above 215 °F are anticipated and may challenge RCIC operation. Fermi does not credit RCIC operation beyond suppression pool temperatures of 215 °F, but these cases are analyzed. Alternative means to maintain core cooling (i.e., FLEX portable pumping system) will be in place prior to RCIC operation being challenged due to anticipated circumstances (e.g., suppression pool temperatures).

RCIC will function to maintain core cooling during a FLEX event by directly injecting into the vessel. When utilizing a "Feed and Bleed" strategy, Torus temperatures (RCIC suction temperatures) will reach a peak of nominally 200 °F. Fermi's design basis allows for RCIC operation at temperatures up to 170 °F for a short period of time. As the peak suppression pool temperature of 200 °F is 30° F above the analyzed limit and several BWROG studies support functionality of RCIC units up to and beyond 215 °F, RCIC is expected to maintain its vessel injection function at suppression pool temperatures of at least 215 °F. Based on these assessments RCIC will be able to support its core cooling function during "Feed and Bleed" operation.

If the secondary strategy of Containment Venting is pursued during a FLEX event, the Torus temperatures are anticipated to rise to a maximum of nominally 260 °F at 15 hours post ELAP. As in the case with "Feed and Bleed," RCIC is expected to function at least up to 215 °F.

However, when a containment venting strategy is pursued, RCIC will be maintained in operation for vessel injection until it fails to function. Torus temperature is expected to reach 200 °F at 5 hours post ELAP, 215 °F at 5.89 hours post ELAP, 230 °F at 6.61 hours post ELAP and 250 °F at 12.41 hours post ELAP. Based on these temperatures RCIC operation may be in question at 5.89 hour post ELAP when the suppression pool temperature reaches 215 °F. Prior to this time (5.89 hours), the FLEX pumping system will be installed (i.e., at 5 hours) and available to support direct vessel injection. Due to the availability of FLEX injection at 5 hours, RCIC is not required to support vessel injection at temperatures beyond 215 °F. In practice, Operations will maintain RCIC in operation until it is no longer able to sustain its vessel injection function.

Net positive suction head (NPSH) available to the RCIC pumps was reviewed in conjunction with the review of the MAAP analysis supporting the Fermi 2 FLEX strategy. This review determined that the RCIC pump has sufficient NPSH to successfully support the primary FLEX strategy.

An environmental evaluation of post-ELAP RCIC Room temperature generated temperature, relative humidity, and room pressure timelines. The maximum temperature over the 72 hour period evaluated was 153.0 ºF. The maximum relative humidity was 70.2%, and the maximum room pressure was 0.5 psig.

The environmental evaluation assumed that the door between the Torus Room and the RCIC Room would be opened at 9 hours to mitigate flooding. This causes a slight rise in RCIC Room temperature. Before opening of the RCIC to Torus Room door RCIC Room temperature was approximately 145 ºF. Operations will be monitoring RCIC Room water level and power to the RCIC Room sump pump is available at approximately 4 hours. This will allow operations to mitigate RCIC Room flooding and opening the RCIC to Torus Room door will not be necessary. Additional cooling, not modelled in the environmental evaluation, may occur at about 8 hours into the ELAP when RBHVAC ventilation can be provided the RCIC room.

Based on the above, RCIC Room temperature is not expected to rise significantly above 150 ºF. The environmental evaluation also demonstrates that RCIC temperatures will be reduced to below 140 ºF if the Reactor Building doors are opened to the environment. Note that the Electronic Governor Module (EGM) for the RCIC controls is located in the Relay Room (a mild environment) and is not affected be RCIC Room conditions. RCIC was previously evaluated under SBO for maximum temperatures of 158 ºF. As the RCIC Room temperatures are anticipated to be below 158 ºF for at least 9 hours post ELAP initiation, simple actions (such as opening external reactor building doors) can maintain temperatures below the design maximum temperature for the RCIC (148 ºF).

The environmental evaluation results for RCIC Room pressure shows an increase to about 0.5 psig until the Torus Room door is assumed to open at 9 hours. As discussed above, Operator actions to mitigate RCIC Room flooding will allow the Torus Room door to remain closed throughout the event. In addition, RBHVAC ventilation restoration, also discussed above, will act to reduce the room pressure.

Per the Fermi 2 Environmental Qualification program, the harsh environment threshold outside primary containment is a combination of 100% relative humidity with room pressure greater than 2.5 psig. Since the RCIC room peak humidity is well below 100%, the area is considered mild in regards to humidity and room pressure; therefore, humidity and room pressure are not of concern for RCIC operation during an ELAP.

Based on the above, there is reasonable assurance of RCIC operation during an ELAP.

The environmental evaluation discusses RCIC and HPCI seal leakage based on Torus temperature conditions. A manufacturer's (Flowserve) assessment concluded that up to temperatures of 200 ºF the seals would be unlikely to catastrophically fail. Flowserve noted that there would be increased wear on the seals. If torus temperatures in excess of 200 ºF occur during a FLEX event, a potential remains for the pump seals to fail which would cause a faster rate of room flooding. This may jeopardize RCIC or HPCI functionality. However, the back-up Containment Heat Removal strategy of venting utilizing the HCVS would be pursued. Based on the MAAP results, temperatures above 200 ºF would not occur until after the 5 hour point when Fermi's FLEX pumps are available to support direct vessel injection, if required. As Fermi's backup venting strategy does not require HPCI or RCIC, failure of the seals when the suppression pool temperatures become significantly elevated above 200 ºF will not impact Fermi's ability to cope with a BDBEE.

The automatic switchover of RCIC suction from the CST to the Torus is a current design basis function described in UFSAR Section 7.4.1.1.3.8.

In addition, Technical Evaluation TE-E41-13-040 shows no loss of CST to Torus transfer function due to tornado missile damage.

Since the swap-over is automatic and no new failure mechanisms are introduced by an ELAP, no modifications are required to support the switchover from the CST to the Torus in an ELAP condition (same response as an SBO condition for immediate damage).

NRC Reference
28B – AQ 28

NRC Audit Item
On page 10 of the OIP, DTE indicates that HPCI will be employed to control reactor pressure so that the safety relief valves (SRVs) do not need to be operated. However, DTE does not supply any information on how this will be performed, nor does DTE discuss the pressure strategy for the RPV. The licensee is requested to supply information to clarify the pressure strategy for the RPV; will it be held at or near operating pressure and if so, for how long? At what point will the RPV pressure need to be lowered, and at what rate? The licensee is requested to discuss how the HPCI system will be used to bleed steam off from the RPV. If the RPV is to be depressurized, DTE is requested to explain how the HPCI system can be controlled finely enough to meet and sustain the required depressurization rate. Also, DTE is requested to indicate which HPCI instrumentation is credited for the coping strategies to work

Licensee Input Needed from NRC Audit Report
Licensee to provide GOTHIC analyses for water accumulation in the HPCI and RCIC rooms during an ELAP event.

What is the maximum operating temperature for HPCI? Is it above its maximum design temperature in certain ELAP scenarios, and if so what is the justification? Alternately, as appropriate confirm that in the scenarios where the HPCI design temperature may be exceeded that (1) safety-relief valves can be relied upon for reactor pressure control if HPCI fails, and (2) the containment vent can be relied upon for containment pressure control if HPCI fails.

DTE Response

Pressure control will be achieved through operation of the SRVs. RCIC initiation for RPV makeup will also remove RPV heat. Operation of HPCI in the test or minimum flow mode can be electively initiated to reduce cycling of the SRVs.

The RPV pressure strategy is specified in 29.400, ‘FLEX Flowchart,” with details contained in 29.400.01, “FLEX” and 29.FSG.03, “RPV Pressure Control.” These procedures specify that HPCI/ RCIC may be operated in the test mode if the CST is available or the minimum flow mode to supplement the SRVs for RPV pressure control. These modes recirculate either CST water (test mode) to the CST or suppression pool inventory (minimum flow mode) back to the Torus. In this configuration steam will perform work in the turbine and then be exhausted into the suppression pool. HPCI/ RCIC operation can be continuous or intermittent as required. Vessel pressure will initially be maintained near normal operating pressures. Operations will follow the EOPs as directed. It is anticipated that the Heat Capacity Limit (HCL) requirements will require Operations to reduce vessel pressure beginning approximately 4 hours after the ELAP initiation. Depressurization will be accomplished by operation of the SRVs. A normal cool down rate will be established unless emergency depressurization is directed by the EOPs. The emergency depressurization would be stopped at about 200 psig based on changes to EOP 29.100.01 Sheet 3 and EPG/SAG Rev 3. The SRVs have sufficient pneumatic and electric supply throughout the FLEX event to ensure operation. Additionally, operation of HPCI to discharge suppression pool inventory to the Circulating Water pond (“bleed”) will remove heat and reduce, but not eliminate, SRV cycling.

Required HPCI instrumentation is listed on page 21 of the Fermi 2 OIP under ‘Key Containment Parameters’ and includes: HPCI Pump Suction and Discharge pressure and Torus Temperature/pressure. These indications are DC powered and not load shed.

RPV Pressure instrumentation is listed on page 12 of the Fermi 2 OIP under ‘Key Reactor Parameters’.

Water accumulation in the HPCI and RCIC rooms during an ELAP is analyzed in DC-6587 Vol. I, Rev. A, “Loss of HVAC – Room Environment Analysis in Support of FLEX: HPCI, RCIC Room Temperature and Water Level.”

Should HPCI fail, then the SRVs are available to control RPV pressure, and the containment vent is available to control containment pressure.

NRC Reference

E-7

NRC Audit Item

a. Discuss the design of the suction strainers used with FLEX pumps taking suction from raw water sources, including perforation dimension(s) and approximate surface area.

b. Provide reasonable assurance that the strainers will not be clogged with debris (accounting for conditions following, flooding, severe storms, earthquakes or other natural hazards), or else that the strainers can be cleaned of debris at a frequency that is sufficient to provide the required flow. In the response, consider the following factors:

i. The timing at which FLEX pumps would take suction on raw water relative to the onset and duration of the natural hazard.

ii. The timing at which FLEX pumps would take suction on raw water relative to the timing at which augmented staffing would be available onsite.

iii. Whether multiple suction hoses exist for each FLEX pump taking suction on raw water, such that flow interruption would not be required to clean suction strainers.

Licensee Input Needed from NRC Audit Report

Licensee to describe method for dealing with blockage of the strainer for the submersible stage of the Neptune pump – including backflushing or winching out the pump, cleaning its strainer, and re-deploying it. The licensee should clarify how long the process would take and confirm it can be performed in a manner that will not lead to uncovering the core

DTE Response

a) Fermi 2 uses a duplex strainer with on-line change-out capability. Perforation dimension is 20 mesh (.3 mm or .012") with an approximate surface area of 800 square inches.

b) *i.* FLEX pumps would take suction on the raw water source after the natural hazard and would screen surface debris based on construction and operation of the source pump. This pump floats on the surface with a screen type debris filter (~1.5" hole size), the pump suction is located about 2.5 to 3' below the surface.

ii. The deployment of the FLEX pumps is expected to take about 4 hours and startup would occur later. Augmented staffing is expected at about 6 hours. Operating experience with the FLEX pumps site acceptance testing showed nearly zero change in strainer differential pressure at full flow (> 3500 gpm) for 3.5 hours using the quarry lake as a source. Based on this, sufficient personnel would be available to operate the strainers prior to exceeding any limit (using 10 psid as a limit).

iii. There is a single hydraulically driven submersible pump that takes suction on the raw water, no suction hose exists (Neptune Source pump) so the only hose that exists into the FLEX Water system is an 8" collapsible hose on the discharge of this Neptune Source pump. This 8" collapsible hose is the suction hose for the Neptune Booster pump. The flow then passes through a short section of hose to the Duplex Strainer. Based on this, no interruption of flow has to occur to clean the suction strainers.

When required, the Source pump strainer would be cleaned in accordance with 29.FSG.02, "FLEX Outside Equipment Setup," Section 7.0, which includes:

- Retrieving the source pump to the ramp
- Cleaning the pump

- Redeploying the pump in the CW reservoir
- Restarting the pump and refilling the FLEX water system

As part of Fermi's FLEX Validation Process (FVP), a timed demonstration was conducted of the deployment of the FLEX Suction Pump, as well as the time to remove the Suction Pump from the CWP, clean the strainer and redeploy the pump. The timed demonstration is documented in the FVP, Attachment 2 for FVP 07E. The timed demonstration showed that the time from stopping system water flow to restarting system flow is less than 25 minutes. In addition, TE-K11-15-042, "Lift-Pump Cleaning Time (FLEX)," concluded that the maximum allowable time for activities associated with cleaning the suction screen on the satellite pump is 125 minutes. Validation activities demonstrated that the activity requires less than 25 minutes, which is provides approximately 80 percent margin to the maximum allowable time. Therefore, there is reasonable assurance that the strainer can be cleaned of debris at a frequency that is sufficient to provide the required flow to prevent uncovering the core.

NRC Reference
E-13

NRC Audit Item
FLEX electrical system runs from FLEX DG to a single transfer switch and from the transfer switch to the battery chargers in the Auxiliary Building, through a single circuit in an underground trench. The underground trench runs from FLEX Bldg. 1 to Auxiliary Bldg. The primary and alternate methods share a common connection and circuit.

Licensee Input Needed from NRC Audit Report
The licensee to request alternative to NEI 12-06 and state why this is acceptable.

DTE Response
The use of a pre-staged permanently installed FLEX electrical distribution equipment allows re-energizing the critical plant electrical loads more quickly and efficiently than the use of extensive portable cables and lengthy deployment of the portable FLEX diesel generators (DGs) from the FLEX storage building. This mitigation strategy constitutes an alternative approach to NEI 12-06 guidance and is acceptable because the FLEX electrical distribution equipment is permanently installed in robust structures designed to adequately withstand all applicable external events and access paths are expected to be clear after the initiating event. Consistent with the July 1, 2014, memorandum from Jack Davis (NRC), the FLEX electrical distribution is installed in robust structures that are designed to survive a BDBEE and can be accessed by operators during a seismic event or a flooding event, as discussed.

The alternative strategy provides a significant reduction in the distance, required staffing, and required manual actions associated with large portable equipment would be required to be transported and setup in the first hours following a BDBEE compared to other strategies that were evaluated. It virtually eliminates cable deployment except at the source and permanent connections (less than 200' of cable run). It also protects both the cable and generators against all hazards associated with the event over the entire path (not subject to unknown issues such as debris clearance). The strategy also minimizes risk by utilizing robust equipment that is located within robust structures that are adequately protected from all applicable external events. The ability to improve response times, simplify required manual actions, utilize equipment in robust locations, and reduced need to perform actions in adverse weather conditions justifies this alternative strategy.

The Civil Electrical Chase (referred to as an “underground trench” in the audit question) between FSF1 and the Auxiliary Building contains 3 independent circuits. Unavailability of the primary circuit will not preclude promptly establishing an alternate circuit alignment to repower key equipment by reconfiguring the distribution circuit in accordance with procedural guidance. This installed redundancy provides reasonable assurance that at least one connection will be available during an ELAP event. Procedures 29.FSG.01 ‘FLEX DC’ and 29.FSG.04 ‘FLEX AC’ contain steps to establish the alternate circuit alignments if warranted. These alternate circuit alignments are evaluated in TE-K11-15-077.

Fermi 2 has reviewed its proposed alternative approach against applicable regulatory guidance and determined that the alternative approach is acceptable. The use of the permanent FLEX electrical distribution equipment is a defense-in-depth approach that does not credit either SBO or 10 CFR 50.54(hh)(2) equipment and meets all of the protection requirements of Order EA-12-049 and NEI 12-06, Revision 0. The strategy improves the time for transitioning from installed plant equipment (i.e., Phase 1) to the onsite FLEX equipment (i.e., Phase 2) during an event. Furthermore, it reduces the amount of equipment required to be deployed, reduces opportunities for operational challenges or errors, and facilitates timely restoration of vital control and instrumentation power. The strategy also minimizes risk by pre-staging Phase 2 electrical distribution equipment within robust structures that are adequately protected from all applicable external events. The strategy of using pre-staged FLEX electrical distribution equipment, as described above, is capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink. This strategy has adequate capacity and installed redundancy to address challenges to core cooling, containment, and spent fuel pool cooling capabilities.

Enclosure 3 to
NRC-16-0005

Fermi 2 NRC Docket No. 50-341
Operating License No. NPF-43

Final Integrated Plan

FINAL

INTEGRATED

PLAN

DOCUMENT

November 2015

FLEX FINAL INTEGRATED PLAN

1.0 BACKGROUND

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

The US Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on actions the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 4) contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to beyond-design-basis external events.

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

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

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

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

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

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

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

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

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

The Nuclear Energy Institute (NEI) developed NEI 12-06 (Reference 5), 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 (Reference 3), dated August 29, 2012, which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

2.0 NRC Order 12-049 – Mitigation Strategies (FLEX)

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of a Fermi 2 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 reactor is initially operating at power, unless there are procedural requirements to shut down due to the impending event. The reactor has been operating at 100% power for the past 100 days.
- The reactor is successfully shut down when required (i.e., all rods inserted, no ATWS). Steam release to maintain decay heat removal upon shutdown functions normally, and reactor coolant system (RCS) overpressure protection valves respond normally, if required by plant conditions, and reseat.

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- 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*:

- 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 and station blackout (SBO) alternate AC power sources 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 BDB equipment stored in structures with designs that are robust with respect to seismic events, floods and high winds and associated missiles, remains available.

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

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

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- Reactor coolant inventory loss consists of unidentified leakage at the upper limit of Technical Specifications and reactor recirculation pump seal leak-off at normal maximum rate.

- 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 BDB event by providing adequate capability to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities at all units on a site. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety have been incorporated into the unit emergency operating procedures in accordance with established emergency operating procedure (EOP) change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the 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 Specifications (TSs) Requirements at the Surry Power Station," (TAC Nos. MC4331 and MC4332), dated September 12, 2006 (Accession No. ML060590273).

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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 reactors, 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, emergency diesel generators and any alternate AC source, but not the loss of AC power to buses fed by station batteries through inverters or rectifiers – with a simultaneous loss of access to the ultimate heat sink (LUHS). This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a Beyond-Design-Basis external event.

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

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

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

The duration of each phase is specific to the installed and portable equipment utilized for the particular FLEX strategy employed to mitigate the plant condition. The strategies described below are capable of mitigating an ELAP/LHUS resulting from a BDB external event by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at Fermi 2. 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 Fermi 2 emergency operating procedures in accordance with established EOP change processes.

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2.3 Reactor Core Cooling and Heat Removal Strategy

The FLEX strategy for reactor core cooling and decay heat removal is to establish and maintain reactor water level using the RCIC system. Heat removal from the RPV to the suppression pool will occur as the Safety Relief Valves (SRVs) cycle to control pressure or as RCIC/HPCI exhaust steam discharges to the suppression pool.

DC bus load shedding will ensure battery life is extended until portable generators are deployed to repower the battery chargers prior to battery depletion. Required AC and DC Loads will be repowered utilizing FLEX Generators that connect to plant 480 VAC ESF buses via a protected cable vault between the FLEX protected storage locations and the plant.

Containment heat removal will utilize a “feed and bleed” strategy as follows: Portable pumps will be deployed to supply cooling water to the suppression pool from the Circulating Water (CW) reservoir. Water from the suppression pool will be returned to the CW reservoir using HPCI or RCIC through the HPCI test line and a crosstie to the GSW system.

In the event of a potential flooding event Fermi 2 has a letter of agreement with the National Weather Service (NWS) whereby NWS will notify Fermi 2 when conditions [sustained elevated wind speed and direction] that can cause extreme site flooding are predicted. Upon receipt of this notification, the plant will be taken to cold shutdown and personnel staged in key locations. Once the flood subsides [estimated 17 hours] the FLEX strategies described above will be implemented, if required.

2.3.1 Phase 1 Strategy

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 Safety Relief Valves (SRV) automatically cycle to control pressure, causing reactor water level to decrease.

   The RCIC system will automatically initiate and will be used as necessary to restore and maintain RPV water level. RPV pressure will be controlled by RCIC operation, HPCI operation, and SRVs as required.

   After determination that installed on-site and off-site AC power sources cannot be restored for a period greater than the SBO coping time (4 hours) or 45 minutes have elapsed with no reasonable expectation of restoration of AC power, the operating crew determines the event is an ELAP.

   Overall coping time for core cooling in Phase 1 is approximately five hours (Reference 8). This is when the Phase 2 FLEX water is needed to remove heat from the suppression pool water supply to support RCIC operation.

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2. Cold Shutdown and Refueling

The overall strategy for core cooling for Cold Shutdown and Refueling modes differs from that for Power Operation, Startup, and Hot Shutdown modes since reactor pressure is unavailable for operation of RCIC.

If an ELAP occurs during Cold Shutdown mode, water in the reactor pressure vessel (RPV) will heat up. When temperature reaches 212°F, (Hot Shutdown) the RPV will begin to pressurize. The Phase 1 strategy for Hot Shutdown described in Section 2.3.1.1 above will then be followed.

During Refueling, many variables impact the ability to cool the core. In the event of an ELAP during Refueling, there are no installed plant systems to provide makeup water 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 ELAP occurs when first reactor head bolt is de-tensioned. An evaluation (Reference 9) has determined that, in this scenario, the core will remain covered for at least 6.75 hours.

Deployment of portable FLEX pumps to supply injection flow should commence immediately from the time of the event. This is possible because more personnel are on site during outages to provide the necessary resources. During outage conditions, deployment area and hose & haul paths will be maintained clear and available in order to ensure FLEX deployment capability is maintained.

3. Response for a Site Flooding Event

Notification of a predicted event from NWS will occur at least 48 hours prior to the predicted site flooding. Upon notification, the plant is shut down and placed in Cold Shutdown mode. Personnel are stationed at the location of the portable AC generator in order to be in place to deploy the generator as soon as possible after high wind and wave action subsides, should an ELAP occur. Plant conditions are established, where possible, that are favorable for response to a potential ELAP.

Upon the occurrence of an ELAP, an extensive shedding of DC loads is performed, reactor decay heat is allowed to pressurize the RPV and RCIC is started using the black-start procedure (if required). Reactor level and pressure is maintained using Main Steam Line Drains to the Main Condenser, RCIC system operation, HPCI System Operation, and SRVs lifting.

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2.3.2 Phase 2 Strategy

1. Primary strategy

Deployment of Phase 2 portable equipment commences when it is recognized an ELAP condition exists during Phase 1, and continues through Phase 2.

To extend station battery life and to protect continued operation of the RCIC and HPCI systems, the system logic is aligned to defeat all trips. DC load stripping will be performed to remove any loads not needed for ELAP response.

A portable 480 VAC generator is deployed and used to restore the battery chargers and maintain DC loads associated with RCIC and HPCI operation. AC load stripping and restoration of required 480 VAC loads then takes place.

Once AC power is available, reactor recirculation pump seal leakage is terminated by shutting the pump supply and discharge valves and RPV bottom head isolation valves. This limits the rate of drywell pressure increase.

Portable, diesel driven FLEX water pumps, hoses and associated equipment are deployed to establish a flow path from the CW reservoir to one of two exterior connections to the RHR system. The RHR system can be configured to direct the flow to the RPV, SFP, or suppression pool.

FLEX flow will be initially directed to the Spent Fuel Pool to vent the lines and support makeup to reduce boiling in the Spent Fuel Pool. FLEX Water is then supplied to the suppression pool to provide the "feed" for containment cooling. Water from the suppression pool will be rejected to the CW reservoir by operation of the HPCI system ("bleed water"). The flow path is through the HPCI test line to a cross-connect to the GSW system which discharges to the CW reservoir. This "feed and bleed" operation will act to maintain suppression pool temperature sufficiently low to support on-going RCIC operation supplying water to the RPV.

A portable, diesel power FLEX air compressor is deployed to provide compressed air to support hardened vent capability and extended SRV operation. A pneumatic hose is deployed from the compressor to pressurize the NIAS system.

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If available, the back-up FLEX 480 VAC generator can be deployed to supply electrical power to additional supplemental loads such as building ventilation or alternative equipment cooling.

The FLEX portable equipment is stored in two robust structures, FSF 1 and FSF 2. FSF 1 is located near the Reactor Building and contains the FLEX generators, air compressors and the “Dominator” FLEX water pump. FSF 2 is located near the CW pond and contains the “Neptune” pumping system that supplies suction to “Dominator” pump. Both buildings contain snow removal and portable support equipment. A large bulldozer is available in FSF 1 for debris removal.

The FLEX portable equipment is deployed to and operated from the building aprons adjacent to the equipment doors. These are elevated above the maximum flood level. For water and pneumatics, hoses are deployed from the building to the plant along predetermined pathways. A permanent FLEX electrical distribution system connects FSF 1 and the plant switchgear rooms where connections to normal plant electrical system are made.

2. Alternate Strategy

If the situation exists in which containment heat removal using the HPCI system cannot be established, then the Torus Hardened Vent system will be used for containment heat removal. Supplemental cooling water for the RCIC and HPCI system is established and these systems used to supply cooling to the reactor. Air and electrical support needed for operation of the Torus Hardened Vent are restored as part of the FLEX response. If necessary, (loss of HPCI/RCIC) FLEX water can be injected into the RPV via the RHR system.

3. Response for a Site Flooding Event

The Phase 2 response for a flooding event is similar to the non-flooding event. Suppression pool “feed and bleed” is established for containment heat removal and RCIC is used to maintain RPV water level. However, since the reactor was earlier brought to cold shutdown, RCIC can be used to intermittently to fill the RPV and provide bleed flow from the suppression pool. HPCI is also available to provide additional bleed flow if needed to due to high decay heat load.

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2.3.3 Phase 3 Strategy

Management of fuel and containment conditions using Phase 2 actions can be continued indefinitely. Additional pumps and electrical generators will be supplied by the National SAFER Response Center (NSRC) and used to provide additional capability and redundancy for on-site equipment until such time that normal power to the site can be restored.

Phase 3 portable equipment is deployed from an off-site facility and delivered to Fermi 2. The off-site facility supplying this equipment is one of the two NSRC's 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 Fermi 2 SAFER Response Plan (Reference 10). The Fermi 2 SAFER Response Plan defines the actions necessary to deliver pre-specified equipment to Fermi 2. Designated local staging areas have been selected and letters of agreement established to support deliveries of requested SAFER equipment from the NSRC to Fermi 2. Resources will be available, and sufficient, at the times required for Phase 3 implementation.

No plant modifications are required to support mitigating strategies for Phase 3. The connection of Phase 3 equipment can be made to connection points established for the corresponding Phase 2 equipment. Phase 3 4160 VAC generators can be connected using procedures developed for this purpose. 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

1. Reactor Core Isolation Cooling System

The RCIC System functions to assure core cooling in response to loss of feed water flow and isolation of the reactor from the main condenser heat sink. The system automatically actuates from reactor protection signals or can be manually initiated from the main control room.

The RCIC system uses a steam turbine driven pump to deliver water to the RPV from either the CST or the suppression pool. The steam exhaust from the RCIC turbine discharges to the suppression pool. During an ELAP, RCIC will take suction first from the CST, if available, and then from the suppression pool. The CST is not credited since it is not sufficiently qualified to be credited for FLEX response to BDBEE.

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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 RCIC operation. Load shedding of non-essential DC loads provides an estimated total service time of approximately 13 hours of operation following an ELAP. An extensive load shed is performed if potential flooding is predicted. In this case the estimated total service time is 24 hours. (Reference 39)

3. Containment Heat Removal

The High Pressure Coolant Injection (HPCI) System is operated to discharge heated water from the suppression chamber. The flow path is via the HPCI test line to a cross-connect to the GSW system which discharges to the CW reservoir. The portable FLEX injection pumps supply cool water to the suppression chamber from the CW reservoir.

4. Nuclear Pressure Relief System

During an ELAP, Relief Valves (SRVs) automatically cycle to initially control reactor pressure until the control room operators manually control RPV pressure by operation of the RCIC/HPCI systems or manually initiating SRV openings to maintain RPV pressure in accordance with Emergency Operating Procedures.

5. Electrical Strategy

Two FLEX portable diesel 480 VAC generators (DG) are stored in the robust FSF 1. One generator is sufficient to functionally support the FLEX mission. The DG is deployed to the FSF 1 building apron for operation.

A permanent FLEX electrical distribution system is provided to deliver electrical power from the generators at FSF 1 to the plant electrical system connection points in the divisional vital switchgear rooms. This distribution system is an alternative strategy to the requirements of NEI 12-06 which has been evaluated to provide the required functions. Connection between the generator and the FLEX distribution at FSF 1 is made using staged cables connected between the generator and a wall mounted connection box in FSF 1. The connection in the switchgear room is made using staged cables from a connection box in the switchgear room to a "breaker insert device" (BID). The BID's are inserted into a designated spare motor control center and load center position prior to the cable connection. See Figure 7 for electrical distribution details.

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6. Alternative Core Cooling and Containment Heat Removal Strategy

If the situation existed in which containment heat removal using the HPCI system cannot be established then the Torus Hardened Vent system will be used for containment heat removal. Supplemental cooling water for the RCIC and HPCI oil cooling systems is established from the FLEX pumps and these systems used to supply water to the reactor. If necessary due to loss of HPCI/RCIC, FLEX water can be injected into the RPV via the RHR system.

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:

Parameter	Transmitter PIS#	Indicator PIS#`
Reactor water level – wide range	B21-N091B/C	B21-R623A/B
Reactor Pressure – wide range	B21-N051A/B	B210R623A/B
RCIC Suction Pressure	E51-R002	E51-R609
RCIC Discharge Pressure	E51-R001	E51-R609

The above instrumentation is available prior to and after load stripping of the DC and AC buses during Phase 1. The instrumentation is powered by rectified 120 VAC fed from the station batteries. Availability during Phases 2 and 3 is dependent on the strategy to re-power the vital 120VAC buses including the station battery chargers.

Portable BDB equipment is supplied with the local instrumentation needed to operate the equipment. The use of these instruments is detailed in the associated FSGs for use of the equipment. These procedures are based on inputs from the equipment suppliers, operating experience, including site testing and training, and expected equipment function in an ELAP.

2.3.6 Thermal Hydraulic Analyses

An analysis of the Fermi 2 plant response to the FLEX mitigating strategies was performed utilizing the Modular Accident Analysis Program (MAAP). The analysis was performed following the guidance of the “EPRI BWR Roadmap,” EPRI Position Paper 3002001785 (Reference 11), and the associated NRC endorsement letter (Reference 12).

MAAP analyses were performed for the plant response to a BDEE with the use of the “feed and bleed” strategy and the use of the alternative containment venting strategy (Reference 36).

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In each of these cases, the analyses showed that reactor water level remained above the top of active fuel and that containment pressure and temperature limits were not exceeded.

For the “feed and bleed” case, the minimum water level above the top of active fuel was 35 inches. The maximum suppression chamber temperature and pressure were 196ºF and 20 psig. The maximum drywell temperature was 312ºF. In addition, the “feed and bleed” evaluation determined that suppression chamber pressure and temperature during the event supported continued RCIC operation.

For the alternative venting strategy, the minimum water level above the top of active fuel was 81 inches. The maximum suppression chamber temperature and pressure were 260ºF and 24 psig. The maximum drywell temperature was 277ºF.

The response to a BDEE in conjunction with the extended flooding event was also analyzed (Reference 37). In this case, the minimum reactor water level is 100 inches above the top of active fuel. The maximum suppression chamber temperature is 183ºF. The maximum drywell pressure and temperature is 10 psig and 352ºF. Operations action at about 56 hours after the ELAP is needed to maintain drywell temperature below the 340ºF design limit.

2.3.7 Reactor Recirculation Pump Seals

The Fermi 2 reactor recirculation pump seals have an allowed leakage limit described in the UFSAR SBO coping analysis of 18 gpm for each of the two pumps. An additional 5 gpm leakage was assumed to account for the Technical Specifications allowed unidentified leak rate.

The MAAP model included the 18 gpm leakage per pump until pump seals are isolated. An additional unidentified leakage to the drywell was continuously applied throughout the event (5 gpm). The RCIC system is capable of sufficient make-up flow to maintain reactor water level with the addition of these assumed leakage rates (Reference 8).

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)."

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The Fermi 2 Technical Specification (Reference 13) for the cold shutdown margin demonstration (Technical Specifications Section 3.1.1) requires that the shutdown margin at any time during the fuel cycle be equal to or greater than: (1) 0.38% $\Delta k/k$ with the highest worth rod analytically determined, or (2) 0.28% $\Delta k/k$ with the highest worth rod determined by test. Core designs provide a minimum of 1% 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% $\Delta k/k$. The value of R, in units of % $\Delta k/k$, 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 Supplemental Reload Licensing Report for Reload 17/Cycle 18 (Reference 14) for the Fall 2015 refueling and subsequent operating cycle, the value of R is 0.001 % $\Delta k/k$ and the minimum shutdown margin that occurs is at end-of-cycle (EOC). The EOC cold K-effective with the strongest rod withdrawn is 0.98883. This translates to a minimum shutdown margin of 1.117% $\Delta k/k$, or approximately 2 to 3 times the Tech Spec requirement. Therefore, Fermi 2 will remain shut down during a simultaneous ELAP and LUHS event with all control rods fully inserted.

Similar justification will be maintained for each subsequent operating cycle.

2.3.9 Flex Pumps and Water Supplies

Capability is provided to pump cooling water from the CW reservoir to either Division 1 or Division 2 of the RHR System to restore core cooling, containment cooling, and spent fuel pool cooling functions. The supply of cooling water from the CW reservoir to Division 1 or 2 RHR System is provided by a two-stage, diesel engine powered, arrangement consisting of a lift pump system (Neptune pump system) and booster pump (Dominator pump). The Neptune lift pump system includes a hydraulically driven source pump that floats in the CW reservoir and feeds to the diesel driven lift pump. See Figure 6 for the pumping system arrangement.

Two Neptune pump systems are stored in FSF 2 and two Dominator pumps are stored in FSF 1. This provides N+1 capability. In addition, sufficient spare hose segments are provided to replace any single hose segment failure.

The Dominator pump is rated to provide 3000 gpm at 150 psig. The Neptune pumping system is rated to provide 3000 gpm at 183 psig. Each pump's capabilities were confirmed by DTE factory and site acceptance testing.

A hydraulic calculation was performed (Reference 15) 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.

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2.3.10 Electrical Analysis

The Class 1E battery duty cycle of thirteen hours for Fermi 2 was calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the licensee's FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles (Reference 39). 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 10 hours for Fermi 2.

The strategy to re-power the stations vital AC/DC buses requires the use of a diesel powered generator (DG). Two DG are stored in FSF 1 to provide N+1 capability.

Each FLEX diesel generator is rated at 550 KW standby rating at 480 VAC with an 80% power factor giving a 687.5 kVA rating. The generators are trailer-mounted with a 600 gal diesel fuel tank.

Calculations have been performed to show that operation of one FLEX DG will provide the needed electrical loads for execution of the FLEX strategies (Reference 40).

Additional, backup 480 VAC generators and 4kV generators are available from the National SAFER Response Center (NSRC) as part of the site's SAFER response plan.

The following instrumentation is used for monitoring electrical system parameters:

Parameter	**Indication PIS#**
DC voltage	R3200-S051 R3200-S052 R3200-S053 R3200-S054 R3200-S055 R3200-S056
AC voltage	R14-R852 R14-R900 R14-R809 R14-R849 R14-R897

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2.4 Spent Fuel Pool Cooling/Inventory

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

2.4.1 Phase 1 Strategy

Evaluations (Reference 16) estimate that with no operator action following a loss of SFP cooling at the maximum design heat load, the SFP will reach 212ºF in approximately 4.2 hours and boil off to a level 10 feet above the top of fuel in a minimum of 28 hours from initiation of the event. This is a bounding analysis for a fully off-loaded core. Evaluations based on fuel pool loading typical for power operation show significantly longer time to reach 212ºF and subsequent boil off.

The initial coping strategy for spent fuel pool cooling is to monitor spent fuel pool level using instrumentation installed as required by NRC Order EA-12-051.

2.4.2 Phase 2 Strategy

Phase 2 strategy is to initiate makeup using the FLEX pumps connected to the RHR system. A portion of the nominal 3000 gpm flow provided by the FLEX pumps can be diverted to SFP by repositioning RHR system fuel pool cooling assist mode valves.

Additionally, as required by NEI 12-06, Table 3-1, a back-up capability is provided by 10CFR 50.54(hh) monitor nozzles with sufficient hose length required for SFP spray. This equipment is located in FSF 2.

2.4.3 Phase 3 Strategy

Additional pumps of sufficient capacity will be available from the NSRC as a backup to the on-site capability.

2.4.4 Structures, Systems, and Components

1. Primary Strategy

   Water is supplied from the CW reservoir to the RHR system in the same manner as described in Section 2.3.9. The alignment of the RHR system can be adjusted to provide makeup flow to the SFP.

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2. Alternate Strategy

The FLEX implementation guidance given in NEI 12-06 requires that alternate methods of water makeup be available. The alternate make up method for Fermi 2 to the SFP is to use 10CFR50.54(hh) monitor nozzles with sufficient hose to spray the SFP. This equipment is located in FSF 2.

3. Ventilation

During an ELAP/LUHS event, normal Reactor Building ventilation will be non-functional. Actions to mitigate temperatures or use of protective equipment have been included in FSGs. It is expected that building ventilation flow can be established at approximately 6 hours into the event.

2.4.5 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 installed in response to Order EA-12-051, Reliable Spent Fuel Pool level Instrumentation. (Reference 2)

2.4.6 Thermal-Hydraulic Analyses

An analyses (Reference 16) was performed that determined with the maximum expected SFP heat load immediately following a full core offload, the SFP will reach a bulk boiling temperature of 212ºF in approximately 4.2 hours and boil off to a level 10 feet above the top of fuel in 28 hours unless additional water is supplied to the SFP. A flow of 101 gpm will replenish the water being boiled. Evaluations based on expected SFP loading during power operation show significantly longer times prior to pool boiling.

FLEX water supply pump flow to the SFP is available within 5 hours. This will provide for adequate makeup to restore the SFP level and maintain an acceptable level of water for shielding purposes.

2.4.7 FLEX Pump and Water Supplies

A description of the FLEX pumps and water supplies is provided in Section 2.3.9.

2.4.8 Instrumentation

The Spent Fuel Pool will be monitored by instrumentation installed for conformance to Order EA-12-051. This equipment has backup battery capacity for 72 hours. Alternative power will be provided within 72 hours using the FLEX portable generators to provide power to the instrumentation and panels. One level indicator is located in the Main Control Room and a second indicator is located on the second floor of the Reactor Building in the vicinity of the SFP fill control valve.

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2.5 Containment Integrity

During an ELAP, containment cooling is lost and, over an extended period of time, drywell temperature and pressure will increase.

Operation of the RCIC system for core cooling adds heat to the suppression pool. Additionally, Safety Relief Valve operation will also add heat resulting in an increase in torus temperature and pressure.

Containment heat removal strategies such as “feed and bleed” (primary) and containment venting (secondary) are used to maintain containment pressure and temperature within design limits.

2.5.1 Phase 1

During Phase 1, Primary Containment integrity is maintained by normal design features of the containment, including the containment isolation valves. In accordance with NEI 12-06, the containment is assumed to be isolated following the event.

SRV actuation and RCIC system operation will remove energy from the Reactor Pressure Vessel (RPV) and deposit it into the suppression pool.

Suppression pool water level, Drywell and suppression pool pressure and temperature indication will be available to the operators for the duration of the ELAP.

2.5.2 Phase 2

Phase 2 coping strategy is to monitor primary containment conditions and establish suppression pool cooling using a “feed and bleed” strategy.

“Feed and bleed” is established by directing FLEX water flow to the torus for cooling and pumping suppression pool water back to the circulating water reservoir using the HPCI system. The HPCI pump takes suction from the torus and discharges through a test line and GSW cross tie to the circulation water reservoir.

An available alternative method to remove containment heat is to use the torus hardened vent to reject containment heat to the outside environment.

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2.5.3 Phase 3

Phase 2 actions can be continued indefinitely. Additional pumps and electrical generators will be supplied by the NSRC and used to provide additional capability and redundancy for on-site equipment until such time that normal power to the site can be restored.

This capability will include a 4kV portable diesel generators (DG) provided from the National SAFER Response Center (NSRC). Mobile 4kV diesel generators will be brought in from the NSRC in order to supply power to either of the two Class 1E 4kV divisions. Additionally, by restoring the Class 1E 4kV bus, power can be restored to the Class 1E 480 VAC via the 4160/480 VAC transformers to power selected 480 VAC loads.

Low pressure/high flow portable diesel driven pumps (up to 5,000 gpm) are also delivered from the NSRC to provide redundancy to existing site phase 2 portable equipment if needed.

Deployment of Phase 3 NSRC equipment will be directed by the emergency response recovery organization based on the circumstances of the specific ELAP/LUHS event.

2.5.4 Key Containment Parameters

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

Parameter	Transmitter PIS#	Indicator PIS#`
Suppression chamber pressure	T50-N414A/B	T50-R802A/B
Drywell pressure	T50-N415A/B	T50-R802A/B
Suppression chamber water level	T50-N406A/B	T50-R804A/B
Suppression chamber temperature	T50-N402B T50-N403B	T50-R800B
Drywell temperature	T50-N408A T50-N409B T50-N413B T50-N400B	T50-R800B
HPCI Suction/Discharge Pressure	E41-N019	E41-R609

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2.5.5 Thermal-Hydraulic Analyses

See Section 2.3.6

2.5.6 Flex Pump and Water Supplies

The NSRC is providing a high capacity low pressure pump which will be used to supplement FLEX portable equipment, if required, to provide cooling loads. The water supply is the Circulating Water reservoir or General Service Water Intake (Lake Erie).

2.6 Characterization of External Hazards

2.6.1 Seismic

The Fermi 2 seismic hazard is considered to be the Safe Shutdown Earthquake (SSE) as described in Regulatory Guide 2.1. Category I safety-related plant structures, systems and components are designed to remain functional in the event of an SSE.

In accordance with the NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Fermi 2 developed a Seismic Hazard and Screening Report 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 (ML12333A170). The Fermi 2 Seismic Hazard and Screening Report was submitted to the NRC on March 31, 2014 (Reference 17).

For Fermi 2, the Seismic Hazard and Screening Report determined that the Ground Motion Response Spectra (GMRS) in the frequency range of 1 to 10 Hz exceeds the SSE. Therefore per the SPID, Sections 3.2 and 7, Fermi 2 screened in for further seismic risk assessments in response to NTTF 2.1: Seismic, including seismic probabilistic risk assessment (SPRA) or seismic margin assessment (SMA), as well as spent fuel pool integrity evaluation and a high frequency analysis (HFA). Additionally, Fermi 2 screened into the Expedited Seismic Evaluation Process (ESEP) interim action per the "Augmented Approach" guidance document, Section 2.2. The Fermi 2 ESEP report was submitted on December 9, 2014 (Reference 18). The NRC has determined that, for Fermi 2, an SPRA or SMA are not needed in response to the Information Request. The criteria and schedule for the SFP and HFA integrity evaluations are under development.

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For FLEX, the earthquake is assumed to occur without warning and result in damage to non-seismically designed structures and equipment. Non-seismic structures and equipment could potentially fail in a manner that would prevent accomplishment of FLEX-related activities. However; FLEX equipment is located in protected Seismic Category I or seismically robust structures. With one exception, deployment and operation of FLEX equipment does not require transit of non-seismically robust structure. The exception is that the HPCI to GSW cross-tie may be inaccessible or non-functional following a seismic event. In this case the alternative heat removal strategy of containment venting will be employed.

An evaluation for potential liquefaction at Fermi 2 was performed. The evaluation determined that the potential for liquefaction for FLEX water supply (circulating water reservoir) and FLEX access and deployment paths was minimal. (References 19 and 20).

2.6.2 External Flooding

Fermi 2 is located on Lake Erie, which has a low water datum at elevation 570.5 feet.

Since the original submittal of the Overall Integrated Plan, Fermi 2 has completed and submitted the Flood Hazard Reevaluation Report (FHRR) for Fermi 2 requested by the 10 CFR 50.54(f) letter dated March 12, 2012 (Reference 21). The reevaluation represents the most current flooding analysis for Fermi 2. The reevaluation results are bounded by the original Fermi 2 design bases flood analysis. Based on this result, an Integrated Assessment of the flooding hazard for Fermi 2 is not required.

The bounding flooding event for Fermi 2 is wind driven storm surge caused by an extended (about 60 hour) storm travelling along the axis of Lake Erie. The resulting wind tide was super-imposed on the monthly mean lake level to calculate a resultant flood elevation of 586.9 feet which is above the site grade of 583.0 feet.

Fermi 2 has entered into a Letter of Agreement with the National Weather Service (NWS) to provide a minimum 48 hour notification of conditions favorable to this bounding flooding event.

This event would flood the Fermi 2 site for up to 17 hours, interfering with deployment of FLEX equipment if an ELAP/LUHS event were to occur during the period when the site is flooded.

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An alternate FLEX strategy has been developed to address this flooding scenario. Upon receipt of the NWS notification, procedures direct that the plant will be promptly brought to Cold Shutdown, and augmented personnel and resources brought on-site and staged in key, protected locations prior to inundation.

After the flooding recedes, if necessary, FLEX deployment and implementation will take place. Further details of the FLEX strategy for a flooding event are in Section 2.3.1.3.

2.6.3 Severe Storms with High Wind

Per NEI 12-06 Figure 7-1, Fermi 2 has less than a 1 in 1 million chance per year of a hurricane induced peak-gust wind speed of greater than 120 miles per hour (mph). Thus, Fermi 2 is not subject to hurricane related winds.

Per NEI 12-06 Figure 7-2, Fermi 2 has a 1 in 1 million chance of tornado wind speeds of 185 mph. This is greater than the threshold of 130 mph contained in NEI 12-06 and therefore Fermi 2 has evaluated tornado hazards, including tornado missiles, impacting FLEX deployment

Fermi 2 may have some warning time prior to the event in which a significant tornado event could occur within the vicinity of the site. The most probable approach direction is from the southwest. Site debris would most likely include all types of building material (metal siding, roofing, lumber, etc.), power lines and poles, Sea-vans, vehicles, light poles, trees and stored material. Minimal debris impacting deployment routes would be generated from offsite sources. Flex portable N and N+1 equipment is stored in the tornado and tornado missile proof FLEX Storage Facility (FSF) buildings. Travel routes for FLEX deployment are considerably wide in most areas providing a drivable path even with debris. FLEX trucks and trailers should be able to travel over small debris such as sheet metal, vegetation and other similar objects. FLEX hoses, cables, and connection points for FLEX Pumps and generators are located in designated areas protected from tornados and tornado missiles. Deployment pathways blocked by tornado debris can be cleared using the FLEX vehicles and bulldozer, and other debris removal tools such as chainsaws, disaster saw, tow chains, etc., which are stored in the FLEX Storage Facilities.

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2.6.4 Ice, Snow and Extreme Cold

The guidelines provided in NEI 12-06 (Section 8.2.1) generally include the need to consider extreme snowfall at plant sites above the 35th parallel. The Fermi 2 site is located above the 35th parallel thus, the capability to address hindrances caused by extreme snowfall with snow removal equipment will be provided. Per Section 8.2.1 of NEI 12-06, "It will be assumed that this same basic trend applies to extremely low temperatures". The lowest recorded temperature at or near Fermi 2 is -19°F (Reference 22). The Fermi 2 site is located within the region characterized by the Electric Power Research Institute (EPRI) as ice severity level 5 (Reference 5).

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 and ice removal by normal means. Clearing of FLEX deployment pathways has been incorporated into the Fermi 2 snow removal plan (Reference 23). The FLEX bulldozer could be used for snow removal of FLEX deployment pathways along with the FLEX trucks which are equipped with a snow removal blade. The FLEX bulldozer, trucks, generators, and pumps are housed in the FLEX Storage Facilities which are temperature controlled to maintain 40ºF to 105ºF (Reference 24). 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.

The FLEX generators are rated for full load operation at temperatures as low as -25°F. Freeze protection for FLEX Pumps and hoses is provided by maintaining flow in the pumps and hoses by the operator at the FLEX distribution manifold and locally at the Neptune pump.

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. The maximum temperature observed in the area of Fermi 2 was 105°F. Extreme high temperatures are not expected to impact the utilization of off-site resources or the ability of personnel to implement the required FLEX strategies.

Portable diesel equipment 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 tolerate the high temperature hazard.

The FLEX phase 2 generators are designed to operate without de-rate at site elevation up to 122°F ambient temperature (Reference 35).

The FLEX Storage Facility Buildings have their own heating and ventilation system. Per the building design (Reference 24), the HVAC systems will maintain interior design conditions of 40°F to 105°F.

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2.7 Planned Protection of Flex Equipment

Fermi 2 has constructed a two hardened FLEX storage structures each of which is approximately 4,600 square feet that meet the requirements for the external events identified in NEI 12-06, such as earthquakes, external floods, storms (high winds, and tornadoes), extreme snow, ice, extreme heat, and cold temperature conditions. The FLEX Storage Facility #1 (FSF 1) is located inside the Protected Area (PA) fence on the north side of the Reactor Building. FLEX Storage Facility #2 (FSF 2) is located outside the PA fence south of the Circulating Water reservoir. Figure 1 shows the site locations for FSF 1 and FSF 2.

The FLEX Storage Facility Buildings have been evaluated equivalent to that of a Seismic Category I structure. The building design is based on ASCE 7-10 and the 2009 Michigan Building Code. The FSF finish slabs (floor elevation) is 587.0 feet which is above the design basis flood hazard elevation of 586.9 feet. The FSF Buildings were designed and constructed to resist water intrusion (including that from wave run-up) and built to protect the housed FLEX equipment from other hazards identified in Section 2.6 above. Each FLEX Storage Building has its own heating and ventilation, and fire detection and suppression system.

Large portable BDB equipment such as pumps and power supplies are secured inside the FLEX Storage Facilities to protect them during a seismic event. The FLEX Storage Facilities have tie downs integrated into the floor slab for this purpose. These tie downs are used to secure any equipment that is not considered stable to ensure the stored BDB equipment remains protected from damage during a seismic event.

Debris removal equipment is also stored inside the BDB Storage Building in order to be reasonably protected from the applicable external events such that the equipment is likely to remain functional and deployable to clear obstructions from the pathway between the BDB equipment's storage location and its deployment location(s). These include mobile equipment such as a FLEX bulldozer and FLEX trucks with front end blades.

Deployments of the FLEX and debris removal equipment from the FLEX Storage Facilities are not dependent on off-site power. All actions are accomplished by either use of a backup generator at the building or manually. The doors to the buildings will open in under five minutes, reliably, using a compressed air bottle and air ratchet which is connected to the door via a sling system.

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

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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 the FLEX Support Guidelines (FSGs). These haul paths have been reviewed for potential soil liquefaction and have been determined to be stable following a seismic event. Additionally, the preferred haul paths generally avoid areas with trees, power lines, narrow passages, etc. However, high winds can cause debris from distant sources to interfere with planned haul paths. Debris removal equipment is stored inside the FLEX Storage Facilities to be 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 Facilities and its deployment location(s). See Figures 2 and 3 for FLEX haul paths.

The 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 immediately required as part of the immediate activities required during Phase 1.

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. As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following an a BDB external event and subsequent ELAP event, FLEX coping strategies may require the routing of hoses and cables to be run through various barriers in order to connect BDB equipment to station fluid and electric systems and to provide air flow for area ventilation. For this reason, certain barriers (gates and doors) may be opened and may need to remain open. This deviation from 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 the Security Diesel and all AC/DC 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. Operators implementing FLEX strategies are provided keys to access inoperative security doors.

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The deployment of onsite BDB equipment to implement coping strategies beyond the initial plant capabilities (Phase 1) requires that pathways between the BDB Storage Building(s) and various deployment locations be clear of debris resulting from BDB seismic, high wind (tornado), or flooding events.

The stored BDB equipment includes vehicles (small trucks) equipped with front end blades and rear tow connections in order to move or remove debris from the needed travel paths. A Caterpillar type D6N bulldozer will also be available to deal with more significant debris conditions.

Vehicle access to the Protected Area is via the double gated vehicle access port. As part of the Security access contingency, the gates will be manually controlled to allow delivery of BDB equipment (e.g., generators, pumps) and other vehicles such as debris removal equipment into the Protected Area. Redundant pathways are available through a truck lock and a vehicle inspection building.

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC and various commodities such as fuel and supplies. Transportation of these deliveries can be through airlift or via ground transportation. Debris removal for the pathway between the site and the NSRC receiving location and from the various plant access routes may be required. The same debris removal equipment used for on-site pathways will be used to support debris removal to facilitate access to the site staging areas.

2.9 Deployment of strategies

2.9.1 FLEX Water Supply Strategy

The Circulating Water reservoir provides an approximately 33 million gallon supply of water to the suction of the portable diesel driven Neptune pump system. The Circulating Water reservoir is a seismically robust earthen structure (Reference 20) that will remain available for any of the external hazards listed in Section 2.6.

A diesel driven Neptune pump is deployed from FSF 2 to the building apron adjacent to the CW reservoir. The floating hydraulically driven pump is deployed into the reservoir.

The Neptune pump discharge is routed using about 700 feet of hose to the suction of the diesel driven Dominator pump. A duplex strainer is provided at the Neptune discharge. The outer protected area security fence will be breached by the security force to allow the hose routing from FSF 2 to FSF 1. The Dominator is deployed from FSF 1 to the east building apron.

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The discharge from the Dominator is fed to using about 500 feet of hose to a discharge manifold staged on the west side of the Reactor Building where the flow rate is controlled. Flow (rated 3000 gpm @ 70 psig) is directed to one of two plant connections at the Reactor Building wall.

Figure 6 depicts the pumping arrangement between the CW reservoir and the plant connections.

The backup (N+1) Neptune pump system is stored in FSF 2 and the backup Dominator pump is stored in FSF 1.

By aligning the RHR system, FLEX water flow can be directed to the RPV, torus, or spent fuel pool as required. See Figure 5.

2.9.2 Electrical strategy

FSF 1 contains two portable FLEX diesel generators (N and N+1).

Either FLEX diesel generator can be connected at FSF 1 to permanently installed FLEX power distribution equipment which routes power to plant switchgear rooms where breaker insert devices bring FLEX power to 480 VAC plant switchgear. Breaker insert devices and interfacing cabling are stored locally in the switchgear rooms. See Figure 7 for the FLEX electrical arrangement.

Electrical power from FSF 1 is routed to the plant switchgear rooms by permanently installed cables and conduit. A Civil Equipment Chase (CEC) provides a protected structure between the Auxiliary Building and FSF 1 for routing of these permanently installed cables. This structure is an alternate strategy to NEI 12-06, Revision 0, and has been evaluated to provide the required functions.

Permanently installed FLEX electrical distribution equipment allows re-energizing the critical plant electrical loads more quickly and efficiently than the use of extensive portable cables and lengthy deployment paths of the portable FLEX DGs from FSF 1. The electrical equipment is installed in robust structures designed to withstand all applicable external events and has access pathways that are expected to be clear of debris following a BDBEE.

2.9.3 Fueling of Equipment

The FLEX strategies for maintenance and/or support of safety functions include the supply of fuel to necessary diesel powered generators, pumps, compressors, etc. The coping strategy for supplying fuel oil to diesel driven portable equipment, i.e., pumps and generators, is to draw fuel oil out of the four Fermi 2 Emergency Diesel Generator Fuel Oil Storage Tanks (FOST). The FOST are located in separate rooms above grade in the RHR Complex, a Category I structure.

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These four diesel tanks contain 42,000 gallons of diesel fuel each (a Technical Specification minimum is 35,280 gallons). Fuel can be obtained using a tank drain valve and a flexible hose. Additional sources of fuel are the Combustion Turbine Generator Fuel Storage Tank and the Auxiliary Boiler Fuel Oil Storage Tank, if intact.

Diesel fuel in the fuel oil storage tanks is routinely sampled and tested to assure fuel oil quality is maintained to ASTM standards. This sampling and testing surveillance program also assures the fuel oil quality is maintained for operation of the station Emergency Diesel generators.

The above fuel oil sources will be used to fill the fuel oil tank on one of the two fuel trailers. A fuel trailer is stored in each of the FLEX Storage Facilities. It has a capacity of approximately 1000 gallons and has a self-powered transfer pump for trailer tank filling or equipment fuelling operations. The fuel trailers will be deployed from the FLEX Storage Facilities to refill the fuel oil tanks of the BDB equipment and to the various fuel oil tank locations where it will be filled from the fuel oil storage tanks.

Based on a fuel consumption calculation (Reference 25), the fuel consumption for seven days of operation of phase 2 FLEX equipment is approximately 24,000 gallons. At this conservative fuel consumption rate, the four 42,000 gallon Fuel Oil Storage Tanks, which are protected from BDB hazards, have adequate capacity to provide the on-site BDB Equipment with diesel fuel for greater than 30 days.

The diesel fuel consumption information above does not include fuel requirements for the portable 4kV generators to be received from the NSRC. The Phase 3 re-powering strategy for use of the 4kV diesel generators will be developed based on the specific event circumstances and will include assessment of on-site and off-site fuel availability.

The BDB external event response equipment includes a chain saw and chop saw that are powered by gasoline engines. These components will be re-fueled using portable containers of fuel. Additional gasoline can be obtained from the station's underground gasoline fuel storage tanks or from private vehicles on site.

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2.10 Offsite Resources

2.10.1 National SAFER Response Center

The industry has established two National SAFER Response Centers (NSRCs) to support utilities during BDB events. Fermi 2 has established contracts and issued purchase orders to Pooled Inventory Management for participation in the establishment and support of two National SAFER Response Centers (NSRC) through the Strategic Alliance for FLEX Emergency Response (SAFER). Each NSRC will hold five sets of equipment, four 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 BDB external event and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area (staging area 'C') established by the SAFER team. For Fermi 2, the local assembly area is the DTE Energy Western Wayne Service Center. From there, equipment can be taken to the Fermi 2 site to staging area 'B' near the site quarry lake by helicopter (via staging area C-Helo at Willow Run Airport) if ground transportation is unavailable. Communications will be established between the Fermi 2 plant site and the SAFER team via satellite phones, and required equipment moved to the site as directed using the SAFER Response Plan. First arriving equipment will be delivered to the site within 24 hours from the initial request. Details of equipment delivery are identified in Fermi 2's SAFER Response Plan (Reference 10).

2.10.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDB external event at Fermi 2 is listed in Table 4. The Table 4 equipment is not specifically credited in the FLEX strategies for Fermi 2 but will be available for backup/replacement if needed. Since all the delivered equipment will be located at Fermi 2 staging area 'B', the time for replacement of a degraded Phase 2 portable component will be minimal.

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2.11 Habitability and Operations

2.11.1 Habitability and Equipment Operating Conditions

Following a BDB external event and subsequent ELAP event at Fermi 2, 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 BDB External Event (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 analyses was performed to quantify the maximum steady state temperatures expected in specific areas related to FLEX implementation to ensure the environmental conditions remain acceptable for personnel habitability and within equipment qualification limits (References 26, 27, 28).

The key operating areas identified for all phases of execution of the FLEX strategy activities are the Main Control Room and Reactor and Auxiliary Buildings. These areas have been evaluated to determine the temperature profiles following an ELAP/LUHS event. The temperature profiles were reviewed against equipment capabilities and it was determined that the equipment required for a FLEX response is capable of operation under these conditions (See section 2.6.5).

The temperature profiles for areas where personnel access is needed for FLEX response have also been evaluated. Actions to mitigate the impact of temperatures or use of protective equipment have been included in FSGs. It is expected that building ventilation flow can be reestablished approximately 6 hours into the event.

An additional ventilation concern applicable to Phase 2 is the potential buildup of hydrogen in the battery rooms. A hydrogen generation calculation was performed which shows that hydrogen concentration in the battery rooms remains less than 2 percent for at least 36 hours (Reference 27).. Mitigating actions are not needed since battery room ventilation is expected to be restored well before this time

2.11.2 Foul Weather Gear

Fermi 2 has stocked cold weather garments and rain gear, in various sizes, for responders to wear during foul weather conditions supporting outside FLEX deployment actions. Foul weather equipment is stored in FSF 2.

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2.11.3 Heat Tracing

Most of the equipment used to support the FLEX strategies is stored in the FLEX Storage Facilities which are designed and protected from snow, ice, and extreme cold in accordance with NEI 12-06, and are temperature controlled. 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. FLEX connection points are maintained dry until connections are made and flow established. Many components for FLEX strategies such as vehicles and generators are provided with cold weather packages. Heat tracing is not required.

2.11.4 Frazil Ice

NEI 12-06 requires that the potential for frazil ice formation be addressed. Frazil ice is a surface and sub-surface phenomena associated with large bodies of water under extremely cold, windy and turbulent conditions. This results in emulsified ice crystals in the surface and subsurface of the large water body.

The Circulating Water (CW) reservoir is normally the heat sink for water that has passed through the Main Condenser. Therefore the water temperature in the reservoir would be greater than 32^{o}F at the start of the BDBEE. Since frazil ice formation requires supercooled liquid, the initial BDBEE conditions would inhibit the formation of frazil ice.

Under conditions where CW reservoir may approach freezing, the low flow conditions in the reservoir in comparison to the total volume would inhibit the formation of frazil ice in favor of formation of a surface ice layer.

Based on the configuration of the CW reservoir, reasonable assurance exists that induction of frazil ice will not be a concern.

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2.12 Lighting

In order to validate the adequacy of supplemental lighting and the adequacy and practicality of using portable lighting to perform FLEX strategy actions, an evaluation of the tasks to be performed and the available lighting in the designated task areas was completed. Tasks evaluated included traveling to/from the various areas necessary to implement the FLEX strategies, making required mechanical and electrical connections, performing instrumentation monitoring, and component manipulations.

Existing battery powered (Appendix “R”) emergency lights and helmet mounted lamps were determined to be adequate lighting for most tasks. For some areas, additional portable, battery powered lighting was provided. These emergency lights are inventoried and periodically tested to insure their availability.

A 60 kw diesel generator is provided for each FLEX Support Facility to provide power to building services including lighting. Additionally, portable light towers are provided in the FLEX Support Facilities; two in FSF 1 and one in FSF 2. This lighting is sufficient to support nighttime operations to implement FLEX.

For Phase 3, the NSRC is deploying portable lighting towers per the Fermi 2 SAFER Response Plan. The deployment of six 6 kW, 440,000 lumens, diesel-driven lighting towers from SAFER will support Fermi 2 exterior lighting for equipment staging areas and FLEX deployment locations.

2.13 Communications

The Fermi 2 communications systems and equipment are designed and installed to assure reliability of on-site and off-site communications in the event of a Design Basis Accident scenario. However, in the event of an ELAP, limited communications systems functionality will be available.

A standard set of assumptions for a BDB ELAP event is identified in NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, May 2012.

2.13.1 On site

Initial communication announcements to on-site personnel during a BDB external event will be via the plant Hi-Com system. However, the Hi-Com system is reliant on AC power and will not function during an ELAP. In this case, plant procedures direct emergency response personnel with responsibilities for ELAP response to report to their ERO Facility when indications of an ELAP are present and no Hi-Com announcement is heard.

Indoor and outdoor locations where temporary BDB equipment is used may be served with either hand-held radios or satellite phones.

There will be 16 dedicated hand-held radios available for the implementation of the FLEX strategies. Sufficient batteries and chargers are also available. The on-site radio repeaters are provided with uninterruptible power supplies to allow their use during the initial 24 hours after the event.

A satellite phone is provided for each of the FSFs. Satellite phone capability (including battery power) is also provided at the Main Control Room and at all emergency response facilities.

2.13.2 Off-Site:

Satellite phones may be the only available means to communicate off-site when the telecommunications infrastructure surrounding the nuclear site is non-functional. They connect with other satellite phones as well as normal communications devices.

NEI 12-01, Section 4.1 outlines the minimum communication pathways to the federal, state, and local authorities. In order to ensure the capability for communications over these minimum pathways, 30 dedicated satellite phones and associated equipment have been installed at both on-site and off-site emergency response facilities. Included are both portable satellite phones that require a direct line-of-sight to the satellite and satellite gateways that allow communications from fixed locations within a building. Each satellite phone is equipped with batteries or backup power for 24 hours of operation.

2.14 Water sources

Fermi 2 has chosen the Circulating Water Reservoir as the primary water source throughout the ELAP/LUHS event. This allows the FLEX strategy to position the FLEX Pumps at a sufficiently large source that can provide make-up water to the RPV, suppression pool, and spent fuel pool.

The CW reservoir chemistry monitored and controlled. Total dissolved solids are controlled by makeup from and decanting to Lake Erie. CW reservoir pH, hardness, conductivity and alkalinity are also monitored.

Debris intrusion to the FLEX water supply is minimized by the placement of the Neptune source pump. The source pump floats away from the reservoir shore and takes suction about 3 feet below the surface to minimize impact of floating debris.

A duplex strainer is provided in the FLEX flow path with a 20 mesh (0.3 mm) filter. By design the FLEX water flow can be switched to the backup strainer and the initial strainer cleaned while maintaining the FLEX water flow. A source of water to clean strainers is provided from the Neptune pump discharge.

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2.15 Shutdown and Refueling Analysis

Fermi 2 has incorporated into plant procedures actions addressing mitigating strategies in shutdown and refueling modes. These actions follow the guidance provided by NEI 12-06, Revision 0, and the Nuclear Energy Institute (NEI) position paper titled "Shutdown/Refueling Modes" (Reference 29) as endorsed by the NRC staff (Reference 30).

For planned outages and early in an unplanned outage, an outage risk profile is developed. This risk assessment is updated on a daily basis and as changes are made to the outage schedule. Contingency actions are developed for high risk evolutions and the time needed for such evolutions is minimized. During the outage additional resources are available on site and during the high risk evolutions individuals are assigned specific response actions. 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, Fermi 2 develops contingencies to address the conditions and response actions for a loss of cooling and maintains defense in depth and availability for key functions. FLEX is included as a mandatory function. (Reference 31) 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. Fermi 2 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, water in the Reactor Pressure Vessel (RPV) will heat up. When temperature reaches 212°F, (Hot Shutdown) the RPV will begin to pressurize and a strategy similar to the flooding timeline will be implemented.

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 begin immediately. All efforts will be made to expeditiously 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. An evaluation (Reference 9) has determined that, in this scenario, the core will remain covered for at least 6.75 hours, giving sufficient time to inject FLEX water and maintain water level above the top of active fuel.

Deployment and implementation of portable FLEX Pumps to supply injection flow will commence immediately from the time of the event. This is plausible because more personnel are on site during outages to provide the necessary resources.

Guidance (postings, signage and markings) has been provided to ensure that travel and hose paths are available for deployment and remain accessible, without interference from outage related equipment.

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2.16 Sequence of Events

The Table 1 below presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS (other than the flooding scenario) event at Fermi 2. Table 2 presents the SOE for an ELAP/UHS for a flooding scenario. Validation of each of the Flex time constraint actions has been completed in accordance the Flex Validation Process document issued by NEI and includes consideration for staffing.

Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	**Elapsed Time**	**Action**	**FVP Validation Plans (Where Applicable)**	**Time constraint Y/N Level of Validation**	**Remarks/ Applicability**
		Event Starts	0	N/A	Plant @ 100% power
		PHASE 1			
01	**0 hr**	**INITIAL EVALUATION OF ABNORMAL OR EMERGENCY SITUATION**	N/A	**N**	Times bounded by VPI 03
01a		Ensure the appropriate actions of the Abnormal and Emergency Operating Procedures are performed. (EP-101)		N	
01b		Operators Start / Evaluate Standby AC sources of power. (20.300.SBO, 20.307.01, 23.324)		N	
02	**0 hr**	**RPV LEVEL AND PRESSURE CONTROL**	**N/A**	**N**	Times bounded by VPI 03
02a		Utilize EOP 29.100.01 (Ref. 24) to monitor, maintain, and restore the RPV Level and Pressure. If needed, use RCIC to restore/maintain the RPV water level per SOP 23.206. Line up RCIC suction from the CST, if available, or the Torus per SOP 23.206. RPV pressure is controlled by RCIC Turbine and SRVs as required.		N	

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
03	**10 Min**	**RESET ATWS/ARI**	**N/A**	**N**	Reset with AOP 20.300.SBO
03a		Following confirmation all rods in, reset ATWS/ARI to preserve battery life.			
04	**15 Min**	**DECLARATION OF EMERGENCY EVENT AND NOTIFICATIONS (EP-101)**	**N/A**	**N**	Times bounded by VPI 03
05	**15 Min - 45 Min**	**WALKDOWNS AND DAMAGE ASSESSMENT**	**N/A**	**N**	Times bounded by VPI 03
05a		Designated personnel perform walk downs and damage assessments to determine plant functional capabilities [20.300.SBO].		N	
06	**20 Min**	**START HPCI TO MINIMIZE SRV CYCLING**	**N/A**	**N**	Times bounded by VPI 03
06a		To minimize SRV cycling and level control issues, restart HPCI in minimum Flow mode per 23.202		N	
07	**30 Min**	**CONTACT SYSTEM OPERATIONS CENTER (SOC)**	**N/A**	**N**	Times bounded by VPI 03
07a		To verify status of Offsite Power lines and potential for restoration prior to 4 hours.		N	

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
08	**42 Min**	**ENTER EXTENDED LOSS OF POWER (ELAP) AND NOTIFICATIONS**	**VPI 03**	**Y Level A**	
08a		Ensure the appropriate actions of the Abnormal and Emergency Operating Procedures are performed, (29.300.SBO, 20.000.011)			
08b		Shift Manager to notify SAFER Control Center to mobilize Phase 3 equipment and support personnel, (29.400.01), including availability of contracted helicopter support.			
08c		Shift communicator to notify State EOC to request Michigan State Police and Michigan National Guard support [helicopters, transport pathway evaluation, other logistical aid], and then notify NRC to request FEMA air transport support.			
08d		Shift Manager to consider invoking 50.54 (x) and (y) to implement Beyond Design Bases response activities [security alternate posture, place FLEX connections in service, align plant equipment, etc.]			
08e		Shift Manager to consider upgrading emergency declaration to General Emergency. [EP-101]			
08f		Operations continue to control RPV pressure. (29.100.01 sh 1)			
08g		Operations continue to control RPV level (29.100.01 sh 11). This meets the RPV Cooling safety function.			

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
		PHASE 2			
09	**45 - 240 Min**	**DC POWER/LOGIC DEFEATS**	**VPI 04 VPI 05**	**Y Level A**	**Range based on start and constraint times**
09a		Perform DC load stripping to preserve battery life, (29.FSG.01/29.FSG.Plant/29.400.01).			
09b		Align HPCI and RCIC Logic to protect these required systems from all trips. Minimum Flow protection and Barometric Condenser operation will be restored, (29.FSG.08, 29.FSG.09, 29.FSG.Plant).			
09c		Defeat ATWS/ARI logic to allow expansion of RPV Level control band, (29.FSG.07).			
10	**100-720 Min**	**DC POWER RESTORATION (to Battery Chargers**	**VPI 06**	**Y Level A**	**Range based on start and constraint times**
10a		Initiate alignment and repowering of DC battery chargers from FLEX DG to restore indefinite coping for DC (29.FSG.01 / 29.FSG.Plant)			
10b		Perform restoration of DC power capability by restoring DC Chargers (29.FSG.01 / 29.FSG.Plant) from FLEX DG power.			
10c		Restore DC loads for HPCI/RCIC Barometric Condensers. (29.FSG.01, 29.400.01)			

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
11	**0.75 - 5 hr**	**CONTAINMENT COOLING/SFP COOLING ALIGNMENT**	**VPI 07A** **VPI 07B** **VPI 07C** **VPI 07D**	**Y** **Level A**	**Range based on start and constraint times**
11a		Perform deployment of the FLEX Water Supply pumps and hoses to the RHR crosstie to allow for feed of cooler water to Torus. (29.FSG.02.)	VPI 07A VPI 07B		
11b		deleted			
11c		Align the HPCI Test line and HPCI to GSW Cross tie to allow for Bleed of hot Torus water. (29.FSG.05)	VPI 07C		
12	**100 - 170 min**	**AC POWER DIV 1**	**VPI 08A &** **VPI 08C**	**Y** **Level A**	**Range based on start and constraint times**
12a		Perform AC load stripping and load AC supplemental power from the FLEX DG. (29.400.01, 29.FSG.04)	**VPI 08A**		
12b		Restore required 480 VAC loads. (29.FSG.04)	**VPI 08C**		
13	**44 min**	**REACTOR RECIRCULATION PUMP SEAL**	**VPI 08C**	**Y** **Level A**	**Based on constraint time**
13a		Close recirculation pump supply and discharge valves and bottom head drain valves [when AC Power restored], to terminate RRS Pump seal leakage. (29.400.01, 29.100.01 Sheet 2)			

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
14	**160-300 min**	**CONTAINMENT COOLING**	**VPI 07D & VPI 09**	**Y Level A**	**Range based on start and constraint times**
14a		Fill the FLEX Water Supply system using the Neptune system. (29.FSG.02)	**VPI 07D**		
14b		When the FLEX Water Supply hoses are full, start remaining FLEX pumps and align the FLEX water to the SFP, (29.FSG.12). This allows venting the FLEX Water Supply system to RB-5 AND meeting the SFP Cooling safety function. Initial flow should be set at about 90 gpm (allows small overflow to containment pool to assist with Drywell Head cooling/DW heat removal).	**VPI 09**		
14c		Commence Torus Feed using FLEX Water supply. (29.FSG.05)	**VPI 09**		
14d		Commence Torus Bleed, (29.FSG.05) using HPCI. A matched flow rate of 2000-3000 gpm [or greater] should be obtained with FLEX Water supply and HPCI. This should be maintained until Torus Temperature stabilizes below 170°F. This meets the Containment Cooling safety function.	**VPI 09**		

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	**Elapsed Time**	**Action**	**FVP Validation Plans (Where Applicable)**	**Time constraint Y/N Level of Validation**	**Remarks/ Applicability**
15	**N/A**	**AC POWER DIV 2**	**VPI 08B & VPI 08D**	**N Level A**	**Contingency Actions**
15a		Perform AC load stripping and load AC supplemental power from the FLEX DG. (29.400.01, 29.FSG.04)	VPI 08B		
15b		Restore required 480 VAC loads. (29.FSG.04)	VPI 08D		
16	**6 - 8.4 hr**	**SUPPORT FUNCTIONS**			**Assumed not to start until 6 hours Venting not required until 8.4 hours**
16a		**NIAS: supporting Vent functionality and SRV Operations**	**VPI 10**	**N Level B**	Not part of Primary Path
16a1		Align the staged bottles to open P5000-F440/F441. (29.FSG.10)			
16a2		Run the FLEX Air hose from the FLEX Compressors to the IAS connection. (29.FSG.10)			
16a3		Start the FLEX Air Compressors. (29.FSG.10)			
16b		**Restoration of Power to support FLEX Venting**	**VPI 13**	**N Level B**	Not part of Primary Path Only needed if HPCI to GSW cross tie is damaged by a seismic event
16b1		Align HCVS valve power supplies to FLEX DG source. [29.FSG.13]			

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	**Elapsed Time**	**Action**	**FVP Validation Plans (Where Applicable)**	**Time constraint Y/N Level of Validation**	**Remarks/ Applicability**
16c		**Oil Cooling/Room Cooling for HPCI/RCIC support**	**VPI 12**	**N Level B**	Not part of Primary Path
16c1		Align FLEX Water Supply to the RB/AB Fire header. (29.FSG.14)			
16c2		Align cooling water from RB Fire header to RCIC skid and Div 1 CSS/RCIC Room Cooler. (29.FSG.14)			
16c3		Align cooling water from RB Fire header to HPCI skid and HPCI Room Cooler. (29.FSG.14)			
16c4		Align RBCCW head tank to GSW return. (29.FSG.14)			
16c5		Start cooling water by opening FLEX supply/Oil Cooling valves Room Cooler supplies. (29.FSG.14)			
17	**40 hr**	**Building Cooling**	**VPI 14**	**N Level B**	Not part of Primary Path
17a		Verify sufficient 480 VAC load capacity. (29.FSG.04)			
17b		Align RBHVAC Dampers and control logic using 29.FSG.Toolboxes RBHVAC.			
17c		Start one RBHVAC fan set to cool RB / AB.			

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Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	**Elapsed Time**	**Action**	**FVP Validation Plans (Where Applicable)**	**Time constraint Y/N Level of Validation**	**Remarks/ Applicability**
18	**8.4 hr**	**Align for SFP Spray on RB 5**		**N**	
18a		**Align FLEX Water for SFP sprays**	**VPI 12**	**B**	
18a		Verify safe temperature conditions exist on RB 5 (29.FSG.13)		N	
18b		Connect Blitzfire nozzles to Fire main on RB 5 per 29.EDM.01 for SFP Spray IF REQUIRED		N	SFP spray Governed by procedure 29.EDM.01 which is not a new FLEX procedure
19	**10 - 72+ hr**	**EQUIPMENT REFUELING**		**N**	Not part of Primary Path
19a		Site and ERO augmented staff replenish operating diesel powered equipment fuel supplies as needed using FLEX Support Fuel transfer equipment and fuel stored in EDG FOSTs [29.FSG.17].		N	
19b		Reference Section 2.7 of this document.		N	
20	**6 - 8.4+ hr**	**Commence Contingency Torus Venting IF REQUIRED**	**VPI 10, VPI 12 VPI 13**	**N**	Not part of Primary Path
20a		Verify FLEX Venting setup complete (29.FSG.13)	**VPI 10 VPI 13**	N	
20b		Verify HPCI/RCIC Alternate cooling established (29.FSG.14)	**VPI 12**	N	
20c		Vent per 29.FSG.13.		N	

FLEX FINAL INTEGRATED PLAN

Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
		PHASE 3			
21	**45 Min**	**ENTER EXTENDED LOSS OF POWER (ELAP) AND NOTIFICATIONS**	**VPI 03**	**Y A**	**Hard Limit per 20.300.SBO**
21a		Shift Manager to notify SAFER Control Center to mobilize Phase 3 Equipment and Support Personnel, (29.400.01), including availability of contracted helicopter support.		N	
21b		Shift communicator to notify State EOC to request Michigan State Police and Michigan National Guard support [helicopters, transport pathway evaluation, other logistical aid], and then notify NRC to request FEMA air transport support		N	
21c		Designate Single Point of Contact [SPOC] for future communication with the SAFER Team.		N	
22	**1 - 2 hrs**	**SAFER CONTROL CENTER (SCC) ACTIVATION AND NOTIFICATIONS**		**N**	
22a		RRC notifications for deployment		N	
22b		Equipment transport function activated		N	
22c		Set-up and Operations personnel Activated		N	
22d		SCC to initiate contracted helicopter support request and Congested Flight Plan approval		N	
22e		Activation of final transport suppliers (FEDEX land and or supplemental helicopter support)		N	

FLEX FINAL INTEGRATED PLAN

Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
23	**3 - 4 hrs**	**SAFER EQUIPMENT OFF-SITE ROUTE ASSESSMENT**		**N**	
23a		SAFER: Perform equipment deployment route assessment-out-of-state.		N	
23b		MSP: Perform equipment deployment route assessment- in-state.		N	
23c		SAFER and SPOC: Designate staging areas to be used.		N	
24	**6 - 12 hrs**	**SAFER EQUIPMENT ON-SITE ROUTE DEBRIS CLEARANCE**		**N**	
24a		ERO: Using site debris clearance equipment create path from Area A to Area B.		N	
25	**8 - 12 hrs**	**SITE DAMAGE AND ON-SITE ACCESSIBILITY ASSESSMENT**		**N**	
25a		Site staff personnel [ERO Augmented] will continue with site damage and on-site accessibility assessments and notify the Emergency Director and SPOC		N	
26	**12 - 16 hrs**	**COMMENCE RESTORATION OF ACCESSIBILITY**		**N**	
26a		Use available FLEX Support debris removal equipment		N	

FLEX FINAL INTEGRATED PLAN

Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
27	**16 - 24 hrs**	**PREPARE PLANT INTERFACE CONNECTIONS**		**N**	
27a		ERO to staff preparation activities for FLEX tie-ins to secondary output of transformers 64 [Procedure 35.321.002] or 65 [Procedure 35.321.003] based upon Site Damage and On-site accessibility assessment.		N	
28	**24 hrs**	**24-hr EQUIPMENT ARRIVES AT SITE**		**N**	
28a		Two - 1MW Combustion Turbine Generators (4160 V).		N	
28b		Followed by One - Low Pressure High Capacity Pump.		N	
29	**24 - 30 hrs**	**CONNECT 24-hr EQUIPMENT**		**N**	
29a		Site damage and on-site deployment accessibility should be performed to determine the appropriate method of deployment for Phase 3 equipment. Phase 3 generators are to be connected to the secondary output of transformers 64 [Procedure 35.321.002] or 65 [Procedure 35.321.003] based upon site damage and on-site accessibility assessment		N	
30	**30 hrs**	**AC POWER**		**N**	
30a		Restore 4160 VAC BUSES (BOP, Div. 1 or Div. 2) from Phase 3 generators or the restoration of permanent plant equipment.		N	

FLEX FINAL INTEGRATED PLAN

Table - 1 Instantaneous FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
31	**72 hrs**	**72-hr EQUIPMENT AVAILABLE AT Staging Areas C and / or B**		**N**	
31a		Use of SAFER Phase 3 Equipment will be directed and implemented by the Emergency Response Organization as part of plant equipment / functionality recovery activities		N	

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
		PHASE 0			
1	**- 48 hrs**	**PREDICTION OF EVENT FROM NWS.**		**N**	
01a		NWS predicts event per Letter of Agreement at between 72 and 48 hours (48 hours minimum).		**N**	
01b		Operators commence Reactor Shutdown per 22.000.03/.04 and AOP 20.000.01, Acts of Nature, Flooding section or as applicable		**N**	
02	**- 38 to 0 hrs**	**COLD SHUTDOWN REACHED.**		**N**	
02a		Reach cold shutdown and maintain RPV Level at least 220" and Temperature at 100°F using RHR in Shutdown Cooling. (22.000.05, 23.205, 20.000.01).		**N**	
02b		Lower Torus Temperature to as low as practicable but at least to 80°F using RHR in Torus Cooling. (23.205, 20.000.01).		**N**	
02c		Fill Hotwell to ~603 ft.; Cool Hotwell to 80°F or lower using CW		**N**	
02d		Align the Main Steam Line Drains with all valves except B2103-F019 open. (29.400.02).		**N**	
02e		Station Operators at RHR Complex to verify/place in service EDGs on loss of Offsite Power. (20.300.SBO, 20.307.01) or grid instability (20.300.GRID), (29.400.02).		**N**	

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
02f		Station Operators at FSF#1 Complex to place the FLEX Generators in service when possible. (29.FSG.01, 29.FSG.04, 29.400.02).		**N**	
02g		Align N2 bottles to the door seals for RR airlock Doors (23.129, 29.400.02).		**N**	
02h		Align HPCI test line for FLEX Bleed path (prior to TB Basement Flooding (20.000.01, 29.400.02).		**N**	
02i		Lower RB temperature using RBHVAC; Lower TB temperature using TBHVAC (29.400.02)		**N**	
02j		Lower SFP temperature as low as possible but not less than 68 °F (29.400.02).		**N**	
02k		Monitor weather conditions for when FLEX Generators can be started or when Offsite power is threatened to at least start an EDG (29.400.02).		**N**	
02l		Close RR valves B3105-F023A/B, B3105-F031A/B, G3352-F101) prior to loss of power to isolate RR Pump seals (20.000.01, 29.400.02).		**N**	
02m		Open B2103-F019 to align for RPV vent to condenser			

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
		PHASE 1			
03	**0 hr**	**INITIAL EVALUATION OF ABNORMAL OR EMERGENCY SITUATION**		**N**	**Times bounded by VPI 03**
03a		Ensure the appropriate actions of the Abnormal and Emergency Operating Procedures are performed. (EP-101)		**N**	
03b		Operators Start / Evaluate Standby AC sources of power. (20.300.SBO, 20.307.01, 23.324)		**N**	
04		Deleted			
05	**15 Min**	**DECLARATION OF EMERGENCY EVENT AND NOTIFICATIONS (EP-101)**		**N**	**Times bounded by VPI 03**
6	**45 Min**	**ENTER EXTENDED LOSS OF POWER (ELAP) AND NOTIFICATIONS**	No Specific time Constraints are applicable due to the 48 hr advance shutdown notice		**Times bounded by VPI 03**
06a		Ensure the appropriate actions of the Abnormal and Emergency Operating Procedures are performed, (29.400, 29.400.02)			
06b		Shift Manager to notify SAFER Control Center to mobilize Phase 3 equipment and support personnel, (29.400.02), including availability of contracted helicopter support.			

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
06c		Shift communicator to notify State EOC to request Michigan State Police and Michigan National Guard support [helicopters, transport pathway evaluation, other logistical aid], and then notify NRC to request FEMA air transport support.			
06d		Shift Manager to consider invoking 50.54 (x) and (y) to implement Beyond Design Bases response activities [security alternate posture, place FLEX connections in service, align plant equipment, etc.]			
06e		Shift Manager to consider upgrading emergency declaration to General Emergency. [EP-101]			
		PHASE 2			
7	**45 Min - 6 Hr**	**LOAD SHED, ALIGN FOR FLEX, RPV PRESSURIZATION AND RCIC BLACKSTART**	**VP P04, VP P10A, VP P10B**	**N Level B**	
07a		**Loss of SDC response will NOT include start of the other division**			
07b		**Deep DC load shed (includes SRVs, HPCI, RCIC)**			
07c		**AC Load shed per 29.FSG.04/29.400.02**			
07d		**Align D1 and D2 MCCs in the AB for DC power for when Generators available per 29.FSG.01**			

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
07e		Align D2 and D2 ESF 480 VAC buses in the AB for Power for when Generators available per 29.FSG.04			
07f		Align FLEX Water system inside RB for when FLEX available per 29.FSG.02			
07g		Align cooling water lines from FLEX water supply to RCIC/HPCI oil coolers per 29.FSG.14			
07h		Monitor for RPV heatup and pressurization (MAAP shows 300 psig at about 4 hours) per 29.400.02			
07i		Deleted			
07j		When at 300 psig, start bleeding steam to the Hotwell per 29.400.02			
07k		When at 1000 psig, blackstart RCIC in minimum flow mode and to fill RPV as required (Band is 100" to 250" for fill cycles otherwise RCIC in Minimum flow) per 29.400.02. This meets the RPV Cooling safety function.			

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
8	~10 hr - 18 hr	Restoration of Power and Loads	VPI 06A, VPI 08C, VPI 08D	N Level A	
8a		Move generators out of FSF #1 and start. Coordinate with P603 operator to restore DC then AC per 29.FSG.01/29.FSG.04			
8b		Restore DC logic to SRVs and RCIC (HPCI logic and DC Control Power to all but RHR should also be restored)			
8c		Following restoration of DC Battery Chargers, restore DC loads for HPCI/RCIC Barometric Condensers (29.FSG.01, 29.400.02)			
8d		Load AC supplemental power, (29.400.02, 29.FSG.04).			
9	~17 hr - 22 hr	CONTAINMENT COOLING	VPI 07A VPI 07B VPI 07C VPI 07D VPI 09	N Level A	
09a		When the flood has receded and weather conditions permit, deploy the FLEX Water supply system per 29.FSG.02. Clear debris from required areas using equipment provided in FSF1 and FSF2			
09b		Fill the FLEX Water Supply system using the Neptune system, (29.FSG.05).			

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
09c		When the FLEX Water Supply hoses are full, align the FLEX water to the SFP, (29.FSG.12). This allows venting the system to RB-5 AND meeting the SFP Cooling safety function. Initial flow should be set at about 90 gpm (allows small overflow to containment pool to assist with Drywell Head cooling/DW heat removal).			
09d		Commence Torus Feed using FLEX Water supply to achieve +5" in the Torus, (29.FSG.05).			
09e		When +5" in the Torus is reached, commence Torus Bleed, (29.FSG.05) using RCIC. A matched flow rate of about 600 gpm should be obtained with FLEX Water supply and RCIC. This should be maintained until Torus Temperature stabilizes below 180 F. This meets the Containment Cooling safety function.			

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
10	**10 - 30 hr**	**SUPPORT FUNCTIONS**			
10a		**NIAS: supporting Vent functionality and SRV Operations**	**VPI 10**	**N Level B**	**Not part of Primary Path**
10a1		Align the staged bottles to open P5000-F440/F441. (29.FSG.10)			
10a2		Run the FLEX Air hose from the FLEX Compressors to the IAS connection. (29.FSG.10)			Conduct after flood recedes
10a3		Start the FLEX Air Compressors. (29.FSG.10)			Conduct after flood recedes
10b		**FLEX electrical power supply: supporting Hardened Vent functionality**	**VPI 13**	**N Level B**	**Not part of Primary Path**
10b1		Align HCVS valve power supplies to FLEX DG source. [29.FSG.13]			
10c		**Oil Cooling/Room Cooling for HPCI/RCIC support**	**VPI 12**	**N Level B**	**Not part of Primary Path**
10c1		Align FLEX Water Supply to the RB/AB Fire header. (29.FSG.14)			Conduct after flood recedes
10c2		Align cooling water from RB Fire header to RCIC skid and Div 1 CSS/RCIC Room Cooler. (29.FSG.14)			
10c3		Align cooling water from RB Fire header to HPCI skid and HPCI Room Cooler. (29.FSG.14)			
10c4		Align RBCCW head tank to GSW return. (29.FSG.14)			
10c5		Start cooling water by opening FLEX supply/Oil Cooling valves Room Cooler supplies. (29.FSG.14)			Conduct after flood recedes

FLEX FINAL INTEGRATED PLAN

Table 2 – Flooding Event FLEX Strategy Timeline

Action Item	Elapsed Time	Action	FVP Validation Plans (Where Applicable)	Time constraint Y/N Level of Validation	Remarks/ Applicability
11	8+ hr	Building Cooling	VPI 14	N Level B	Not part of Primary Path
11a		Verify sufficient 480 VAC load capacity. (29.FSG.04)			
11b		Align RBHVAC Dampers and control logic using 29.FSG.Toolboxes RBHVAC.			
11c		Start one RBHVAC fan set to cool RB / AB.			
		PHASE 3			
12		Phase 3 strategy is the same as for Instantaneous Events			See Table 1 for the details

FLEX FINAL INTEGRATED PLAN

2.17 Programmatic Elements

2.17.1 Overall Program Document

Fermi 2 procedure MOP25 provides a description of the Beyond Design Bases Event Coping Strategies (FLEX) Program for the Fermi 2 Station. The key elements of the program include:

- Summary of the Fermi 2 FLEX strategies
- Maintenance of the FSGs including any impacts on the interfacing procedures (EOPs, SAMGs, EDMGs, etc.)
- Maintenance and testing of FLEX equipment (i.e., SFP level instrumentation, emergency communications equipment, portable FLEX equipment, FLEX support equipment, and FLEX support vehicles)
- Portable equipment deployment routes, staging areas, and connections to existing mechanical and electrical systems
- Validation of time sensitive operator actions
- The FLEX Storage Facilities 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

In addition, the program description includes:

(1) A list of the BDB FLEX basis documents that will be kept up to date for facility and procedure changes,

(2) A historical record of previous strategies and their bases, and

(3) The bases for ongoing maintenance and testing activities for the BDB equipment.

FLEX FINAL INTEGRATED PLAN

Existing design control procedures have been revised to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies. Changes for the FLEX strategies will be reviewed with respect to operations critical documents to ensure no adverse effect.

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.

2.17.2 Procedural Guidance

The inability to predict actual plant conditions that require the use of BDB equipment makes it impossible to provide specific procedural guidance. As such, the FSGs provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs ensure that FLEX strategies are used only as directed for BDB external event conditions, and are not used inappropriately in lieu of existing procedures. When BDB equipment is needed to supplement EOPs or Abnormal Procedures (APs) strategies, the EOP or AP, Severe Accident Mitigation Guidelines (SAMGs), or Extreme Damage Mitigation Guidelines (EDGMs) 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) provide available, pre-planned FLEX strategies for accomplishing specific tasks in the EOPs or APs. FSGs are used to supplement (not replace) the existing procedure structure that establishes command and control for the event.

Changes to FSGs are controlled by Fermi 2 Conduct Manual MGA02, Procedures, Manuals and Orders (Reference 32). FSG changes will be reviewed and validated by the involved groups to the extent necessary to ensure the strategy remains feasible. Validation for existing FSGs has been accomplished in accordance with the guidelines provided in NEI's FLEX Validation Process (Reference 33).

2.17.3 Staffing

Using the methodology of (Nuclear Energy Institute) NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, an assessment of the capability of the Fermi 2 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 April 17, 2015 (Reference 34).

FLEX FINAL INTEGRATED PLAN

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.

A team of subject matter experts from Operations, Maintenance, Radiation Protection, Chemistry, Security, Emergency Preparedness and industry consultants performed tabletop exercises in July 2014 and February 2015 to conduct the on-shift portion of the assessment. The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft FLEX Support Guidelines (FSGs) for coping with a BDBEE using minimum on-shift staffing. 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 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 Fermi 2 Emergency Response Plan and associated administrative procedures, as augmented by site auxiliary personnel, is sufficient to support the implementation of the Fermi 2 FLEX strategies, as well as the required Emergency Plan actions, with no unacceptable collateral duties.

The expanded ERO analysis concluded that sufficient personnel resources exist in the current Fermi 2 augmenting ERO to fill positions for the expanded ERO functions. Thus, the ERO resources and capabilities necessary to implement Transition Phase coping strategies performed after the end of the “no site access” 6-hour time exist in the current program.

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2.17.4 Training

Fermi 2's Nuclear Training Program has been revised to assure personnel proficiency in the mitigation of BDB external events is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training (SAT) Process or similar process.

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

Using the SAT process, Job and Task analyses were completed for the new tasks identified as applicable to the FLEX Mitigation Strategies. Based on the analysis, training for Operations was designed, developed and implemented for Operations continuing training. "ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training" certification of simulator fidelity is considered to be sufficient for the initial stages of the BDB external event scenario training. Full scope simulator models have not been explicitly upgraded to accommodate FLEX training or drills. Overview training on FLEX Phase 3 and associated equipment from the SAFER NSRCs was also provided to Fermi 2 Operators. Upon SAFER equipment deployment and connection in an event, turnover and familiarization briefings on each piece of SAFER equipment will be provided to station operators by the SAFER deployment/operating staff.

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 or operate permanently installed equipment during these drills.

2.17.5 Equipment List

The equipment stored and maintained at the Fermi 2 FLEX Storage Facilities necessary for the implementation of the FLEX strategies in response to a BDB external event at Fermi 2 is listed in Table 3. Table 3 identifies the quantity and capacity/rating for the major FLEX equipment components only. Details regarding fittings, tools, hose and cable lengths, consumable supplies, etc. are not in Table 3.

Fermi 2 has provided spare cabling and hose of sufficient length and sizing to replace the single longest run needed to support any single FLEX strategy. This conforms to NRC guidance provided on this topic in Reference 38.

FLEX FINAL INTEGRATED PLAN

2.17.6 Equipment Maintenance and Testing

Conduct Manual MES51 defines the Fermi 2 Preventive Maintenance (PM) program which includes the FLEX-related components. The technical requirements for the FLEX component PM activities are based on input from Electric Power Research Institute (EPRI) templates, vendor recommendations and industry practices. PM technical requirements include the maintenance, inspection and testing activities and frequencies appropriate for the specific piece of equipment to maintain system readiness

EPRI has completed and has issued "Preventive Maintenance Basis for FLEX Equipment – Project Overview Report" (Report 3002000623). 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 inspections of stand-by equipment
- 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. Fermi 2 used the EPRI templates as an input for the development of FLEX maintenance and testing programs. In those cases where EPRI templates were not available, Preventative Maintenance (PM) actions were developed based on manufacturer provided information/ recommendations.

Additionally, the Emergency Response Organization (ERO) performs periodic facility readiness checks for equipment that is outside the jurisdiction of the normal PM program and considered a functional aspect of the specific facility (EP communications equipment such as UPS, radios, batteries, battery chargers, satellite phones, etc.). These facility functional readiness checks provide assurance that the EP communications equipment outside the jurisdiction of the PM Program is being properly maintained and tested.

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The unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy for core, containment, and SFP will be managed such that risk to mitigating strategy capability is minimized. Maintenance/risk guidance conforms to the guidance of NEI 12-06 as follows:

- Portable FLEX equipment may be unavailable for 90 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., repair equipment, use of alternate suitable equipment or supplemental personnel) within 72 hours.

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Table 3 – On-site FLEX Equipment

Flex Storage Facility 1:

N/N+1 Equipment:

1. Two (2) 550 KW Diesel Generator on trailer, trailer includes:
    a. 550 KW Diesel Generator.
    b. 600 gallon diesel fuel oil tank (built-in).
2. Two (2) Dominator Pump Trailers, each trailer includes:
    a. Dominator Pump.
    b. 230 gallon built in fuel tank.
3. Two (2) Diesel driven air compressors to supply 100 psi.

Support Equipment:

1. One FLEX truck [Ford 550 4x4] with plow, winch, tow hitch, with hose reel and hose.
2. FLEX water distribution manifold.
3. Spare Hose Lay.
4. One portable fuel tank with self-powered transfer equipment.
5. One 60kW diesel generator.
6. One FLEX Bulldozer equipped for debris removal.
7. One electric Trailer Caddie [for relocating DG & Pumps].
8. Two light towers.
9. Portable berms [environmental protection] for testing.
10 Red Devil Fans.
11. Hoses.
12. Cables.
13. Assorted tools.

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Flex Storage Facility 2:

N/N+1 Equipment:

1. Two (2) Neptune Pump Trailers, trailers include:
    a. Hydraulic Diesel Powered Floating Lift Pump
    b. Diesel Powered Booster pump
    c. 150 gallon built in fuel tank for both Lift Pump & Booster Pump

Support Equipment:

1. Two Duplex Strainer Sets.
2. One FLEX truck [Ford 550 4x4] with plow, winch, tow hitch, with hose reel and hose.
3. One (1) 60kW diesel generator.
4. One portable fuel tank with self-powered transfer equipment.
5. One electric Cart Caddie [for relocating DG & Pumps].
6. One light tower.
7. Portable berms [environmental protection] for testing.
8. MRE's drinking water, comfort supplies.
9. Hoses.
10. Cables.
11. Assorted tools.

Table 4 - List of Phase 3 Generic Equipment Delivered by NSRC

Equipment	Performance Characteristics	
Medium Voltage Generator	4160 V	1 MW
Low Voltage Generator	480 V	1100 kW
Cable / Electrical	Various	Various
High Pressure Injection Pump	2000 psi	60 gpm
SG/RPV Makeup Pump	500 psi	500 gpm
Low Pressure / Medium Flow Pump	300 psi	2500 gpm
Low Pressure / High Flow Pump	150 psi	5000 gpm
Hose / Mechanical Connections	Various	Various
Lighting Towers	440,000 lumens	(minimum)
Diesel Fuel Transfer	500 gallon air-lift container	
Diesel Fuel Transfer Tank	264 gallon tank, with mounted AC/DC pumps	
Portable Fuel Transfer Pump	60 gpm after filtration	
Electrical Distribution System	4160 V, 250 MVA, 1200 A	
SAFER Support Equipment	As defined in the SAFER Response Plan	

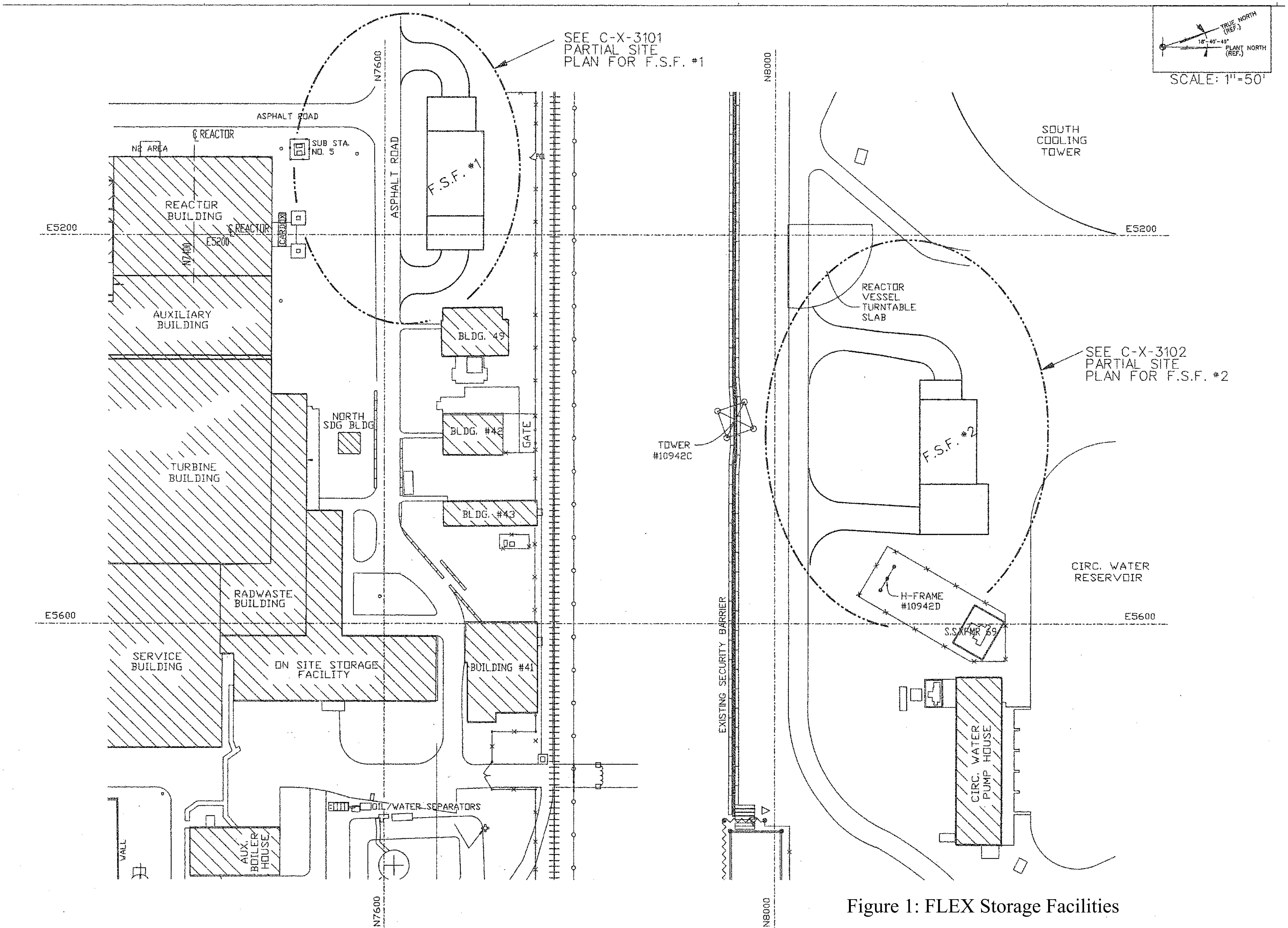


Figure 1: FLEX Storage Facilities

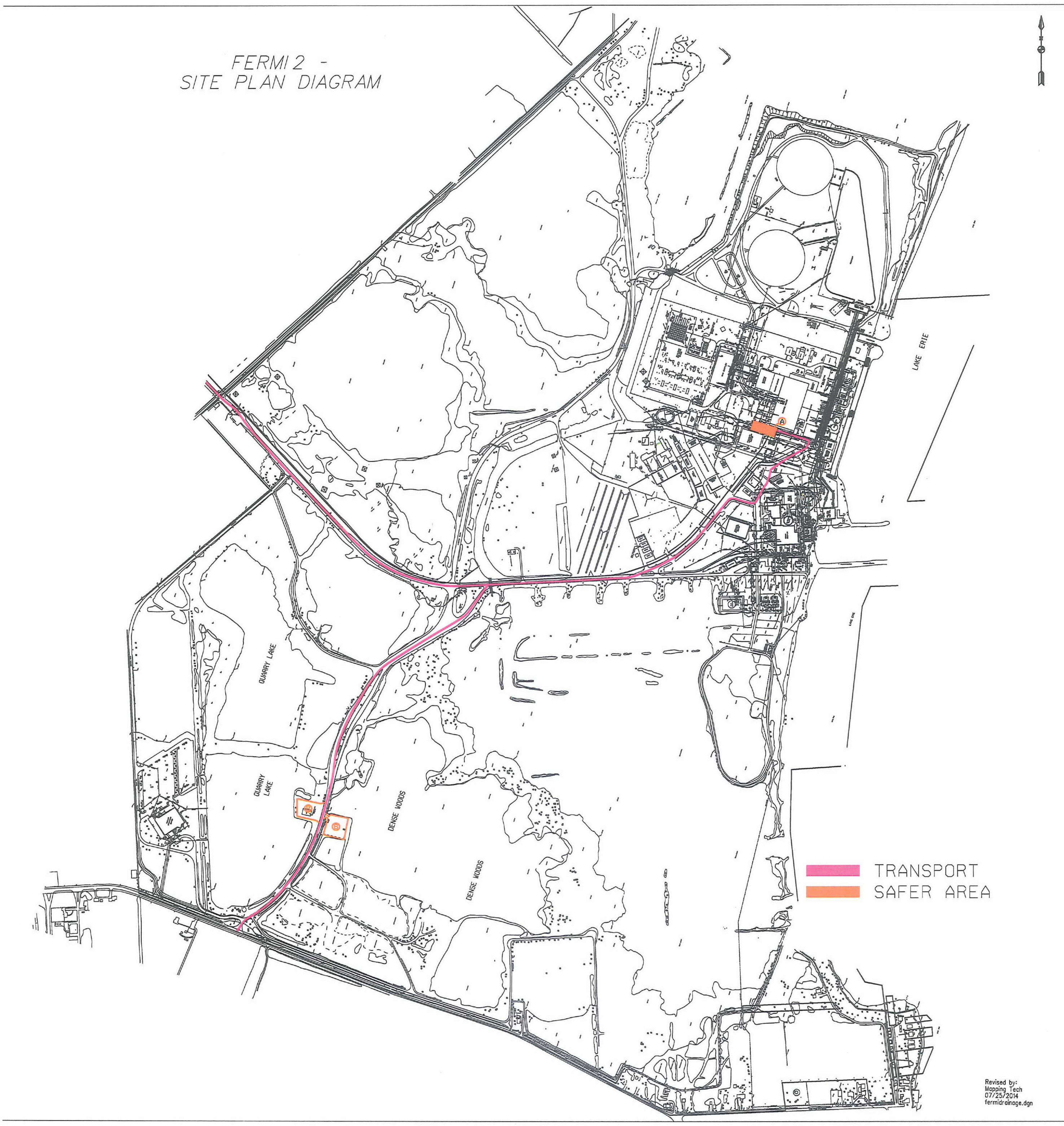


Figure 2: FLEX Deployment Paths (Outside Protected Area)

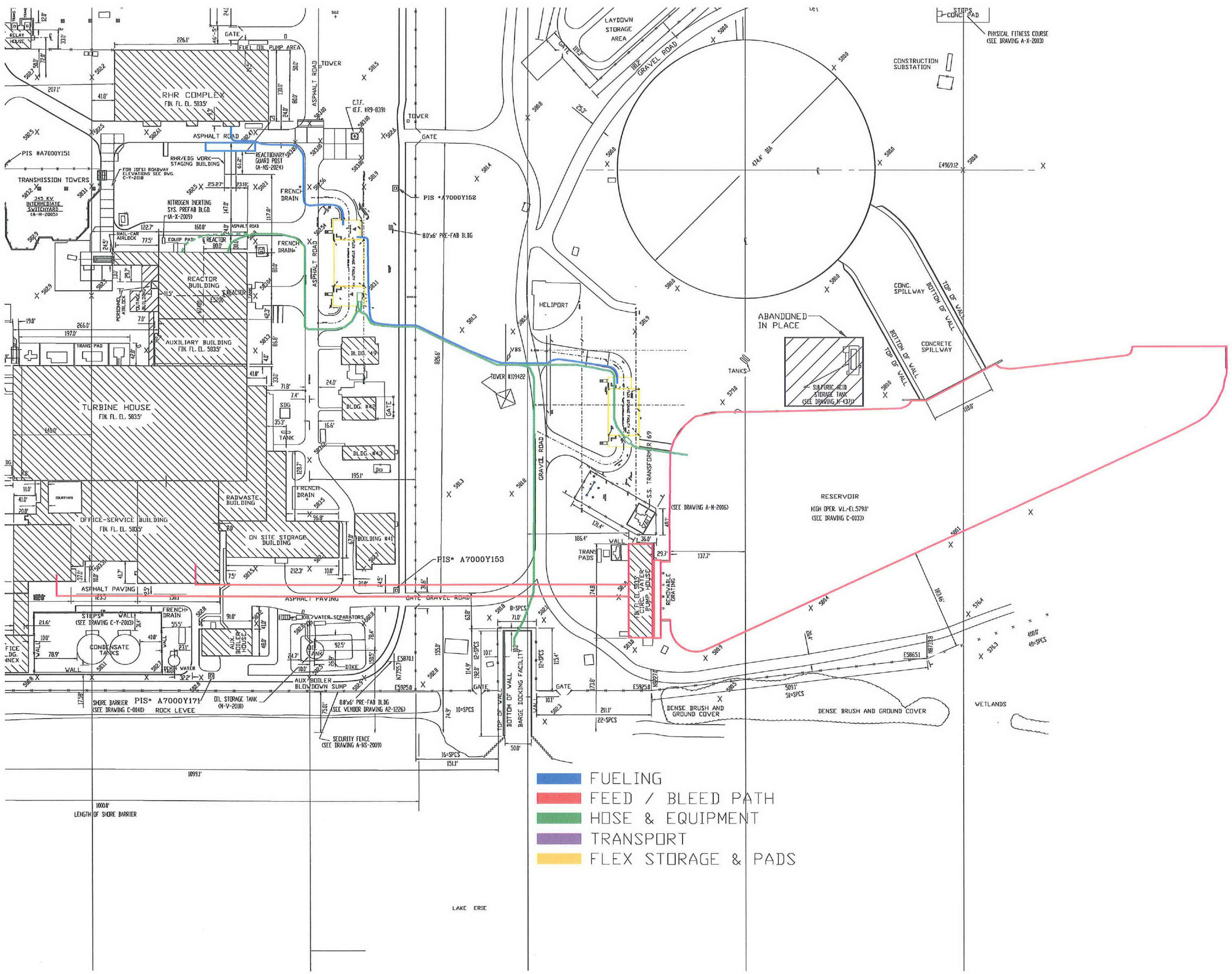


Figure 3: FLEX Deployment Paths (Inside Protected Area)

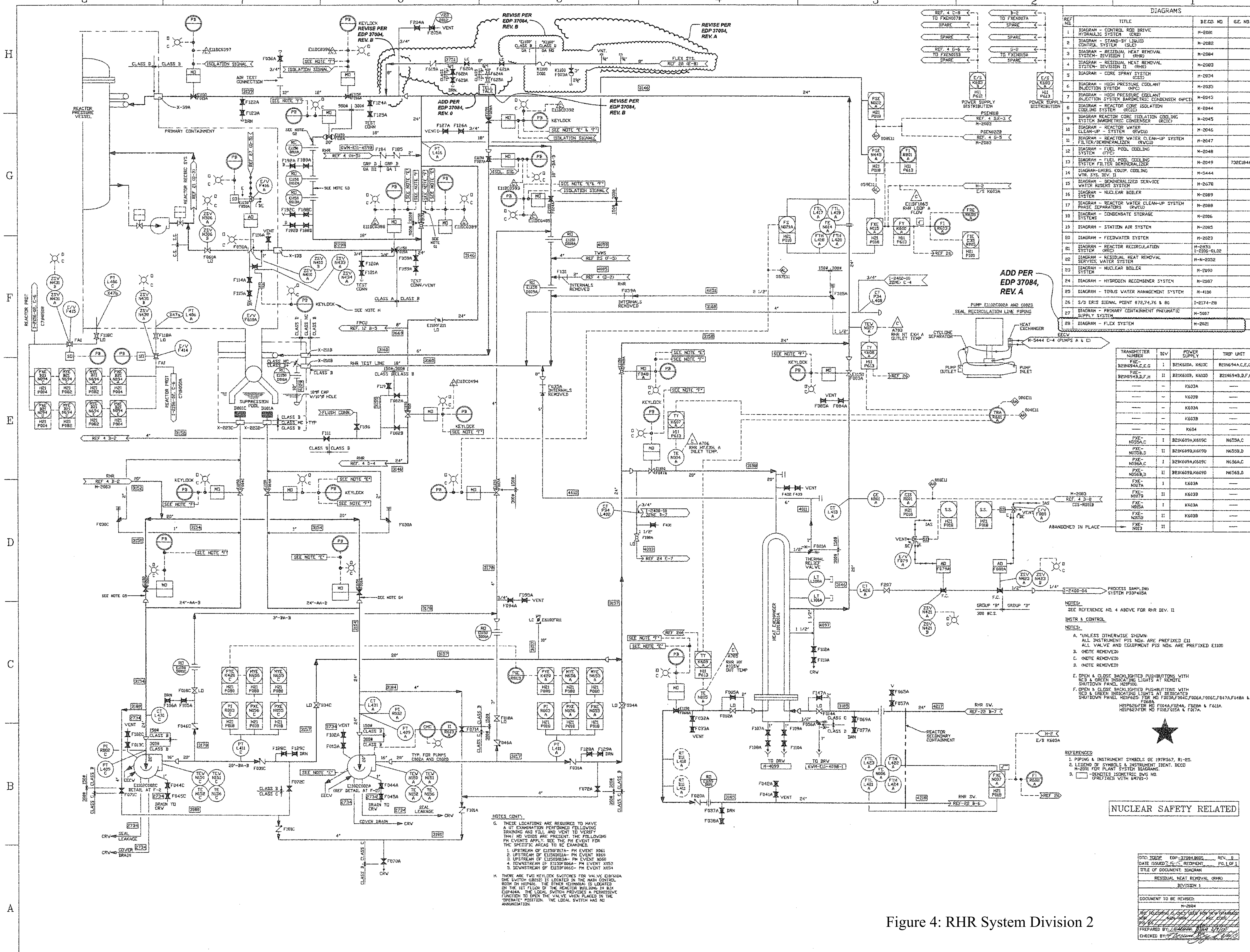


Figure 4: RHR System Division 2

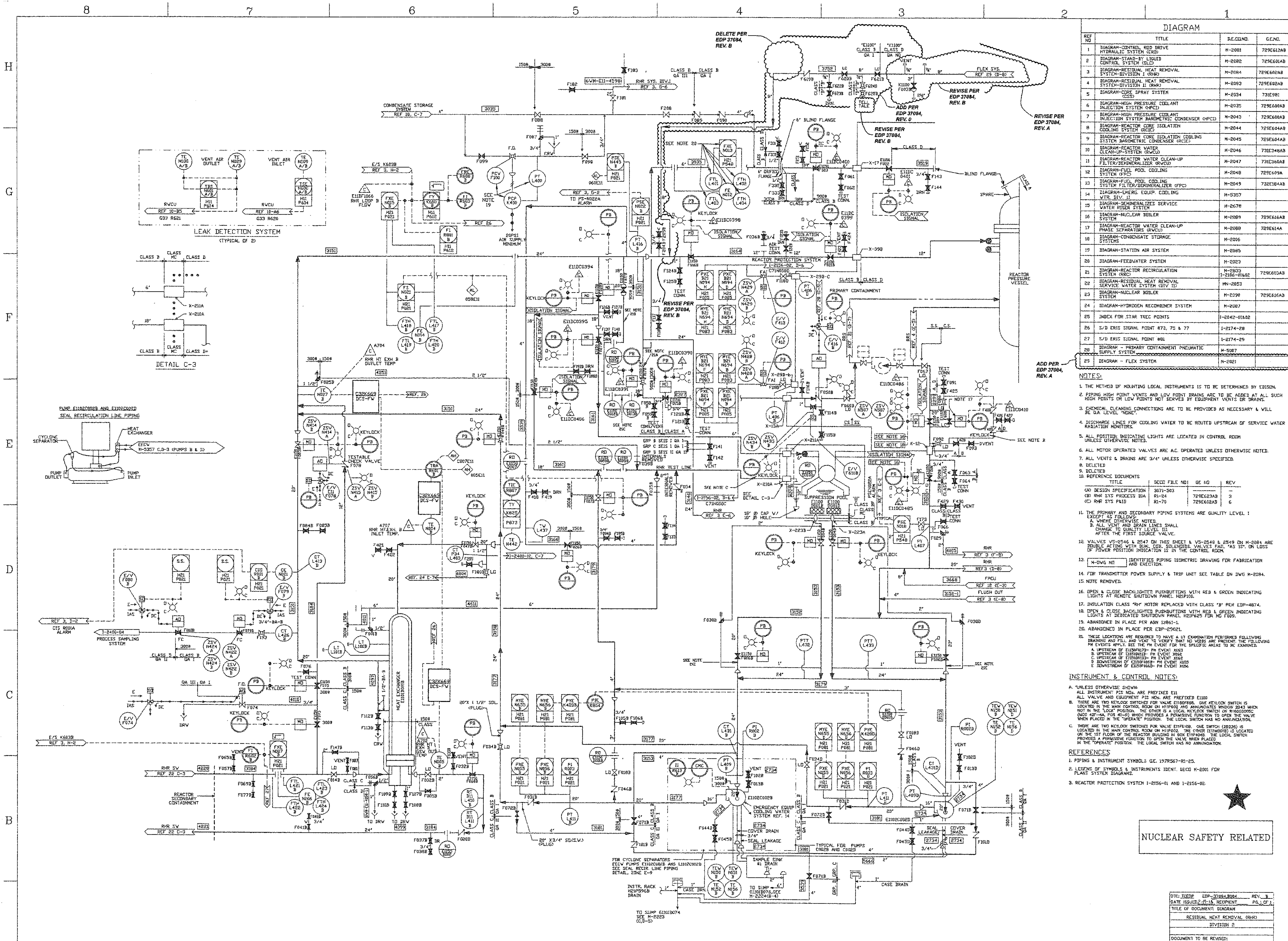


Figure 5: RHR System Division 1

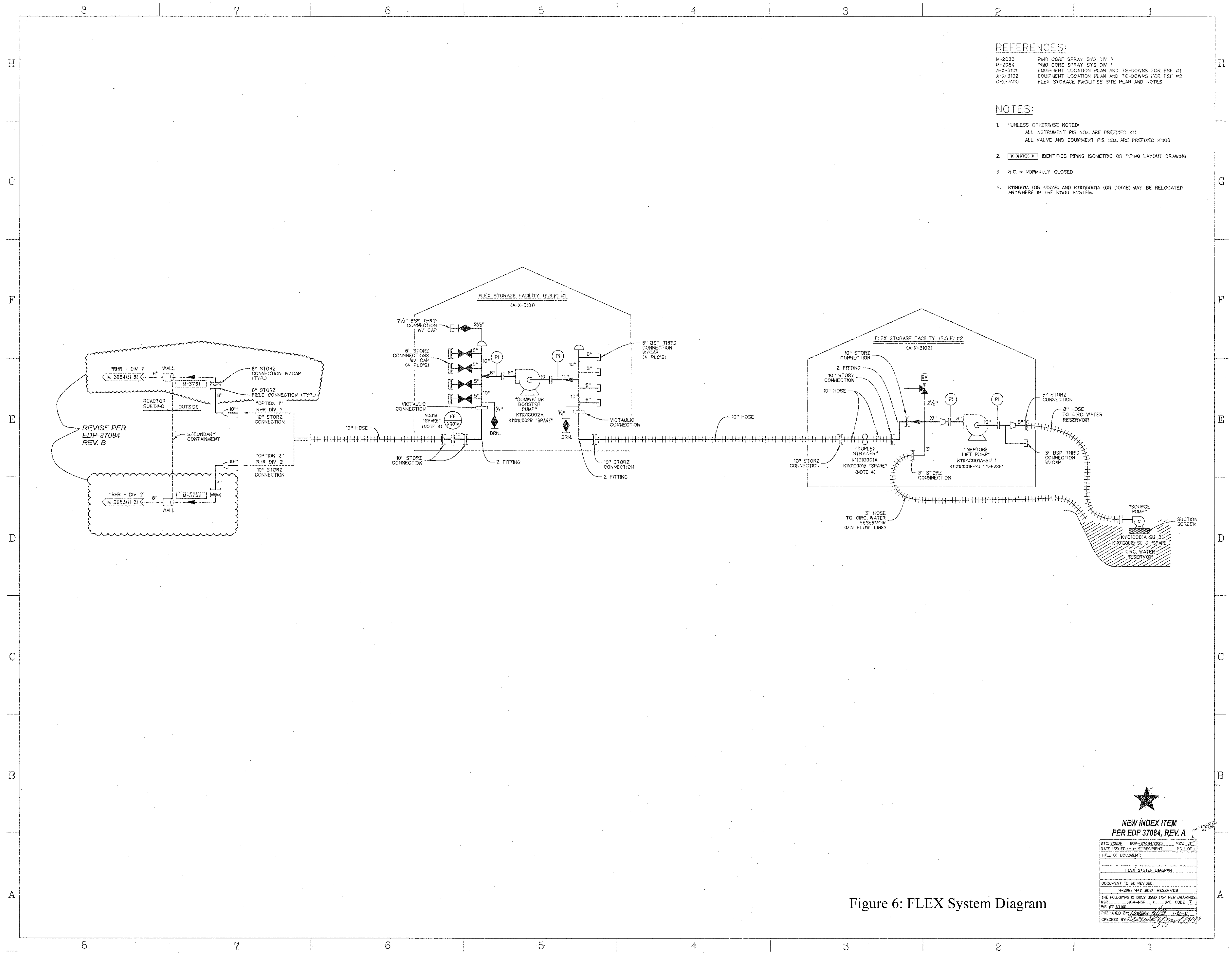
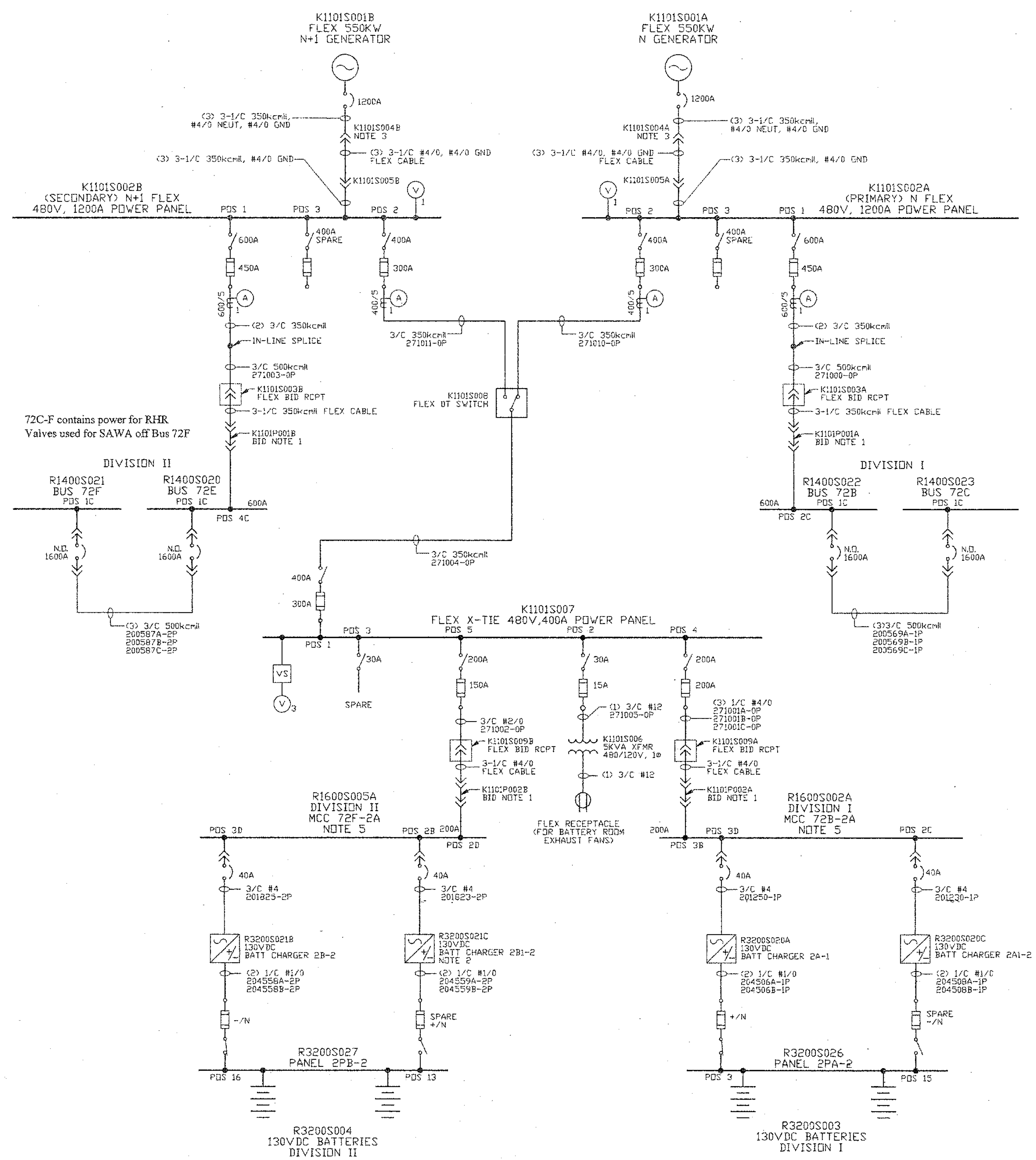


Figure 6: FLEX System Diagram

EDP 37122 FLEX AC ONE LINE DIAGRAM



NOTES:

1. BREAKER INSERT DEVICES (BID) ARE NOT INSTALLED AND FLEX CABLES NOT CONNECTED DURING NORMAL OPERATION.
2. SPARE CHARGER 2B1-2 LEFT IN +/N CONFIGURATION AFTER MAINTENANCE.
3. FLEX CONNECTION ENCLOSURE MOUNTED ON GENERATOR TRAILER.
4. ONLY SELECT BREAKERS FROM R1400S020, S21, S22 AND S23 ARE SHOWN. SEE SD-2510-01 FOR ALL BREAKERS.
5. ONLY SELECT LOADS FROM R1600S002A AND R1600S005A ARE SHOWN. SEE SD-2S12-20 AND SD-2S12-22, RESPECTIVELY, FOR ALL LOADS.

SYMBOLS & ABBREVIATIONS

BID	BREAKER INSERT DEVICE
N.O.	NORMALLY OPEN
(A)	ANALOG AMMETER MTD IN SEPARATE ENCLOSURE
(V)1	ANALOG VOLTMETER MTD IN SEPARATE ENCLOSURE 1Φ (PH X-Y) METERING
(V)3	ANALOG VOLTMETER MTD IN SEPARATE ENCLOSURE 3Φ, 480V METERING
VS	VOLTMETER SELECTOR SWITCH
600/5	CURRENT TRANSFORMER W/STATED RATIO MTD INSIDE POWER PANEL METERING PHASE Y
	FEMALE CONNECTOR
	MALE CONNECTOR
	BREAKER INSERT DEVICE (BID) NOTE 1
	BATTERY CHARGER

REFERENCE DRAWINGS:

SD-2510-01	ONE LINE DIAGRAM 480V E.S.S. BUS
SD-2512-20	FRONTAL ELEVATION 480V MCC 72B-2A
SD-2512-22	FRONTAL ELEVATION 480V MCC 72F-2A
SD-2530-10	ONE LINE DIAGRAM 260/130V E.S.S. 2PA
SD-2530-11	ONE LINE DIAGRAM 260/130V E.S.S. 2PB
SD-2500-14	FLEX PHASE 2 AC MODIFICATION CONNECTING BDBBE ELECTRICAL SUPPLY OPERATORS ACTIONS
SD-2500-15	FLEX WIRING DIAGRAM

TCECR-37122-7 REV. 0 ECR PAGE NO.
INDEX ITEM NO. A028 REV. 0 INDEX PAGE NO.
PREPARED BY:
CHECKED BY:

TITLE OF DOCUMENT: FLEX ONE-LINE DIAGRAM
SD-2500-13 HAS BEEN RESERVED

Figure 7: FLEX Electrical

FLEX FINAL INTEGRATED PLAN

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