Entergy

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John A. Dent Jr.
Site Vice President

July 17, 2015

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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SUBJECT: Pilgrim Nuclear Power Station's Notification of Full Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, Submittal of Final Integrated Plan, Responses to NRC Interim Staff Evaluation Open & Confirmatory Items, and Responses to FLEX/ SFPI Audit Report Items

Pilgrim Nuclear Power Station
Docket No. 50-293
License No. DPR-35

PNPS Letter 2.15.050

REFERENCES:
1. NRC Order Number EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012 (ML 12054A736).
2. NRC Order Number EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012 (ML12054A682).
3. Entergy letter to NRC (PNPS Letter 2.13.012), 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 (ML13063A063)
4. NRC Letter Regarding Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0777), December 16, 2013 (PNPS Letter 1.13.067)
5. NRC Letter Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0777 and MF0778), January 26, 2015 (PNPS Letter 1.15.003)

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NRR

Dear Sir or Madam:

The purpose of this letter is to notify the NRC that Pilgrim Nuclear Power Station (PNPS) is in compliance with Order EA-12-049. On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued Orders EA-12-049 (Reference 1) and Order EA-12-051 (Reference 2) to Entergy Nuclear Operations Inc. (Entergy). Reference 1 was immediately effective and directs Entergy 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.

Reference 2 was immediately effective and directed Entergy to install reliable spent fuel pool level instrumentation. The notification of full compliance with Order EA-12-051 was submitted under separate cover via PNPS Letter No. 2.15.051 since no Final Integrated Plan (FIP) is required for the SFPI Order.

Order EA-12-049, Section IV.A.2 requires completion of full implementation to be no later than two refueling cycles after submittal of the Overall Integrated Plan (OIP), as required by Condition C.1.a, or December 31, 2016, whichever comes first. In addition, Section IV.C.3 of Order EA-12-049 requires that Licensees and CP holders report to the NRC when full compliance is achieved. The OIP for EA-12-049 was submitted (Reference 3) on February 28, 2013. On May 20, 2015, PNPS entered Mode 2 (startup) following refueling outage 20 which was two refuel cycles after submittal of the OIPs. Full compliance with Order EA-12-049 was achieved at that time.

Attachment 1 provides a summary of compliance bases with responses to NRC Interim Staff Evaluation Open & Confirmatory Items (Reference 4) and FLEX/ SFPI Audit Report Items (Reference 5) associated with compliance to Order EA-12-049. A listing of each item that has not been docketed as closed by the NRC from the Open and Confirmatory Items identified in the Interim Staff Evaluation (Reference 4), Open Items in the OIP (Reference 3), and FLEX/ SFPI Audit Report Items (Reference 5) is provided which references the responses.

Attachment 2 contains the required Final Integrated Plan (FIP) Document. The FIP provides the strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event for PNPS.

The responses and FIP are based on information and analyses that have been completed as of the date of full compliance. As such, Energy considers these items complete pending NRC closure.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Mr. Everett (Chip) Perkins Jr., Manager, Regulatory Assurance at (508) 830-8323.

I declare under penalty of perjury that the foregoing is true and correct; executed on July 27, 2015.

Sincerely,

John A. Dent Jr.
Site Vice President

JAD/rmb

Attachments:

1] Pilgrim Nuclear Power Station Summary of Compliance Bases in Response to Order EA-12-049 & Responses to NRC FLEX Interim Staff Evaluation Open & Confirmatory Items & FLEX/ SFPI Audit Report Items
2] Pilgrim Nuclear Power Station Final Integrated Plan for Order EA-12-049, Order Modifying Licenses With Regard To Requirements For Mitigation Strategies For Beyond-Design-Basis External Events

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ATTACHMENT 1
TO PNPS Letter 2.15.050

PILGRIM NUCLEAR POWER STATION

SUMMARY OF COMPLIANCE BASES IN RESPONSE TO ORDER EA-12-049 AND RESPONSES TO NRC FLEX INTERIM STAFF EVALUATION OPEN & CONFIRMATORY ITEMS AND FLEX/ SFPI AUDIT REPORT ITEMS

PILGRIM NUCLEAR POWER STATION (PNPS) SUMMARY OF COMPLIANCE BASES IN RESPONSE TO ORDER EA-12-049

Attachment 1 provides a brief summary of the key elements associated with compliance to Order EA-12-049 for PNPS. A listing of each item that has not been docketed as closed by the NRC from the Open and Confirmatory Items identified in the Interim Staff Evaluation, Open items in the OIP, and Audit questions and open items is provided which references the responses. The responses are based on information and analyses that have been completed as of the date of full compliance. As such, Entergy considers these items complete pending NRC closure.

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," to Entergy. This Order was effective immediately and Entergy Nuclear Operations, Inc. (Entergy) developed an Overall Integrated Plan (OIP) for Pilgrim Nuclear Power Station (PNPS, documenting the diverse and flexible strategies (FLEX) required. The Order required compliance prior to plant startup from the second refueling outage following submittal of the OIP, or by December 31, 2016, whichever comes first. The compliance date for PNPS was May 20, 2015. The NRC staff requested that the compliance report be submitted within 60 days of the compliance date. The information provided herein documents full compliance for PNPS in response to the Order.

Milestone Schedule - Items Complete

The following milestone(s) have been completed as of May 20, 2015:

Milestone	Target Completion Date*	Activity Status
Submit Overall Integrated Implementation Plan	Feb 2013	Completed
Submit Six Month Updates		
Update 1	Aug 2013	Completed
Update 2	Feb 2014	Completed
Update 3	Aug 2014	Completed
Update 4	Feb 2015	Completed
Perform Staffing Analysis	Nov 2014	Completed
Procedures		
Procedure Changes Training Material Complete	Jan 2014	Completed
Implement Training and Validation / Demonstration	March 2015	Completed
Submit Completion Report	July 2015	Completed
Modifications		
Engineering Complete and Approved for Implementation	Feb 2014	Completed
Modification Implementation Complete	May 2015	Completed

Milestone	Target Completion Date*	Activity Status
On-site FLEX Equipment		
Purchase / Procure	Jan 2015	Completed
Procedures		
Create Pilgrim FSGs	Oct 2014	Completed
Pilgrim FSGs Issued	May 2015	Completed
Create Maintenance Procedures	March 2015	Completed
Training:		
Develop Training Plan	March 2014	Completed
Implement Training	March 2015	Completed

* - Target Completion Date is the last submitted date from either the overall integrated plan or previous Six-month status reports

STRATEGIES – COMPLETE

Pilgrim strategies are in compliance with Order EA-12-049. There are no strategy related Open Items, Confirmatory Items, or Audit Questions/Audit Report Open Items. Although there are items not reviewed by the NRC Staff, Entergy considers these items to be closed.

MODIFICATIONS – COMPLETE

The modifications required to support the FLEX strategies for Pilgrim have been fully implemented in accordance with the station design control process.

EQUIPMENT – PROCURED AND MAINTENANCE & TESTING – COMPLETE

The equipment required to implement the FLEX strategies for Pilgrim has been procured in accordance with NEI 12-06, Section 11.1 and 11.2, received at PNPS, initially tested/ performance verified as identified in NEI 12-06, Section 11.5, and is available for use.

Maintenance and testing will be conducted through the use of the Preventative Maintenance program such that equipment reliability is achieved.

PROTECTED STORAGE – COMPLETE

The storage facility/facilities required to implement the FLEX strategies for Pilgrim has been completed and provides protection from the applicable site hazards. The equipment required to implement the FLEX strategies for Pilgrim is stored in its protected configuration.

PROCEDURES – COMPLETE

FLEX Support Guidelines (FSGs), for Pilgrim have been developed, and integrated with existing procedures. The FSGs and affected existing procedures have been validated per NEI12-06, Section 11.4.3 and are available for use in accordance with the site procedure control program.

TRAINING – COMPLETE

Training for Pilgrim has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6.

STAFFING – COMPLETE

The staffing study for Pilgrim has been completed in accordance with 10CFR50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012 (Ref, as documented in letter dated November 21, 2014 which submitted the Phase 2 Staffing Assessment and updated to Revision 1 on July 17, 2015.

NATIONAL SAFER RESPONSE CENTERS – COMPLETE

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

VALIDATION – COMPLETE

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

FLEX PROGRAM DOCUMENT – ESTABLISHED

The Pilgrim FLEX Program Document; SEP-FLEX-PNP-001 has been developed and issued in accordance with the requirements of NEI 12-06.

Open Items from Overall Integrated Plan and Interim Staff Evaluation

The following summary type of answers provide an updated status of any open items documented in the Overall Integrated Plan and any open items or confirmatory items documented in the Interim Staff Evaluation (ISE). Additionally included are the FLEX related NRC Audit Visit Open Items, which includes open items on previously issued Audit Questions and new Safety Evaluation (SE) Open Items that were not closed during the October 2014 NRC Audit Visit as documented in the NRCs Report for the Onsite Audit

Responses to NRC FLEX Interim Staff Evaluation Open & Confirmatory Items And FLEX/ SFPI Audit Report Items

OPEN ITEMS:

Item Number 3.2.1.4.A (12A)

On pages 16, 23, and 63 of the Integrated Plan regarding Portable Equipment to Maintain Core Cooling, the licensee describes the use of portable pumps to provide RPV injection. No technical basis or a supporting analysis was provided for the diesel-driven FLEX pump capabilities considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of hoses runs, connecting fittings, and elevation changes to show that the pump is capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths.

PNPS Response:

Calculation M1384 Rev 0 "Pilgrim FLEX Hydraulic Analysis" has been issued and has been placed on the ePortal site. This calculation performs a hydraulic analysis of the FLEX design modifications to be installed at Pilgrim. The analysis includes the FLEX Phase 2 and Phase 3 water injection configurations during the FLEX core cooling strategy. The Phase 2 core cooling strategy consists of using two portable FLEX pumps in series to inject seawater through a connection to the Reactor Core Isolation Cooling (RCIC) Condensate Storage Tank (CST) suction line into the RPV. The Phase 3 core cooling strategy is similar to Phase 2, but uses a FRAC or bladder tank for a suction source and additionally adds a mobile demineralizer to the water source. Additional analysis is performed in M1384 to show that RCIC suction line relief valve PSV 1301-31, which is set to 230 psig, will not open during FLEX operation. The Calculation uses classical hydraulic analysis head loss and pressure gradient methods and includes all pumps, valves, hoses, strainers, elevations, and line distances and is the design basis for the FLEX Strategy water supply using the most limiting set of conditions, which is the use of the raw seawater source.

CONFIRMATORY ITEMS:

Item Number 3.1.1.1.A (1A)

The Integrated Plan does not specify procedures and programs will provide for securing large portable equipment to protect them during a seismic event or to ensure unsecured and/or non-seismic components do not damage the equipment as is specified in NEI 12-06, Section 5.3.1, considerations 2 and 3.

PNPS Response:

The FLEX Portable Equipment is stored in a manner that withstands seismic events. The equipment that is in Sea-Land Containers (ISO Cargo Containers) was analyzed and secured in accordance with Calculation C15.0.3661 "Evaluation of FLEX Storage Containers for Seismic Loads" to ensure that the equipment will not displace or dislodge from seismic motion within the limited confined space of these containers that inherently limit movement. Equipment that is pre-staged within the plant is in low profile Job-Boxes that are secured as-needed. Very large mobile equipment, such as the pre-staged 150 kW Generator in the Turbine Building Trucklock and the Debris Removal Wheel Loader, have been chocked in-place and situated to preclude potential effects from the movement or damage of surrounding structures or debris sources.

Item Number 3.1.1.2.A (2A)

The licensee identified that at least one connection point for the equipment will require access through routes that are not FSAR Seismic Class I, however they have been evaluated, and the potential for large scale debris that would prevent access to the equipment needed to be repowered is not present. Their evaluation should be validated during the site audit.

PNPS Response:

The Battery Chargers for 125VDC A / B, 250V, and the 120VAC Panels Y3 / Y4 connections are in FSAR Seismic Class I structures. Access to these areas is through four distinct and separate routes; the Turbine Building, the Radwaste Building, the Maintenance Shop, and the Engineering Support Building. The first two routes are preferred and they include seismically rugged structures. The latter two are less seismically rugged, they are spatially diverse, and provide additional alternative pathways should the Beyond Design Basis External Event (BDBEE) not be of seismic origin. The routing was walked down during NRC Region I site visit, April 2014. The alternate routings are described in FLEX Support Guidelines (FSGs).

Item Number 3.1.1.3.A (3A)

The licensee was requested to provide additional information concerning coping strategies for the failure of seismically qualified electrical equipment that can be affected by beyond-design-basis seismic events as discussed in NEI 12-06, Section 5.3.3 consideration 1.

PNPS Response:

NEI 12-06 identified that even seismically qualified equipment can fail in a BDBEE event. Section 5.3.3 - consideration #1 recommends procedural guidance should be provided to operations crews in such an event. Pilgrim is BWR ¾, Mark I, and as such has permanently mounted, or immediately available, process system connections that would allow operators to adjudge critical reactor pressure vessel and drywell parameters. Pilgrim provides that information in the form of an attachment to its Station Blackout Procedure 5.3.31 along with directions to enter FLEX Support Guideline (FSG) Procedure 5.9.1, "Extended Loss of AC Power (ELAP)", which is a flowchart that refers to all the other FSGs.

Item Number 3.1.3.1.A (4A)

The storage of the FLEX equipment is in sea vans. The licensee is in the process of performing a calculation to demonstrate conformance with NEI 12-06, Section 7.3.1.b, bullet 4 related to adequate tie down of the sea vans. Evaluation of the completed calculation must be completed to determine if it demonstrates conformance to guidance in NEI 12-06, Section 7.3.1.b, bullet 4.

PNPS Response:

PNPS Calculation C15.0.3642 performs the wind-loading analysis of the FLEX Storage Sea-Land Container storage configuration. The containers were evaluated for a sustained wind speed of 105 mph based on hurricane wind loading, and further evaluated for beyond design basis wind speeds up to 180 mph. The close grouping and alignment of storage containers is such that individual tie-downs are not required. The potential for more damaging tornado conditions is addressed by having two widely separated redundant FLEX storage sites. Calculation C15.0.3642 has been placed on the ePortal site.

The tie down of equipment within the FLEX Sea-Land Containers was evaluated per Calculation C15.0.3661 and equipment has been secured accordingly.

Item Number 3.1.3.2.A (5A)

During the audit process, the licensee identified that there are existing plant procedures that address hurricanes. The procedures need to be evaluated for conformance to NEI 12-06, considerations 1, 2, and 5.

PNPS Response:

A list of procedures related to hurricane response is provided below. These procedures have been updated with changes required for FLEX and conformance with the guidance provided in NEI 12-06 Sections 7.3.2, considerations which apply to the deployment of FLEX equipment for high wind hazards, and the Section 11.4 procedural approach for the implementation of FLEX strategies.

- 2.1.37 Coastal Storm - Preparations and Actions
- 2.1.42 Operation During Severe Weather
- 2.4.154 Intake Structure Fouling, no revision needed
- 5.2.2 High Winds (Hurricane)
- 5.2.3 Tornado, no revision needed
- 5.3.31 Station Blackout
- 5.3.36 Extensive Damage Mitigation Guidelines (EDMG) Support Procedures and Strategies

Item Number 3.2.1.1.A (6A)

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

PNPS Response:

The topic of MAAP4 Code benchmarking for the program's use in support of Post-Fukushima applications is discussed in detail in Section 5 of EPRI Report 3002001785, which includes MELCOR Code result comparisons as well as direct result comparisons to actual plant pressure & temperature data from Fukushima Dai-ichi Units 1, 2, and 3. The EPRI report concludes that the MAAP4 code is acceptable for use in support of the industry response to Order EA-12-049.

Item Number 3.2.1.1.B (7A)

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

PNPS Response:

The MAAP4 analysis performed in support of the PNPS Integrated Plan is documented in Calculation ENTGPG012-CALC-001, Rev 1 and is available on the ePortal. Case 1 was the specific MAAP4 run selected to represent the scenario as described in Pilgrim's FLEX Strategy. The Pilgrim FLEX Strategy is based on operators commencing a cooldown of the RPV at 6 hours in accordance with existing EOP Heat Capacity Temperature Limit Curves over a three hour period until a vessel pressure of approximately 120 psig is reached, followed by a final depressurization to allow FLEX low pressure injection. The Pilgrim Technical Specifications limit is 100 degF/hr. averaged over a period of one hour. The resulting plot of the RPV pressure from the MAAP4 analysis confirms this cooldown rate and the collapsed RPV water level remains over 2.5 ft above TAF at its lowest point at the end of RCIC operation and depressurization, which is followed by RPV flooding.

Item Number 3.2.1.1.C (8A)

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.

PNPS Response:

This item reference is to EPRI Report 3002001785 June 2013 Section 4 "Assuring Quality of MAAP4 Analyses", which has the Software Quality Assurance, Training, and Certification requirements for installing, testing, and running the MAAP software. These items are specifically addressed in Attachment 1 to Calculation ENTGPG012-CALC-001, Rev 1 that is available on the ePortal. Proper installation of the MAAP4 code was verified and the Pilgrim MAAP 4.0.5 parameter file, which is based on the Probabilistic Risk Assessment (PRA) model, was tested to validate the overall performance of the systems and containment (steady-state run).

Item Number 3.2.1.1.D (9A)

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.

PNPS Response:

These items are specifically addressed in Attachment 1 to Calculation ENTGPG012-CALC-001, Rev 1 that is available on the ePortal. The reactor vessel & containment nodalization followed standard schemes that are described. The MAAP4 Code is readily capable of analyzing the two-phase flow conditions from the RPV, and validations were performed for the key parameters that are checked for these two-phase level and flow conditions. Modeling of heat transfer and losses from the RPV, decay heat, and the plant-specific inputs are also described and followed standard practices.

Item Number 3.2.1.1.E (10A)

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 on the ePortal for NRC staff to view. 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 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.

PNPS Response:

These items are all included in the Calculation ENTGPG012-CALC-001, Rev 1 and is available on the ePortal. Case 1 is the specific MAAP4 run that represents the scenario as described in Pilgrim's FLEX Strategy. The requested plots are included as well as plots for RCIC Flow, Suppression Pool Water Level, Pressure, & Temperature; FLEX Pump Flow, Reactor Water Level, Pressure, Gas & Core Temperature, SRV Flow, and Drywell Pressure & Temperature.

The plots demonstrate that reactor water level remains over 2.5 ft above TAF at its lowest point at the end of RCIC operation and depressurization, and that the initial depressurization from 6 hours to 9 hours results in a cooldown that is within the 100 degF/hour (Tech Spec limit). The MAAP4 results are more favorable and provide validation for the simplified heat balance calculations that are the basis for the FLEX Strategy timeline, which are included in PNPS FLEX Calculation M1380 "FLEX Strategy Thermal-Hydraulic Analysis" that has been placed on the ePortal.

Item Number 3.2.1.2.A (11A)

The following is requested:
1. Justification for the assumptions made regarding primary system leakage from the recirculation pump seals and other sources.
2. Assumed pressure-dependence of the leakage rate.
3. Clarification on 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.

PNPS Response:

Recirculation Pump P-201A/B seal leakage is assigned a value of 16 gpm at 75 psig for the purpose of evaluating FLEX makeup water supply requirements. The MAAP4 analysis assumed an initial primary system leakage of 25 gpm at normal operating pressure based on the allowable Technical Specification 3.6 primary system leakage of 25 gpm. The primary system leakage is assumed to start at time zero and vary with reactor pressure. The RPV leakage location is set at the Reactor Recirculation (RR) Pump suction nozzle elevation ZSRR and it was iteratively determined that a leakage area (ALOCA) of 3.81E-4 ft2 would provide the assumed initial leakage of 25 gpm at normal reactor pressure. The leakage is determined using an area in order to allow variations in the leakage value depending on primary side pressure conditions. This location and conditions would result in a single-phase liquid discharge that flashes to a liquid-vapor mixture that is representative of RR Pump seal leakage. Upon exiting the RR Pump, 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 that is included in the MAAP4 Model.

Item Number 3.2.1.5.A (13A)

The integrated plan does not identify non-powered local instrumentation other than Containment pressure and RPV level and pressure. The integrated plan identifies that phase 2 equipment will have installed local instrumentation needed to operate the equipment. The licensee needs to identify the instrumentation that will be used to monitor portable FLEX electrical power equipment.

PNPS Response:

The FLEX diesel generators are equipped with an integral "Power Zone Controller" Module, which monitors all vital generator and engine functions and can display all the parameters that are relevant to the operation of an AC power generator. DC output voltage can be monitored at the battery chargers and the associated battery primary distribution panels.

Item Number 3.2.4.2.A (14A)

The licensee was requested to provide the maximum calculated MCR temperature and a detailed summary of the analysis used to determine the temperature and the procedure for control of MCR temperature. The licensee response was that existing procedure 2.4.149 addresses "Loss of MCR H&V". The procedure is symptom driven, containing temperature limits to perform actions, and it is not time driven. Pilgrim will provide the referenced "GOTHIC" evaluation. Evaluation of the "GOTHIC" analysis is needed to evaluate the MCR temperature.

PNPS Response:

PNPS Calculation M1382 Rev 0 "MCR Heatup for Extended Loss of AC Power (FLEX)" has been issued and is available on the ePortal. The analysis uses the GOTHIC Computer Code Version 7.2b (QA). At 72 hours, the Main Control Room (MCR) temperature does not exceed 110 degF. Outside temperature is assumed at the design maximum value of 102 degF. The only heatup mitigating actions assumed are that the MCR ceiling tiles are removed to enhance the heat loss through the ceiling as is directed by existing Procedure 2.4.149 "Loss Of Control Room Air Conditioning". There are no additional ventilation measures, portable fan installations, or other compensatory actions assumed to occur during the initial 72 hour period.

References:

- NRC Letter 1.13.067 Interim Staff Evaluation Relating To Overall Integrated Plan for Mitigating Strategies
- Technical Evaluation Report Related to Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, EA-12-049 Revision 1, Mega-Tech Services, December 9, 2013
- PNPS Calculation M1384 Rev 0 Pilgrim FLEX Hydraulic Analysis
- PNPS Calculation C15.0.3642 Rev 0 Evaluation Of FLEX Storage Containers For Wind Loads
- ENTGPG012-CALC-001 Rev 1 Pilgrim Containment Analysis of FLEX Strategy MAAP4
- NRC Letter Use of Modular Accident Analysis Program (MAAP), October 3, 2013, ML13275A318
- EPRI 3002001785 Use of MAAP in Support of Post-Fukushima Applications June 2013 ML13190A201
- PNPS Calculation M1380 Rev 0 PNPS FLEX Strategy Thermal-Hydraulic Analysis
- PNPS Calculation M1382 Rev 0 MCR Heatup for Extended Loss of AC Power (FLEX)

Item Number 3.2.4.4.A (15A)

During the audit process, the licensee was requested to provide details of portable lighting.

PNPS Response:

There are two FLEX storage depots. Each location contains three Scene Star, LED, tripod mounted, 110VAC, 19000 Lumen, intrinsically safe fixtures, with six 100` cord reels. Each location includes a trailer mounted Magnum Light Tower, with four 1KW light fixture, powered by an integral diesel generator. Each location also contains three 6KW diesel driven generators. In summary; there are total of six LED light fixtures, 6 diesel generators, 1200` of cord, plus two diesel powered light towers, and two pickup trucks with directionally mounted LED flood lights for area setup.

Item Number 3.2.4.4.B (16A)

The licensee provided its communications assessment in letters dated October 31, 2012 and February 21, 2013 (ML12321A051 and ML 13058A032) in response to the NRC letter dated March 12, 2012, 50.54(f) request for information letter. The NRC staff provided its evaluation on May 21, 2013 (ML13127A179). The NRC staff has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. This has been identified for confirmation that upgrades to the site's communications systems has been completed.

PNPS Response:

Enhancements performed to address gaps associated with compliance with NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," for emergency communications have been performed under Engineering Change EC47637, "FLEX Emergency Plan (EP) Communications Modifications". PNPS Letter 2.15.052, dated July 17, 2015 provides updated emergency communications information.

Item Number 3.2.4.5.A (17A)

The Integrated Plan does not identify procedures/guidance with regard to the access to the Protected Area and internal locked areas. During the audit process, the licensee identified existing security doors that provide egress capability and have key access in the event of a power loss. Operations and Security are currently researching options, the intention is to include it in the Emergency procedures addressing BDBEE perimeters, the site declaration of 50.54(x), and recognizing resource needs, including Security and compensatory measures based on the event.

PNPS Response:

Access to the Protected Area during a BDBEE is being addressed in the FLEX Support Guidelines (FSGs) and FSG Support Procedures. In particular Attachment I, of FSG-5 Initial Assessment and FLEX Equipment Staging, addresses security implementation of FLEX Strategies including suspension of the Security Plan under provisions of 10CFR50.54(x) and the use of security personnel in response to the BDBEE. Details with respect to BDBEE perimeters have been addressed in the following support procedures

- 5.9.5.2 Retrieval and Staging of Equipment
- 5.9.2.2 FLEX Low Pressure Injection - Seawater through Condensate Transfer to RPV
- 5.9.2.3 FLEX Low Pressure Injection - Seawater through Fire Water X-Tie to RHR/SSW X-Tie to RPV

Item Number 3.2.4.8.A (18A)

During the audit process, the licensee was requested to provide electrical Single Line Diagrams showing the proposed connections of Phase 2 and 3 electrical equipment to permanent plant equipment. The licensee responded that Engineering Change markup of the One-Line Diagrams E13 and E14Sh1 (EC45555 & EC45556), will be posted to the ePortal.

PNPS Response:

One line diagrams E13, E14Sh1 and E14Sh2 have been posted to the ePortal as Pilgrim's response to NRC Order EA-12-049 question 66.

Item Number 3.2.4.8.B (19A)

During the audit process, the licensee identified Engineering Changes are being developed to support the FLEX project which requires electrical studies to be performed. This includes the electrical diesel loading and load flow studies. The addition of the transfer switches and additional cable lengths are being incorporated into the Pilgrim design calculations (load flow, short circuit and coordination.) The FLEX diesel generator sizes need to be verified after the loading calculations are finalized.

PNPS Response:

Pilgrim design engineering change packages EC45555 and EC45556 have been issued and provide the electrical system design details. These ECs include FLEX diesel loading study PS262 and other electrical studies to verify that the FLEX modifications to be implemented will not adversely impact the Pilgrim existing electrical system or associated equipment. The FLEX diesel loading study PS262 demonstrates that the FLEX diesel can support the required design loads

Item Number 3.2.10.A (20A)

Attachment 1A of the Integrated Plan notes that at one hour, the ELAP decision is made and deep dc load shedding begins at one hour (item 3), and at 2 hours the dc load shed is complete (item 4). The licensee was requested to provide the direct current (dc) load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling. During the audit process, the licensee responded that the de load flow profiles are being developed as part of a new electrical battery FLEX extended operation load flow and battery sizing study PS258.

PNPS Response:

The DC flow profiles, which were developed as part of Pilgrim DC Study (PS258), have been posted in the ePortal as Pilgrim's response to NRC Order EA-12-049 question 50. The initial DC load shedding is initiated within 2 hours and will isolate (opening breakers non-essential loads supplied from DC panels within close proximity of the Control Room (Cable Spreading Room, 'A' Switchgear Room and 'B' Switchgear Room). Additional non-essential load shedding will be accomplished within 4 hours.

Item Number 3.2.10.B (21A)

The licensee was requested to provide a detailed discussion on the loads that will be shed from the DC bus, the equipment location (or location where the required action needs to be taken). During the audit process, the licensee responded by identifying that a list of loads proposed to isolate, isolation time and panel locations are available and provided in the ePortal. (Note: this list is being reviewed by Operations at this time.) The licensee needs to finalize the load-shed list after the Operations' review.

PNPS Response:

The proposed DC load shedding was posted in ePortal as part of Pilgrim's response to NRC Order EA-12-049 question 50, see response to item 3.2.4.10.B.

PNPS Procedure 5.3.31 "Station Blackout" has been revised to reference a new Procedures 5.9.1 "Extended Loss of AC Power (ELAP. Additionally, Procedures 5.9.4," DC Bus Load Shed & Repower battery Chargers and Safeguards Panels (FSG 4)" and Procedure 5.9.4.1 "DC Load Shedding" have been developed and issued.

Item Number 3.4.A (22A)

The licensee's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2 with regard to the capability to obtain equipment and commodities to sustain and back up the site's coping strategies. However, the licensee did not address considerations 2 through 10 of NEI 12-06, Section 12.2 (below).

Provisions have been made to ensure:

2) Off-site equipment procurement, maintenance, testing, calibration, storage, and control.
3) A provision to inspect and audit the contractual agreements to reasonably assure the capabilities to deploy the FLEX strategies including unannounced random inspections by the Nuclear Regulatory Commission.
4) Provisions to ensure that no single external event will preclude the capability to supply the needed resources to the plant site.
5) Provisions to ensure that the off-site capability can be maintained for the life of the plant.
6) Provisions to revise the required supplied equipment due to changes in the FLEX strategies or plant equipment or equipment obsolescence.
7) The appropriate standard mechanical and electrical connections need to be specified.
8) Provisions to ensure that the periodic maintenance, periodic maintenance schedule, testing, and calibration of off-site equipment are comparable/ consistent with that of similar on-site FLEX equipment.
9) Provisions to ensure that equipment determined to be unavailable/ nonoperational during maintenance or testing is either restored to operational status or replaced with appropriate alternative equipment within 90 days.
10) Provision to ensure that reasonable supplies of spare parts for the off-site equipment are readily available if needed. The intent of this provision is to reduce the likelihood of extended equipment maintenance (requiring in excess of 90 days for returning the equipment to operational status)

PNPS Response:

These guidelines pertain to operation of the Strategic Alliance for FLEX Emergency Response (SAFER) team, an alliance between AREVA Inc. (AREVA) and Pooled Equipment Inventory Company (PEICo) is contracted by the nuclear industry to establish and operate Regional Response Centers (RRC) to purchase, store, and deliver emergency response equipment in accordance with the SAFER FLEX Phase 3 program. The RRCs are located in Memphis, Tennessee and Phoenix, Arizona and are under contract to perform PMs, testing, calibration and maintenance in accordance with EPRI Guidelines. Five (5) sets of equipment are maintained at each RRC, with four (4) available for deployment and one (1) being tested and maintained.

Responses to Open Items From FLEX/ SFPI Audit Report

Item Number ISE O1 3.2.1.4.A (12A)

Pages 16, 23, and 63 of the Integrated Plan [NRC Order EA-12-049, dated February 28, 2013, (ADAMS Accession No. ML 13063A063)], regarding Portable Equipment to Maintain Core Cooling, Entergy describes the use of potable pumps to provide reactor pressure vessel injection. No technical basis or supporting analysis was provided for the diesel driven FLEX pump capabilities considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of hose runs, connecting fittings, and elevation changes to show that the pump is capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths.

PNPS Response:

PNPS has updated the following calculation that demonstrates that the portable pump has sufficient net positive suction head and has been uploaded to the E-Portal:

Calculation M1384 Rev 0;"Pilgrim FLEX Hydraulic Analysis" updated 12-16-2014 via ECN 54090 to EC 45558

The updated Calculation M1384 includes NPSH-Required data for the FLEX Godwin HL100M and HL110M Pumps. It is shown that with the Godwin HL100M performing the suction lift at the designated location and elevation, the two FLEX Pumps operating in tandem can deliver a peak flow of 400 GPM at the Minimum Low Tide condition at EL (-) 7.1 ft msl with the Pump Centerline at EL (+) 13.4 ft msl with the final injection pressure at the required 176.5 psig. All component & fitting losses and piping & hose frictional losses and elevation changes are included.

Item Number AQ 60 (48B)

Describe plans for supplying fuel oil to FLEX equipment (i.e., fuel oil storage tank volume, supply pathway, etc.). Also, explain how fuel quality will be assured if stored for extended periods of time.

PNPS Response:

Fuel Supply

At Pilgrim, Technical Specifications requires a minimum of 73,600 gallons of diesel fuel on-site for the Emergency Diesel Generators (EDG), with at least 19,800 gallons in each EDG Fuel Oil Storage Tank, with the remaining fuel being in the Station Blackout (SBO) Diesel Generator Fuel Oil Storage Tank. Additionally, per Calculation M1394, there are about 444 gallons in each of the two EDG Fuel Oil Day Tanks and 612 gallons in the credited equipment at the time of the event.

The EDG Fuel Oil Tanks are located underground on the north side of the site, while the SBO Diesel Generator Fuel Oil Storage Tank is underground on the south side of the site. The EDG Fuel Oil Day Tanks are located in the EDG Building and the credited equipment is stored in the Sea Van Storage Areas in the North and South Parking Lots. If access to these diesel fuel oil supplies is blocked due to debris from the event , the debris removal vehicle will be used to provide clear paths.

Diesel fuel will be pumped from one of the storage tanks into a 100 gallon pickup mounted tank and transported to each component requiring refueling. The fuel will then be pumped to each component from the 100 gallon pickup mounted tank using a truck mounted 12VDC electric pump. Calculation M1394 indicates that the maximum nominal fuel consumption rate of the credited equipment is slightly less than 1130 gallons per day. This calculation also provides a suggested routing for the refueling equipment and confirms the adequacy of the routing, thus assuring that the credited equipment can be maintained refueled until off-site resources become available after 72 hours into the event.

As can be seen from the calculated fuel consumption rate (M1394) of about 1130 gallons per day and the required diesel fuel stored on-site of greater than 70,000 gallons, it is clear that there is sufficient capacity to maintain credited equipment refueled for a significant period of time into the event. Additionally, the capability exists to maintain credited FLEX equipment refueled throughout a long term event.

Fuel Quality

To prevent moisture intrusion in the fuel tanks, each piece of credited equipment will be stored fully fueled. Preventative Maintenance (PMs) will be performed on the equipment by an outside service organization. This organization has recommended winter additives and fuel stabilizers to be added to the fuel. Additionally, all diesel fuel in credited FLEX equipment will be drained and replaced every two years. These items will be added to the equipment PMs to be developed prior to full implementation of the FLEX Program. In this manner, diesel fuel stored within the credited FLEX equipment will be assured to be of operational quality at the time of an event.

Technical Specifications require that diesel fuel be sampled at least once a month in accordance with ASTM D4057-81 or D4177-82 to ensure the quality of the fuel is within the limits specified in Table 1 of ASTM D975-81. This assures the operational quality of the larger long term supply of diesel fuel for the credited FLEX equipment to be used during the event.

Item Number AQ 69 (53B)

Entergy plans to use ground water well pumps during phases 2 and 3. The staff requested information on the seismic qualification of the pumps.

PNPS Response:

The FLEX Well Pump & Motor Starter Seismic Qualification Testing was completed in March 2015. The testing was performed in accordance with the below referenced Technical Requirements Documents that have been uploaded to the ePortal, along with the complete Qualification Report.

3.003 FLEX Well Pump Motor Starter Technical Requirements Rev2 04-28-2014 EC-0000042259

3.005 FLEX Submersible Well Pump & Motor Technical Requirements Rev0 02-24-2014 EC-0000042259

EN-DC-149 NLI-AZZ QR-351022619-1 Rev 2 NLI Qualification Report FLEX Well Pump Motor Starter, Pump, & Motor.

Item Number RAI SE NO.5 (9E)

The NRC staff needs to review the ventilation analysis for areas containing electrical equipment to ensure the equipment can perform as expected during a loss of ventilation as a result of ELAP (Primary Areas included HPCI/RCIC Pump Rooms, Switchgear Rooms, Main Control Room, and Battery Rooms).

PNPS Response:

To address this item, a temperature response (heat-up) study was performed to determine the temperature rise in Switchgear Rooms, Battery Rooms, Main Control Room, Cable Spreading Room, and Vital MG-set Room. The HPCI & RCIC Pump Rooms are addressed under a separate review.

Discussion

Temperature response Calculation M1411 "Temperature Response of Key Rooms During an ELAP Event" was performed to determine maximum room temperatures at various essential areas. Multiple equipment operating configurations were assumed in M1411 and four temperature response cases were evaluated for component impact.

Four of the Case 2 studies (2B, 2C, 2E & 2F) were determined not to be valid since they assumed recharging of a station battery without the required ventilation fan in service. These operating configurations are not in accordance with Pilgrim FLEX Procedure 5.9.4.2 "Repower battery Chargers D11, D12, D13, D14 and D15". A battery room fan is required to be in-service prior to returning a battery charger to service to prevent hydrogen build-up during battery recharging.

Therefore, Cases 1, 2A, 2D and 3 were used as the bases for maximum calculated room temperatures at which station electrical equipment would need to operate in to support the FLEX mitigation strategy.

Case Descriptions:

Case 1 - Heat up analysis with maximum peak ambient temperature, no doors are opened, no Ram Fans are turned on, and no battery chargers are getting powered. The portable diesel generators do not get powered or are attached to the battery chargers.

Case 2A - Heat up analysis with maximum peak ambient temperature and operator actions are required to transition into FLEX Phase 2. At T4 hours: Both Ram Fans are turned on, various battery chargers are in operating configurations (four sub-cases), and doors 181, 100, 95, 93, 144, 145, and 141 are opened.

Case 2D - Heat up analysis with maximum peak ambient temperature and operator actions are required to transition into FLEX Phase 2. At T8 hours: Both Ram Fans are turned on, various battery chargers are in operating configurations (four sub-cases), and doors 181, 100, 95, 93, 144, 145, and 141 are opened.

Case 3 - Cool down analysis with minimum ambient temperature, no doors are opened, no Ram Fans are turned on, and no battery chargers are getting powered. The portable diesel generators do not get powered or are attached to the battery chargers. Case 3 is intended to asses FLEX Phase 1 temperatures with no operator actions during minimum ambient temperatures.

The results of these studies were used to determine the maximum area temperatures as follows:

Location	**Maximum Temperature ^{0}F**	**Case Number**	**Comments**
Lower Switchgear Room	114	2A-1	
Lower Battery Room	112.5	2A-1	
Upper Switchgear Room	118.3	2A-5	
Upper Battery Room	115.5	2A-5	
Cable Spreading Room	99.14	2A-1	
Control Room	103.3	2A-5	
MG-Set Room	130	All Cases	Operator action is required when approaching 130^{0}F at T29 hours.

The above Switchgear and Battery Room temperatures will decrease within 27 hours after the 250V battery charger is returned to service and has fully charged the 250V battery at which time the charger will supply just the connected loads (primarily the Vital MG-Set DC motor) and battery float charge (which will be minimal). These loads would be less than 50% of battery charger capability. If the Vital MG-Set has been secured because of elevated Vital MG-Set Room temperature (as discussed below) the loading and heat losses from the 250V battery charger will be less than 20A DC.

The charger loading is based on Calculation PS258, "125V & 250V DC Load Flow Studies – Fukushima Response". The twenty seven (27) hour 250V battery recharge time is based on a conservative recharge efficiency of 85% at an output limit of 160A DC minus connected loads.

The following method was used to determine the 250V battery recharger period;

- Calculation PS258; Attachment D3, Page 2, provides the 250V Battery discharge over the FLEX operating period of 8 hours.
- The total Amp-Hours at time 8 hours (when the charger is returned to service) is approximately 1580 AH.
- The long time connected load is 91A.
- Therefore, the battery charger ~~is~~ has approximately 69A to recharge the battery (160A -91).
- Assuming 85% recharge efficiency, there is 58.6A recharge rate.
- Based on a 58.6A recharge rate and a 1580AH discharge it will take 27 hours to recharge the battery.

DC Equipment Lower and Upper Switchgear and Battery Rooms

The table above provides the highest temperature based on Calculation M1411, as previously discussed. These temperatures are within the service temperature of the Pilgrim battery chargers and will not adversely impact the capability of the DC breakers need to support the loads required to support the FLEX Mitigation Strategy. Lastly, the elevated battery room temperatures remain within an acceptable range to support recharging of the station batteries.

1. 125V Battery Chargers (D11, D12 & D14)

   The three 125V Battery Chargers are located in the lower and upper switchgear rooms. The maximum calculated temperature for these areas is 118.3°F in the upper switchgear room. The 125V battery chargers have an operating ambient temperature range of 0°C - 50°C (32°F to 122°F) based on Solidstate Controls, Inc. Document No: SCI-QA-14.2 page 4.1 (Pilgrim Vendor Manual V-1188). Therefore, the maximum calculated temperature does not exceed the operating range of Pilgrim's 125V Battery Chargers (D11, D12 & D14).

2. 250V Battery Chargers (D13 & D15)

   The two 250V Battery Chargers are located in the lower and upper switchgear rooms. The maximum calculated temperature for these areas is 118.3°F in the upper switchgear room. The 250V battery chargers have an operating ambient temperature range of 0°C - 40°C (32°F to 104°F) at full load based on Exide Power System Document No: USF 260-3-200 (Pilgrim Vendor Manual V0265 page 63).

The Exide Manual Section "How the Exide US & USF Single - & 3-Phase Charger Works" (V-0265 page 18) provides details on how to size chargers for elevated temperature operation and provides derating factors. These derating factors can be used to determine maximum allow charger output at operating ambient of 122°F and 140°F.

Assuming an operating ambient temperature of 122°F, which is above the maximum calculated temperature of 118.3°F the derating factor is 0.83. The Pilgrim 250V Battery Chargers are rated at 200A DC full load output and therefore the output lime at 122°F would be 166A (200 * 0.83).

The Pilgrim 250V Battery Chargers have a procedurally controlled operating limitation of 160A DC output (Procedure 8.9.8.3, Section 6 Caution) states:

> "While energizing the 250V DC normal battery charger, D13 (or backup charger D15), gradually increase the voltage of the charger up as close as possible to, but not exceeding, 286 volts. Do not operate the battery charger with the current above a maximum of 160 amps for an extended period of time. (PR95.9200.01)"

Therefore, the 250V Charger output would be limited to 80% (160A/200A) of the full load rating. In addition, after approximately 27 hours in service the loading on the 250V Charger will decrease to approximately 100A or 50% of the unit rating, since the 250V battery will be full charged and connect loads (Reference Calculation PS258) plus float current, would be less than 100A.

This reduction in charger loading has two advantages; it decreases heat load, thereby lowering the area temperature (as can be seen in the Case 2 studies). Secondly, it increases the 250V battery charger acceptable operating temperature to beyond 140°F. (The derating factor for 140°F operation is 0.64 or 128A).

Therefore, the maximum calculated temperature does not exceed the operating range of Pilgrim's 250V Battery Chargers (D13 & D15), based on existing operating limits.

3. Station Battery Capability

The impact of elevated ambient temperature on the battery operation in the short time (initial discharge) would be an increase in battery capability. In the long term, elevated temperature decrease battery life. Since Pilgrim is on an enhanced battery replacement schedule of every 6 refueling outages (12 years for a battery with a 20 year service life due to elevated battery room temperature during normal operation, reference CR-PNP-2011-04499; CA007) the impact of accelerated aging because of elevated temperature is not an operational concern.

It is recommended that the recharge and float voltage used at an elevated temperature should be lowered to compensate for the elevated ambient temperatures on battery heating and H_2 generation. Since Pilgrim will be recharging the battery with loads connected, the recharge voltage is therefore limited by the connected components voltage operating ranges.

During a normal recharge the battery charger output voltage as maintained at 143V DC for a 125V Battery per procedure. During a FLEX recharge the voltage will be limited to 134V DC (Procedures 8.9.8.1, 8.9.8.2 and 8.9.8.3), to ensure there is no damage to the connected components. This will reduce battery internal heating during recharge and float and help compensate for the elevated temperatures.

4. DC Breakers and Fuse

DC breaker and fuses required to support FLEX Mitigation Strategy systems and components are located in the lower and upper switchgear rooms. The maximum calculated temperature for these areas is 118.3°F (47.9°C), which is above the normal 104°F (40°C) ambient temperature used to determine system coordination.

Elevated ambient temperature has an impact on the trip characteristics of breakers with thermal elements. The impact is to shift the thermal element trip curve to the left thereby decreasing the load capability of the breaker and coordination with upstream protection devices. A review of the DC Coordination Study PS-31 was used to identify the type of breakers and fuses used in the Pilgrim DC system. A review of the breaker types determined that thermal-magnetic breakers remained coordinated with upstream fuses and could support connected loads.

At temperature beyond 40°C and up to 50°C based on breaker manufacture's information for typical molded case circuit breakers (GE type TED & THED Breakers) show a -10% shift in the breaker thermal trip curve. This shift results in a reduction in breaker load capability up to 10% at 122°F and a faster response to a system overload condition. Since Pilgrim's design is to have the breaker sized for 125% of design loads the 10% decrease will not adversely impact the capability of the supply breaker to support connected loads.

The second factor in selection of the breaker is to ensure that it coordinates with the upstream protection device. In 1999, Pilgrim redesigned (PDC98-26) the 125V and 250V DC system to replace the breaker to breaker coordination with a fuse to breaker coordination. This was done to eliminate the potential of over-tripping as a result of having two breakers with magnetic trip in series.

The ratings of upstream fuses, which supply the DC panels, are significantly larger than the downstream breakers they supply. This ensures that the breaker magnetic trip element will have time to respond to a bolted DC fault prior to the fuse starting to melt and de-energizing the associated panel.

The primary DC panel fuses are Bussmann FRN-R dual-element time delay fuses (Reference: Bussmann Fuseology Dual-Element Fuse Benefits). The increase in temperature will decrease the current rating by 10%, which is not a concern since the fuses are oversized to ensure coordination with the down-stream breakers magnetic trip unit and cable protection. Therefore, load capacity is not an issue with the decrease in fuse carrying capacity.

The other impact of temperature on the fuses is a decrease in clearing time by approximately 20%. This will have an effect in the very high fault current range < 9,000A where coordination between the breaker's magnetic trip unit and fuse clearing time is being provided. This area of the coordination is in the 50msec range; therefore, a decrease of 20% is equal to 10msec and could cross into the breakers magnetic trip field (Calculation PS32 curve PS31-5 D2-2). Since the coordination assumes a conservative bolted fault at the panel down-stream of the fuse the actual maximum fault values that are needed to be coordinated will be lower. Therefore, this provides additional clearance margin to account for the temperature effect on fuse opening time.

In addition, the increase in temperature will increase cable resistance which will also lower the maximum fault seen by the breaker and fuses further increasing the breaker to fuse coordination margin.

5. Battery Charger FLEX Transfer Switches

The FLEX Transfer Switches were purchased and tested in accordance with Pilgrim Purchase Order 10399804. The Transfer Switches have an Operating Temperature of -5°C to +40°C (23°F to +104°F) at a full load of 200A per ABB Technical Data – "Automatic Transfer Switches". The Transfer Switches are located adjacent to the battery chargers in the lower and upper switchgear rooms and therefore are subject to the same maximum temperature of 118.3°F.

Since the maximum loading without the FLEX Transfer Switches would be 102A (reference calculation PS262 for the 250V Charger) or approximately 50% of the switch rating the level of loading would more than compensate for operating at temperature above 104°F. Since the internal heat load is a factor of the square of the current load times contact resistance, a reduction in current has a significant impact on internal heat load. The internal heat load at 102A would be approximately a quarter of the full rating heat load. This decreased load would allow for operation of the transfer switches at a slightly elevated area temperature. There could be some accelerated aging affects but this is more than compensated by the fact that the switches are new (installed in 2014) and normally operate at very low loads and are located in mild ambient conditions.

Vital MG-Set Room

The Vital MG-Set will remain in service on loss of all AC power as it will be powered from the 250V Battery System. Calculation M1411 shows that the Vital MG-Set Room will start approaching a temperature of 130°F in approximately 29 hours (Reference M1411 Heat-up Figure 32). Prior to reaching this temperature actions will be taken in accordance with Pilgrim Station Procedure 2.4.153, "Loss of Turbine Building/Aux Bay Area Ventilation".

The Vital MG Set is a "Set D Load", which is the last group to be Load Shed when necessary in accordance with the procedure 2.4.153 Attachment 10 section [1] (e) states: (The RPS MG Set Room and Vital MG-Set Room are the same locations.)

Procedure 2.4.153 states:

> "IF EITHER B15 OR B10" which would be the cases assumed for FLEX, is NOT available, THEN the Vital MG Set AND/OR RPS MG Set A or B may be maintained in-service if RPS MG Set Room temperature does not exceed 130°F peak."

If the Vital MG-Set Room temperature exceeded 130°F operation, PNPS would need to take action to load shed the Vital MG-set by opening the MCC D10 breaker 72-1022 located in the lower switchgear room. The shedding of the Vital MG-Set, which is the major load within the Vital MG-Set Room, would result in a decrease in room temperature. The only remaining operating electrical equipment in the room would be the 120V Safeguards Distribution Panel Y3. The impact of elevated temperatures on panel breakers is a shift in the thermal trip curves by the approximately -15% in breaker capacity. See discussion on DC breaker above. Based on Calculation M1411 the Vital MG-Set room could reach a temperature of 130°F within 29 hours assuming maximum outside ambient air temperature.

Section 5 "Description" of procedure 2.4.153 states:

> "All equipment is considered to be capable of performing its specified safety functions when exposed to the following conditions:
>
> - Short (15 minutes) temperature peak of 130°F"

Pilgrim Calculation M1304, "Vital MG Set Room Temperature during a Loss of Ventilation Event" determined that operation up to 130°F is acceptable per station procedure and action would need to be taken to prevent temperature exceeding 130 °F.

Main Control Room

The Main Control Room temperature based on Calculation M1411 could reach 103.3°F. This temperature is below 120°F specified in the Pilgrim FSAR section 7.1.8 which states the following:

> "The equilibrium condition for temperature and humidity in the control room and other equipment rooms following the loss of all air-conditioning and normal ventilation would be 114⁰F, 48 percent relative humidity. The equilibrium temperature of 114⁰F would be achieved during ambient conditions of 90⁰F, 90 percent relative humidity.
>
> All control board instrumentation is specified to be operable up to 120⁰F and 90 percent relative humidity. Therefore, the temperature within the control room will never increase to a point that will require reactor shutdown. All instrumentation will be functionally tested after installation and prior to plant startup to confirm satisfactory operability of control and electrical equipment under normal environmental conditions. The extreme of environmental conditions is far less than the design requirement of the instrumentation."

Therefore, based on Pilgrim FSAR section 7.18 the control room instrumentation is designed to operate well above the M1411 calculated control room temperature of 103.3°F.

The Spent Fuel Pool Level Monitoring instrumentation to be installed in the control room is designed to operate at a temperature in access of 110°F per EC45088, Section 3.1.24

Conclusion

Based on a review of the essential station equipment required to support the FLEX Mitigation Strategy which are located in the Switchgear Rooms, Battery Rooms & Main Control Room, it has been determined that the equipment can perform their required functions at the temperatures described in Calculation M1411. The above component reviews; design basis equipment requirements (FSAR Requirement); and previous equipment evaluation (Vital MG-Set Room) provides the bases for this conclusion.

References

A. Calculation M1411 "Temperature Response of Key Rooms During an ELAP Event"
B. Calculation PS258 "125 & 250V DC Load Flow Studies Fukushima Response Project"
C. Calculation PS262 "FLEX Diesel Generator Loading"
D. Calculation PS31 :D-C System Overcurrent Protection Coordination Study"
E. Calculation M1304, "Vital MG Set Room Temperature during a Loss of Ventilation Event
F. PDC98-26
G. Vendor Manual V1188
H. Vendor Manual V0265
I. Procedure 2.4.153, "Loss of Turbine Building/Aux Bay Area Ventilation"
J. Procedure 8.9.8.1 "A 125V DC Battery Acceptance, Performance, or Service Test – Critical Maintenance"
K. Procedure 8.9.8.2 "B 125V DC Battery Acceptance, Performance, or Service Test – Critical Maintenance"
L. Procedure 8.9.8.3 ""250V DC Battery Acceptance, Performance, or Service Test – Critical Maintenance"
M. Procedure 5.9.4.2(DRAFT) "Repower battery Chargers D11, D12, D13, D14 and D15"
N. Pilgrim FSAR Section 7.18
O. CR-PNP-2011-04499 CA007

Station Equipment Temperature Review for HPCI and RCIC Areas

To address this item the temperature response (heat-up) studies for the HPCI and RCIC areas were reviewed to determine the operating temperature in at the HPCI and RCIC equipment. These temperatures were reviewed against the HPCI and RCIC design operating temperature limitations provided by General Electric as the system/equipment supplier.

The Switchgear Rooms, Battery Rooms, Main Control Room, Cable Spreading Room and Vital MG-set Room will be address under a separate review.

Summary

The RCIC and HPCI systems are capable of performing their Beyond Design Basis External Event (BDBEE) Extended Loss of AC Power (ELAP) Event response functions at the maximum calculated ambient temperatures based on a review of the General Electric Nuclear Energy Division Design Specification.

Discussion

RCIC System

The temperature conditions in areas with steam turbine driven pumps are primarily a function of the surface temperatures and heat losses for piping and components along with assumptions on the amount of steam leakage from the turbine shaft seals, which is designed to be controlled to minimal levels by the use of gland seal condensing systems. The RCIC analyses that have been performed attempt to provide an upper-bounding area temperature based on a range of assumed values for steam leakage that represents various degrees of degradation or failure of the steam seal and condensing systems. These previous analyses that were performed for Station Black-Out (SBO) conditions where the RCIC & HPCI Area Coolers are also not operating, as they are dependent on AC powered fans and pumps.

Based on the PNPS FLEX Strategy Report ENTGPG012-PR-001, "Review of FLEX Strategy for Mitigation of Beyond Design Basis External Events for Entergy Pilgrim Nuclear Power Station" the peak RCIC area temperature at 10 hours event time would be approximately 112°F for a realistic 10 lbm/hr. leakage rate and up to 138°F assuming a much larger upper bounding steam leak rate from the turbine seals of 70 lbm/hr. These leakages were conservatively evaluated as releasing steam directly into the room. The results for the 10 lbm/hr. leakage rate are plotted over a period of 200 hours (over 8 days) while the 70 lbm/hr. leakage rate case is plotted for 50 hours. Longer term temperatures for the 10 lbm/hr. leakage rate case are approximately 115°F at 24 hours and 125°F at 72 hours. The 10 hour period corresponds with the end of the required RCIC system FLEX ELAP operating period prior to the depressurization of the RPV and initiation of FLEX Low Pressure injection.

General Electric Specification 22A1290AJ, "Reactor Building Ventilating, Cooling and Heating Systems", requires that these ventilation and cooling systems be capable of maintaining area temperatures at or below a Maximum Temperature of 148°F when the RHR, RCIC, HPCI, and Core Spray Pumps are operating. GE Specification 21A5822AC for the RCIC System also specifies a Maximum Emergency Operating Temperature of 148°F at 100% RH for the ambient conditions. Therefore, operation of the RCIC system up to a maximum area temperature of 138°F at the end of the 10 hour duty cycle in response to an ELAP type event is within the area temperatures limits specified for the equipment installation.

HPCI System

Based on Pilgrim Calculation N120, "HPCI Pump Room Heatup without Unit Coolers" the bulk temperature at 8 hours event time (the end of the analysis) is 124°F, with no Area Coolers, and no assumed turbine steam seal leakage, but with LOCA heat load conditions, as determined by a RELAP4B computer model. This time is slightly shorter than the ELAP response HPCI operating period of 9 to 10 hours.

The summary section of Calculation N120 shows the temperature rise between time 5 hours and 8 hours was only 0.72°F. Therefore, it is assumed an area operating temperature 125°F at time 10 hours, just before HPCI is removed for service for the initiation of FLEX Low Pressure injection.

General Electric Specification 22A1290AJ described above, and Specification 21A1068AC for the HPCI System both specify a Maximum Emergency Operating Temperature of 148°F at 100% RH for the ambient conditions. Operating the HPCI system at a maximum area temperature of 125°F at the end of the 10 hour duty cycle in response to an ELAP type event is within the area temperatures limits specified for the equipment installation.

References:

1. Enercon Report ENTGPG012-PR-001, "Review of FLEX Strategy for Mitigation of Beyond Design Basis External Events for Entergy Pilgrim Nuclear Power Station", Enercon 02-13-2013
2. General Electric Specification 21A5822AC Rev 0, REACTOR CORE ISOLATION COOLING RCIC PUMP DATA SHEET
3. General Electric Specification 22A1290AJ Rev 1, REACTOR BUILDING VENTILATING COOLING & HEATING SYSTEM
4. General Electric Specification 21A1068AC Rev 0, HIGH PRESSURE COOLANT INJECTION PUMP DATA SHEET
5. Calculation N120 Rev 0 "HPCI Pump Room Heatup without Unit Coolers"

Item Number RAI SE NO.6 (10E)

As described in Item 5 on page 8 of the integrated plan, confirm that the stresses associated with passing liquid phase water through the SRV tail pipe, including those on the tail pipe, the tail pipe supports, the quencher and the quencher supports are evaluated with acceptable results.

PNPS Response:

The applicable analyses that together bound all modes of operation of the SRVs includes the Design Basis Pipe Stress Analysis and the Abnormal Operational Transient case analyzed for RPV High Pressure Overfill Events, which are both described and referenced below. Taken together, these analyses bound all modes of operation of the SRVs, including the low pressure FLEX subcooled flow boiling mode with a liquid & vapor mixture discharge through the SRVs.

A comprehensive design basis analysis of the Pilgrim SRV discharge piping was performed to determine the fluid loading caused by SRV actuations. The analysis of the Main Steam Lines (MSLs) and SRV Discharge Lines (SRVDLs) was performed in 1987 as a complete reanalysis to support the enlargement of the SRV throat bores to the 5.125 inch Maximum Diameter related to a 1.5% Thermal Power Uprate. This updated analysis is included in the Teledyne SRV Fluid Analysis Calculation CP-6732-2 [Ref. 1].

The SRV discharge lines are subject to a number of transients due to their actuation. The piping and supports must be qualified for the loads due to these events. In addition the SRV actuation applies loads to the torus shell and submerged structures which also must be qualified.

Normal Operating Condition (NOC) Transients are SRV actuations that occur during Normal Operation. Small Break Accident (SBA) Transients are SRV actuations which occur after a "small pipe" is assumed to have broken, pressurizing the Torus to some initial pressure. Intermediate Break Accident (IBA) Transients are SRV actuations which occur after an "intermediate size pipe" is assumed to have broken pressurizing the Torus shell to some larger Initial pressure.

In the Teledyne analysis, a distinction is also made between first actuation and a subsequent SRV actuation. On the initial actuation of the SRV the lines will be full of air which has come in through the vacuum breakers. Initial temperature of the pipe will be that of the surroundings. After actuation the lines are filled with steam.

This steam then condenses, creating a vacuum which pulls the water from the torus up the line. The water returns as air is pulled in through the vacuum breakers. If the SRVs are actuated again while the water leg is high in the line, the loads are significantly increased in those sections containing water, these are referred to as the "Water Clearing Loads" and these control the design of the lower segments of SRVDL Downcomer Piping and all of the Submerged Structures, including the T-Quencher.

For the steam blow down loads the initial actuation Intermediate Break (IBA) case is limiting. These loads are the most severe loads for the upper portion of the SRVDL piping and are applicable when there is air in the piping for these cases. For the last (lower) Downcomer segments of the SRVDL the water clearing loads experienced during the high water leg Intermediate Break (IBA) case are controlling. These loads are applied to the last segments where the water leg is present. The limiting loads on the Torus and submerged structures was found to be caused by the oscillating bubble of air blown out during the initial actuation Intermediate Break (IBA) case, i.e., the case with air in the piping rather than steam.

The controlling cases for Torus Shell Transient Pressure and Highest Shell Frequencies were found to be the cases where the SRVDL was filled with air prior to an SRV actuation, which is more severe than steam-filled with a higher water leg for the Torus Shell loading.

The Force Time Histories developed from the Teledyne Calculation CP-6732-2 were used as inputs to the Main Steam Line & SRV Discharge Line updated Pipe Stress Analyses performed for each of the four individual MSLs and their associated SRVDLs [Ref 3]. The piping was analyzed for deadweight, hydro test, thermal, seismic anchor movement, seismic inertia and fluid transient blowdown loadings. Pipe stress was evaluated to the requirements of the ASME Code, Section NC 3600. Pipe Support Loads were reported out from these Pipe Stress Analyses and then each Support is analyzed separately in its own Pipe Support Design Calculation. The evaluation of the Torus Shell and Submerged Structures, including the T-Quenchers was performed in Calculation M1206 [Ref. 2], and other Penetrations, the Jet Deflectors, and the Torus Vent Pipes were evaluated in Calculation M1225 [Ref. 4].

In addition to the Design Basis Analysis of the SRVs and the Main Steam and SRV Discharge Line Piping and Supports, there is a particularly applicable Abnormal Operational Transient that is analyzed for the SRVs. This evaluated scenario involves spurious operation of Condensate and Feedwater Pumps and failure of the Reactor Level Control System and Feedwater Regulating Valves and the resulting uncontrolled injection into the Reactor Pressure Vessel (RPV) at the limiting high pressure conditions, referred to as the "RPV High Pressure Overfill Analysis". The initiating scenario is based on a postulated fire in one of the two Switchgear Rooms causing a loss of DC control power to the Breakers which control the motor driven Feedwater Pumps that results in the inability to isolate or control the Feedwater Pumps from the Main Control Room. Condensate & Feedwater Pumps on the Opposite Train Switchgear (not affected by fire) can be isolated from the Main Control Room, resulting in one Condensate & two Feedwater Pumps injecting and rapidly overfilling the RPV. The analysis provides an evaluation of an RPV High Pressure Overfill and Main Steam (MS) system flooding fluid transient at the most limiting and overall bounding high pressure conditions for operation and generates the resulting maximum loads on the piping system and supports [Refs 5 & 6].

To perform the RPV High Pressure Overfill Analysis and to determine Main Steam & SRVDL transient loads, an analysis was performed utilizing the RELAP5 Mod 3.3 computer software code for fluid dynamics simulation. A model was developed using RELAP5 Mod 3.3 to represent the volumes of the RPV and Main Steam piping, including the SRV discharge piping to the Torus. The incoming feedwater flow rate throughout the transient is defined as a constant rate of 10,000 gpm based on run-out flow for one Condensate Pump. The SRV lift setpoint was set to 1155 psig +3% = 1190 psig. Higher RPV pressure is conservative due to greater reaction forces upon SRV opening.

The LPI Calculation A12426-C-001 [Ref. 5] determined the transient loads on the piping system and performed multiple cases to determine the bounding conditions and configuration (among the four Steam Lines) that produced the greatest loads. In all cases, the transient is terminated at 120 seconds due to the steady state balance between incoming feedwater and flow out the SRVs. This continues to 600 seconds, at which point the Condenser Hotwell volume is consumed, which will starve the pumps and stop feedwater flow into the vessel. The first case (Load Case A) shows the results with valve operation staggered by 5 psi between each SRV. The valve setpoints are reduced in 5 psi intervals from the 1204 Pisa set point (1155 psig +3% +14.7psia). In this case, the first SRV lifts at 11 89 psi (1204 psi - 3x5 psi) at approximately 13.5 seconds and the second SRV lifts at 1194 psi (1204 psi - 2x5 psi) at approximately 75 seconds. After the second valve lifts, the feedwater mass flow into the vessel is matched by the mass flow out of the SRVs, producing a steady state condition for the remainder of the transient.

The selection of the staggered lift pressures and the location at each SRV is not significant to the results. The first SRV will lift under all steam conditions due to the compression of the available steam volume. Changing this pressure will only change the timing of the lift. The steam pressure is initially relieved and then recovers between 13.5 and 75 seconds. The second SRV will lift under mixed water and steam (two-phase) conditions. The water reaches the Main Steam Line (MSL) nozzles at 38 seconds as shown by the increase in mass flow at this time and begins to accumulate at the closed MSIVs. Water flow in MSL lines without an open SRV is driven by gravity and is approximately equal at 40-75 seconds due to the equal elevation of all four MSL nozzles. This condition is maintained until a second SRV lifts and a large water slug is pulled down the line at 75 seconds. Since the conditions producing the water slug are the same, i.e., the water flow in each line and the high mass flow upon SRV lift, the resulting water slug will be equivalent between MSLs. Therefore, the selection of the specific valves in the staggered lift sequence does not affect the resulting loads.

The results show that the greatest piping loads are transient spikes that occur upon SRV lift and the largest such spike occurs after the second SRV lift where the water slug is carried down the Main Steam Line by the mixed water and steam (two-phase) flow and there is a momentary SRV peak mass flow rate of 2500 lbm/sec above the baseline value of approximately 500 lbm/sec steady state flow that is established after the transient. With the second SRV lift, there are two SRVs open and the 1000 lbm/sec total flow matches the nominal 10,000 gpm RPV injection flow rate. Note that the rated steam flow condition for an SRV is a steam mass flow of 921,000 lbm/hour at 103% set pressure (256 lbm/sec at 1190 psig).

The mixed water and steam (two-phase) mass flow rates that occur immediately (within the first two minutes) after RPV shutdown (scram) when the SRVs open at the pressure setpoint limits due to the RPV High Pressure Overfill Event are the most severe conditions for the Main Steam Lines and SRV Discharge Lines. Due to the high pressure and high injection flow rates, the Pressure x Area reaction forces and the Inertia and Momentum fluid forces are all maximized simultaneously.

The highest amplitude bounding load for the SRV Discharge Line piping for the four SRVs was found to occur for the initial steam-only lift of SRV 203-3A, which has a Peak Load at 9400 lbf occurring by 14 seconds after shutdown (Case 4 Load Case "A"). This Peak Load is slightly higher than for any of the subsequent SRV lifts that involve mixed water and steam (two-phase) flow. This shows that the normal High Pressure Setpoint lift of an SRV, with steam flow only, results in the highest SRVDL loads, slightly higher than for the mixed water and steam (two-phase) mass flow rates that occur subsequently for the RPV High Pressure Overfill Event [Ref. 5].

Although the four MSL are similarly configured, the Train B Main Steam Line piping and its associated SRV 203-3D Discharge Line piping were found to provide the bounding configuration for all four Main Steam Lines and for the SRV Discharge Lines for the conditions where SRV lifts occur with two-phase flow conditions during the RPV Overfill Event [Ref. 5]. This is likely because the Train B MSL piping run has the longest single vertical drop in elevation right off the RPV Nozzle connection, with a 34 ft change in height, followed by two 5D Bends and a 90 Degree Elbow. Train C MSL is very similar but does not have an SRV in the line.

As described above, the Peak Transient Load occurs at 75 seconds and is 8800 lbf Peak Load for the SRV 203-D Discharge Line and 8000 lbf Peak Load for the Train B Main Steam Line piping (Case 5 Load Case "A"). The loads subsequent to the SRV lift transient are below 2000 lbf in a steady state manner for the SRV 203-3D Discharge Line. The Main Steam Line Train B piping, when exposed to the continued slug flow with water and steam discharging from the RPV MSL nozzle due to the overfill, has a more widely fluctuating load profile with the greatest peaks occurring at the location of a 5D 30 Degree elbow bend at the bottom of the longest vertical drop in elevation of 34 ft for the MSL Piping (Location 410-12). The Peak Loads up to the 80 second point at this location are less than 6000 lbf. Beyond 80 seconds after shutdown, the highest loads at this elbow fluctuate between 2000 and 3000 lbf in a steady state manner at this elbow location that experiences the highest loading with mixed water and steam (two-phase) flow at 500 lbm/sec in the Main Steam Line.

The LPI Calculation A12426-C-002 [Ref. 6] provides a structural evaluation of the Train B Main Steam piping and the associated SRV 203-3D discharge piping resulting from transient-type loads caused by RPV overfill and Main Steam Line (MSL) flooding, using the fluid loads determined in the above analysis. Based on results summarized in Section 4.0 of the report, the modeled Main Steam Line B and SRV 203-3D Discharge Line and associated supports are shown not to compromise the design basis capacities. Although there are some modest increases in support loads, these are shown to be within the capacity of the affected supports. By inference, the results also indicate general acceptability of all the Main Steam Lines and associated SRV Discharge Line piping and supports if subjected to the postulated overfill scenario.

The RPV High Pressure Overfill Analysis compares favorably to the FLEX Low Pressure 400 GPM FLEX maximum injection flow rate where the mixed water and steam (two-phase) flow is approximately 50 lbm/sec. It is therefore concluded that the FLEX flow conditions, at approximately one-tenth the 500 lbm/sec steady state mixed flow rate for a single SRV in the LPI analysis, is well bounded by that evaluation.

The RPV High Pressure Overfill Analysis bounds the FLEX RPV Subcooling and Low Pressure Injection based on the following factors:

1. The Reactor is operating 100 percent power prior to the event at time zero of the analysis.

2. Offsite power is assumed to be available, so that the Condensate and Feed Pumps continue operating after the Turbine Trip and Closure of the Main Steam Isolation Valves (MSIVs).

3. Feedwater Regulating Valves fail as-is and cannot be closed due to loss of control power. This causes rapid overfilling of the RPV up to the Main Steam Lines, which begin flooding with liquid water.

4. RPV Pressure rises to the SRV Setpoint Limits and that is what initiates opening of the first and second SRV, which results in a high amplitude transient spike in Mass Flow when the SRV opens.

5. The water slugs that fill the Main Steam Lines cause the largest transient load spike for the MSL when the SRV opens on the MSL opens. The Peak Load occurs at the upstream elbow at the bottom of the largest vertical drop in height of the MSL piping from the RPV Nozzle as would be expected.

6. After the initial transient caused by the SRV opening, the loads are significantly reduced and fluctuate in a steady state manner at low amplitudes.

7. SRV Flow with steam at the Setpoint Pressure of 1190 psig is 256 lbm/sec. The Peak SRV Flow that occurs with a MSL water slug at the Setpoint Pressure of 1190 psig is 2500 lbm/sec, which settles back at 500 lbm/sec for each of two SRVs for 1000 lbm/sec total flow.

8. In the LPI Analysis, the RPV Overfill injection rate is 10,000 GPM with the Feedwater saturated at 550°F (1000 lbm/sec). This is the steady-state RPV Overfill flow condition.

9. The Maximum SRV Flow for the FLEX Strategy is 50 lbm/sec (400 GPM) total at an RPV Pressure no greater than 85 psig and typically discharging through two SRVs that were fully opened at the end of the RPV depressurization before the RPV was flooded up to the Main Steam Lines, and remain open continuously.

10. Based on the FLEX Strategy utilizing significantly lower Mass Flow Rates, lower RPV Pressure, and the flow is established at steady-state conditions with typically two SRVs full open, the Main Steam Line and SRV Discharge Line Piping and Support Loads are substantially bounded by the LPI RPV High Pressure Overfill Analysis.

References:

1. SUDDSRF02-7 Teledyne Engineering Services Calculation CP-6732-2 MAIN STEAM SRVDL FLUID ANALYSIS, 06-15-1987
2. Calculation M1206 Rev 1 EVALUATION OF TORUS AND SUBMERGED STRUCTURES DUE TO POWER UPRATE
3. Calculation M1215 Rev 1 MS LINE A PIPE STRESS ANALYSIS PER SPECIFICATION M626
   Calculation M1216 Rev 1 MS LINE B PIPE STRESS ANALYSIS PER SPECIFICATION M626
   Calculation M1217 Rev 1 MS LINE C PIPE STRESS ANALYSIS PER SPECIFICATION M626
   Calculation M1218 Rev 1 MS LINE D PIPE STRESS ANALYSIS PER SPECIFICATION M626
4. Calculation M1225 Rev 1 MISCELLANEOUS COMPONENT EVALUATIONS USING OUTPUTS FROM THE ANALYSIS OF MS AND SRV DISCHARGE PIPING
5. A12426-C-001 LPI Report MAIN STEAM LINE TRANSIENT DUE TO SPURIOUS PUMP START
6. A12426-C-002 LPI Report STRESS ANALYSIS FOR SPURIOUS PUMP START LOADS MAIN STEAM LINE B AND SRV DISCHARGE LINE D

Item Number RAI SE NO.7 (11E)

Extended loss of alternating current during low power modes.

PNPS Response:

The most limiting condition for the low power mode would be during the process of de-tensioning of the reactor pressure vessel (RPV) head and flood-up at the start of refueling. This would occur approximately 36 hours into the refueling outage. At this time re-pressurizing the RPV would not be possible and therefore neither RCIC nor HPCI would be available. A Fukushima type event during this period would require the implementation of the FLEX core cooling phase 2-strategy, earlier than the 9 – 10 hours determined for an event from power. Therefore, in order to ensure the adequate core cooling within 2 hours, procedures will be modified to require pre-staging the B5B diesel driven pump, 20kW portable diesel generator with light stand, duplex strainer, and any necessary support equipment. Certain portions of the hose and cable connections may remain incomplete to facilitate outage activities while minimizing the risk of harm to those components. Upon the loss of all AC power, the FLEX Support Guideline 5.9.1 will be entered from the Station Blackout procedure then will be used to implement the strategy.

The pre-staging will need to be in place prior to the start of detensioning to flood-up and prior to the start of drain-down until the head is reinstalled.

Item Number RAI SE NO.8 (12E)

Flex support guidelines for transitioning from Phase 2 to Phase 3

PNPS Response:

Assuming the worst case event, the current plan to transition from FLEX Phase 2 to Phase 3 for RPV makeup involves changing from the injection of seawater to the RPV using two FLEX Injection Pumps, to the injection of water from the FRAC Tank using one FLEX Injection Pump. Groundwater Wells will be placed in service and a skid mounted demineralizer, obtained from the SAFER National Response Center, will be used to demineralize the water. This methodology can be used indefinitely and has built in redundancy, as only one FLEX Injection Pump is needed and two are available.

Electrically, the transition is simpler in that the FLEX 150kW and/or 86kW Portable Diesel Generator that supply the battery chargers and assorted minor loads are assumed to continue to supply these loads during Phase 3. The FLEX 20kW Portable Diesel Generators will provide power to the Groundwater Well Pumps. (Reference: FLEX Generator one line diagrams provided in ePortal)

While their use is not expected to be required during Phase 3, it would be beneficial to have the capability to use the generic equipment supplied by the SAFER National Response Center to supplement the on-site FLEX equipment. The generic SAFER equipment identified by Pilgrim to be the most likely to be used considering the Pilgrim FLEX Strategy include the following:

- Low Pressure / Medium Flow Pump

  The SAFER Low Pressure / Medium Flow Pump could be used as a backup to the FLEX Injection Pump. As this pump may be oversized for the proposed use, it may be necessary to throttle the pump or provide makeup to the RPV in intervals.

- Low Voltage Three-Phase Generator

  It has been determined that the SAFER 480VAC Low Voltage Three Phase Turbine Generator can be run at light load near idle (between 50kW to 100kW) for an extended period of time. This allows the SAFER 480VAC Low Voltage Three Phase Turbine Generator to be a backup to the 150kW and/or 86kW FLEX Diesel Generators for the required 480VAC loads. This would require connection through the FLEX 480VAC Power Distribution Box. (Reference: FLEX Generator one line diagrams provided in ePortal)

- Mobile Lighting Towers

  Since the SAFER 480VAC Low Voltage Turbine Generator does not have the capability to supply 240VAC or 120VAC loads directly, these loads could be powered by a SAFER 6kW Diesel Generator (Mobile Light Tower) through the FLEX 240/120VAC Power Distribution Box. (Reference: FLEX Generator one line diagrams provided in ePortal)

- Diesel Fuel Transfer equipment

  In its generic equipment package, SAFER will be delivering truck mountable Diesel Fuel Transfer equipment that has higher capacity than the Pilgrim FLEX Strategy equipment. This includes a 500 gallon capacity drum along with a 60 gpm fuel transfer tank. Additionally, a 264 gallon capacity drum along with attached 25 gallon per minute (gpm) DC fuel transfer pump and 30 gpm AC fuel transfer pump are included in the package. FLEX equipment refueling times will be reduced by the addition of this equipment, as the refueling strategy for the FLEX equipment assumes a truck mounted tank capacity of 100 gallons and a flow rate of 12 gpm.

Although the SAFER equipment has higher rated fuel consumption rates (26 gallons per hours (gph) for the Low Pressure / Medium Flow Pump, 110 gph for the Low Voltage Three-Phase Generator, 1 gph for the Mobile Light Tower), operation at lower capacities for the larger pump and generator, although less fuel efficient, will require significantly less fuel per hour (estimated < half the rated fuel consumption rate). This is within the capabilities of the SAFER supplied Diesel Fuel Transfer equipment.

At Pilgrim, Tech Spec 3.9.A.3 requires a minimum of 73,600 gallons of diesel fuel on-site for the Emergency Diesel Generators (EDG). There will also be about 612 gallons of fuel in the equipment and 888 gallons of fuel in the EDG fuel oil day tanks, for a total of 75100 gallons on-site at the time of the event. Considering a fuel consumption rate of about 2500 gallons per day when using the SAFER equipment, it is clear that there is sufficient fuel oil on-site to supply all equipment for about one month. This should be adequate time to allow deliveries to the site to begin.

FLEX Support Guideline, PNPS 5.9.12, SAFER National Response Center Equipment Utilization, has been developed to provide guidance to utilize the SAFER equipment.

In addition to the SAFER generic equipment, Pilgrim will be using the non-generic SAFER Water Treatment System, a diesel powered reverse osmosis unit with pre-filter. Since the use of this SAFER Water Treatment System is expected during Phase 3, the operation of the unit has been included in the draft FSG for Long Term Reactor Vessel Cooling. Fuel usage for the diesel powering this system is included in the above discussion of fuel consumption.

Item Number RAI SE No.9 (13E)

Diesel 'N' Storage - Entergy believes one 86 KW diesel generator is sufficient as 'N' if the 250 volt battery lasts 10 hours

PNPS Response:

This is a generic issue the NRC is addressing with the industry on the accuracy of battery discharge data beyond 8 hours. Pilgrim has a calculation showing the 250V Battery can operate >10 hours based on battery vendor supplied test data. The accuracy of the data is the issue being reviewed by the NRC, battery suppliers and IEEE battery standard sub-committee.

The Pilgrim FLEX response resources consists of three diesel generators to support repowering the battery charges, 120V AC panels Y3/Y31 & Y4/Y41 and battery room ventilation fans. One diesel generator is a 150kW unit staged in the Turbine Building Truck Lock. The other two 86kW diesel generators are staged at each of the two FLEX storage locations.

If the 150kW generator was not available, the two 86kW generators have the capability to repower the three battery charges (125V 'A' & 'B' chargers and the 250V charger), both 120V AC panels and ventilation fans. A

single 86kW generator can support operation of two 125V Battery Chargers, both 120V AC Panels and the both Battery Room portable ventilation fans (Calculation PS262).
Assuming the 150kW generator was not available; one of the 86kW generators was lost and HPCI was being utilized to support shutdown, a single 86kW diesel generator would be adequate. The HPCI operation period is 10 hours and needs the 'B' 125V and 250V dc systems available for operation. The 250V dc system battery has been evaluated (Calculation PS258) as part of the FLEX Project and has been shown to maintain adequate voltage for at least 10 ½ hours.

The single 86kW generator would be assigned to the power 125V battery charges, battery room portable fans and 120V panels (Y3/Y31 & Y4/Y41). The 250V battery would be used to support the HPCI system through the 10 hour HPCI mission time without charger support and would then be isolated by opening the breaker 72-1013 at MCC D10 in the 'B' Switchgear Room.

Therefore, the Pilgrim FLEX response can be implemented with a single 86kW generator.

ATTACHMENT 2
TO PNPS Letter 2.15.050

PILGRIM NUCLEAR POWER STATION

FINAL INTEGRATED PLAN

FOR ORDER EA-12-049
ORDER MODIFYING LICENSES WITH REGARD TO REQUIREMENTS FOR MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS

FINAL
INTEGRATED
PLAN
DOCUMENT

PILGRIM
NUCLEAR POWER STATION

July 2015

Table of Contents

1. Background

In 2011, an earthquake-induced tsunami caused Beyond-Design-Basis (BDB) flooding at the Fukushima Dai-ichi Nuclear Power Station in Japan. The flooding caused the emergency power supplies and electrical distribution systems to be inoperable, resulting in an extended loss of alternating current (ac) power (ELAP) in five of the six units on the site. The ELAP led to (1) the loss of core cooling, (2) loss of spent fuel pool cooling capabilities, and (3) a significant challenge to maintaining containment integrity. All direct current (dc) power was lost early in the event on Units 1 and 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 3.1) 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 3.2) on March 12, 2012 to implement mitigation strategies for Beyond-Design-Basis (BDB) 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 spent fuel pool (SFP) cooling capabilities following a beyond-design-basis external event.

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

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

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

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

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

- Phase 1 - The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities.
- Phase 2 - The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site.
- Phase 3 - The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely.

NRC Order EA-12-049 (Reference 3.2) 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 3.3), 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 3.4), dated August 29, 2012, which endorsed NEI 12-06 with clarifications on determining baseline coping capability and equipment quality.

NRC Order EA-12-051 (Reference 3.5) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level. This order was prompted by NTTF Recommendation 7.1 (Reference 3.1).

NEI 12-02 (Reference 3.6) provided guidance for compliance with Order EA-12-051. The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 3.7), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

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

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of a Pilgrim ELAP/LUHS event and the development of FLEX strategies are stated below.

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

- Flood re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 has been completed and submitted to the NRC on March 12, 2015 (Reference 3.8). Appropriate issues will be entered into the corrective action system to be addressed as required.
- The following conditions exist for the baseline case:
    - Seismically designed dc battery banks are available.
    - Seismically designed 120 VAC and 125 and 250 VDC distribution systems are available.
    - Plant initial response is the same as Station Black-Out (SBO) event.
    - Decay heat curve used for Reactor Pressure Vessel (RPV) Core Cooling and Containment Heat Removal thermal calculations is the ANSI/ANS 5.1-1979 decay heat nominal values calculated based on a maximized full power end-of-cycle power history, with additional allowances for miscellaneous Actinides and Activation Products, that is the Current Licensing Basis for Accident Analysis Containment Heat Removal when used with 2-Sigma Uncertainty Adders.
    - Decay heat curve used for RPV and Spent Fuel Pool (SFP) Refueling Mode conditions is the NRC Branch Technical Position ASB 9-2 Rev 2 that is the Current Licensing Basis for SFP Thermal and Heatup Analyses.
    - No additional failures of safety-related SSC assumed except those in the base assumptions, i.e., extended loss of alternating current (ac) power (ELAP) and loss of normal

access to the ultimate heat sink (LUHS). Therefore, the steam-driven RCIC, and HPCI if available, will operate either via automatic control or with manual operation capability per the guidance in NEI 12-06.

- Margin will be added to design FLEX components and hard connection points to bound future increases as re-evaluation warrants. All components will be procured commercially and tested or evaluated, as appropriate, for seismic, environmental, and radiological conditions.
- The design hardened connections are protected against external events or are established at diverse locations.
- Implementation strategies and roads are assessed for hazards impact.
- All Phase 2 components are stored at the site and will be protected against the "screened in" hazards in accordance with NEI 12-06. At least N sets of equipment that directly supports maintenance of a key safety function will be available after the event they were designed to mitigate.
- Additional staff resources are expected to arrive beginning at 6 hours and the site will be fully staffed 24 hours after the event. The FLEX Strategy can be implemented through Phase 2 and into Phase 3 with only on-site resources if necessary.
- Maximum environmental room temperatures for habitability or equipment availability is based on NUMARC 87-00 (Reference 3.9) guidance and/or other design basis information or industry guidance for habitability under extreme emergency conditions. High environmental temperatures are not expected to impact the utilization of off-site resources or the ability of personnel to implement the required FLEX strategies.
- This plan defines strategies capable of mitigating a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink resulting from a beyond-design-basis event by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities. Though specific strategies 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 will be incorporated into the unit emergency procedures and guidelines in accordance with established change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the beyond-design-basis event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x), 10 CFR 73.55(p) and/or 10 CFR 72.32(d). (Reference 3.10)

- NEI 12-06, Section 3.2.1, General Criteria and Baseline Assumptions:
    - The assumptions listed in NEI 12-06, Section 3.2.1, are applicable to PNPS.

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 (as defined in 10 CFR 50.2) but not the loss of ac power to buses fed by station batteries through inverters – with a simultaneous loss of access to the ultimate heat sink (LUHS). This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a beyond-design-basis external event.

The plant indefinite coping capability is attained through the implementation of pre-determined strategies (FLEX strategies) that are focused on maintaining or restoring key plant safety functions. The FLEX strategies are not tied to any specific damage state or mechanistic assessment of external events. Rather, the strategies are developed to maintain the key plant safety functions based on the evaluation of plant response to the coincident ELAP/LUHS event. A safety function-based approach provides consistency with, and allows coordination 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 FLEX equipment.
- Phase 3 – Obtain additional capability and redundancy from off-site equipment and resources until power, water, and coolant injection systems are restored or commissioned.

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

The strategies described below are capable of mitigating an ELAP/LHUS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at Pilgrim. 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 Pilgrim emergency operating procedures in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

The basic FLEX Strategy described in this plan is the overall bounding worst case scenario, that is, in addition to the ELAP, all preferred sources of water are lost such that only the Ultimate Heat Sink (UHS) water source remains available and viable during the initial 72 Hours. This extreme scenario has the most challenging timeline and thereby bounds all other scenarios with respect to the implementation effort. For most postulated events, even within the realm of extreme BDBEEs, there will be preferred water sources in addition to the UHS available for the FLEX Phase 2 response including, most likely, the FLEX Groundwater Wells. The FLEX Strategy described herein nonetheless describes the use of the UHS raw seawater source for Phase 2, with a transition to the FLEX Groundwater Wells for Phase 3. This should not imply that any available preferred water sources would not be fully utilized to the extent possible, as that option is always available and the FLEX Strategy includes such flexibility in approach as a fundamental principle.

2.3 Reactor Core Cooling and Heat Removal Strategy

During the first 6 hours after shutdown caused by the BDBEE, the reactor remains isolated and pressurized with RCIC or HPCI providing core cooling, drawing water from the Torus. The SRVs control reactor pressure.

The operator is directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedures; load shedding starts within 2 hours ensuring the station battery will have greater than 8 hours capability and will be available until the FLEX generators are placed in service on or before 8 hours.

During hours 6 through 9, reactor pressure is reduced to maintain the suppression pool in the acceptable region of the Heat Capacity Temperature Limit (HCTL) Curve.

At approximately hour 9, core cooling is transitioned to the FLEX diesel powered low pressure pumps with suction from the UHS.

At approximately hour 16, the containment is vented for containment heat removal to maintain containment parameters within design temperature limits.

The FLEX diesel powered low pressure pumps with suction from the UHS continue to provide core cooling until approximately hour 72 at which time the suction of the FLEX Pump is transferred to the nominal 21,000 gallon mobile water storage tank, referred to herein as the "FRAC Tank", to provide reactor makeup with the FLEX Pump discharging to the RPV via the CST suction line through the RCIC or HPCI system piping.

2.3.1 Phase 1 Strategy

At the initiation of the BDBEE, the Reactor Scrams, Main Steam Isolation Valves (MSIVs) automatically close, Feedwater is lost, and Relief Valves (SRVs) automatically cycle to control pressure, causing Reactor Water Level to drop (Reference 3.11). When reactor water level reaches the RPV Low-Low Water Level (-46.3 inches), Reactor Core Isolation Cooling (RCIC) and High Pressure Coolant Injection (HPCI) (References 3.11) automatically start with suction from the Condensate

Storage Tank (CST) and operate to inject makeup water to the Reactor Pressure Vessel (RPV). Because the CST is not seismically qualified, it is considered unavailable for the BDBEE (Reference 3.12), and the RCIC suction will be manually switched to the Suppression Pool (Torus) (Reference 3.11, 3.13). The HPCI system suction will automatically switch to the Torus on a low CST level and HPCI will then be secured when the Low-Low Water Level Trip (-46.3 inches) clears (Reference 3.11). This is assumed to happen within the first two (2) minutes of the event.

The RCIC or HPCI system will continue to operate after the reactor level returns to the normal band. During the first 6 hours after shutdown, the reactor remains isolated and pressurized with RCIC providing the core cooling, drawing water from the Torus (see Figure 1 and Figure 6). The SRVs control reactor pressure (Reference 3.11). The operator is directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedures (Reference 3.11). One (1) hour into the event, the determination that the Emergency Diesel Generators (EDGs) cannot be restarted is made and the operating crew classifies the event as a beyond-design-basis event and anticipates a loss of power for an extended time period. The RCIC trip signals and isolation signals that could possibly prevent RCIC operation when needed during the ELAP will be overridden in accordance with procedural direction. Additionally, the Automatic Depressurization System (ADS) will be placed in 'inhibit' to prevent automatic initiation of ADS (Reference 3.11, 3.14). This is necessary to ensure reactor pressure is not reduced to a pressure which would prevent operation of RCIC.

At six (6) hours after the reactor shutdown (see Figure 2 and Figure 6), the Torus will be at 170°F and a controlled reactor depressurization is commenced based on EOP-11 HCTL curve (Reference 3.15). The RPV will be depressurized by manually cycling the SRVs in conjunction with continued RCIC operation to reduce reactor pressure to 120 psig over a three hour period, at which time the Torus will heat up to 235°F (Reference 3.16, 3.17). The SRVs are powered off of the 125 VDC batteries and a Backup SRV Nitrogen Cylinder Supply to SRVs RV-203-3B and C provides a dual set of pressure regulated sources of backup nitrogen that are configured to operate when the normal Drywell Essential Instrument Air Nitrogen Makeup System and the SRV Accumulator pressure is depleted below 98 psig.

The BWROG has performed RCIC studies (Reference 3.18, 3.19) that assess the operation of the RCIC System for long term operation at elevated Suppression Pool temperatures exceeding 230°F. For the successful implementation of the PNPS FLEX Strategy, the RCIC System is operated for approximately 9 hours total time, at the end point of which the Torus temperature is just exceeding 230°F. This short term operation of RCIC at elevated temperatures is considered well within the capabilities of the system, and there is additional margin to allow operation for a longer period of time at these conditions if it were necessary due to delays in implementing the Phase 2 low pressure injection. The PNPS FLEX Strategy does not include Containment Venting until after reactor depressurization and thereby will not affect the Containment Pressure available for RCIC or HPCI Pump NPSH at 230°F Torus temperature during the time that these pumps may be operating (Reference 3.16, 3.17).

At 9 hours after shutdown the reactor remains isolated and pressurized with RCIC providing core cooling, drawing water from the Suppression Pool (Torus). At this time the core cooling strategy will transition from RCIC to diesel powered FLEX Low Pressure Injection Pumps (see Figure 3 and Figure 6), which will be staged and connected from the Ultimate Heat Sink (UHS) to the CST suction line for injection via either the HPCI or RCIC Pump flow path, by injecting through the idle pump and into the normal pump discharge path to the RPV Feedwater lines. An alternate FLEX injection point is to the RHR System via the readily accessible Firewater to Service Water Cross-Tie to RHR, which provides a path to inject into the RPV, Drywell Spray, or Torus via the RHR System. Both FLEX injection points will be similarly outfitted with 5" Storz hose connections, as will all other FLEX connectors to the pumps, strainers, water tanks, and demineralizer tanks.

Electrical/Instrumentation – Load stripping of non-essential loads at readily accessible Circuit Breaker Panels would begin within 2 hour after the occurrence of an ELAP/LUHS and completed within the next 1 hour. With such load stripping, the usable station Class 1E battery life is extended beyond eight (8) hours for the station batteries, with the intention that the FLEX Generators will have repowered the DC Battery Chargers within that timeframe, well before the batteries are approaching the significantly depleted state. (See Section 2.3.11)

2.3.2 Phase 2 Strategy

Primary Strategy Core Cooling

When the Torus exceeds 230°F and no other preferred sources of water are available, the UHS (seawater) will be used to provide subcooled flow boiling conditions to the RPV and the core cooling strategy will transition from using installed equipment to using portable equipment stored on-site (Reference 3.3). The strategy for this transition phase (Phase 2) will be capable of maintaining core cooling capabilities from the time it is implemented until offsite resources are provided in the final phase. The duration of the transition phase will provide sufficient overlap with both the initial and final phases to account for the time it takes to install equipment and for uncertainties (Reference 3.3). Prior to transition to Phase 2, at approximately 6 to 9 hours after shutdown, two diesel powered FLEX Low Pressure Pumps are set up in tandem using 5" hoses with a suction lift from the UHS. The injection pump discharge line is connected to the Strainer Cart, which includes a duplex strainer, flow rate meters and totalizers, then to the primary injection connection point located at the vault between the CST tanks feeding into the underground HPCI/RCIC common suction line as shown on Figure 3 with an alternate injection point to the RHR System if needed. (Reference 3.16, 3.17, 3.20).

Calculation M1384 (Reference 3.21) was prepared to confirm that the diesel powered pumps selected for the FLEX injection strategy could provide required seawater flow through the RCIC system flow path to the RPV. The calculation analyzes the controlling case of the most restrictive FLEX flow path configuration into the RPV. The RCIC flow path was found to be the most conservative flow path as, overall, it has the smallest diameter piping and flow is through the idle RCIC pump.

The HPCI/RCIC common suction line in the CST vault location has a removable protective housing to facilitate connection and provide hardened protection. FLEX portable diesel generator(s) will also be staged and connected to re-power the "A" and "B" 125 VDC battery chargers or the "B" 125 VDC and 250 VDC battery chargers and 120V distribution panel (Y3/Y31 and/or Y4/Y41) to maintain critical instruments and vital AC power. (Reference 3.16, 3.17, 3.20, 3.22)

The RPV will be finally depressurized to its minimum pressure by opening the SRVs and transitioning from RCIC drawing water from the Torus to the diesel powered FLEX Low Pressure Pumps injecting via the idle HPCI or RCIC Pump flow path (see Figure 3 and Figure 6). The final depressurization will be based on EOP-11 HCTL curve (Reference 3.15, 3.24). The SRVs are remote manually held full open to depressurize the RPV for Subcooled Flow Boiling. When RPV pressure drops to approximately 50 to 100 psi above Torus pressure, core cooling will be transitioned from RCIC operation to the diesel powered FLEX Low Pressure Pumps to subcool the RPV at minimum pressure. The tandem FLEX Pumps will provide a Subcooled Flow Boiling injection flow to the RPV with the heated liquid and vapor mixture flowing out the SRVs to the Torus. The flow thru the RPV will be maintained at approximately twice the boil-off rate to preclude concentrating minerals from seawater in the RPV and to thereby preclude any significant fouling of heat transfer surfaces. The initial FLEX flow rate during the final depressurization will be 400 GPM to restore RPV level after which the flow will be reduced to approximately 180 GPM for continuous Subcooled Flow Boiling of the core at 10 hours, and steadily reduced after that at a prescribed rate that will be used to control the FLEX Pump injection rate, via manual speed control of the pump. Torus water level will also be monitored and available in the Main Control Room to evaluate the Torus inventory and water level and make adjustments as needed. At 10 hours after shutdown the Torus will be at 250°F and 15 psig and the Torus level will be slowly rising above the initial 132 inch water level (Reference 3.16, 3.17, 3.20).

The FLEX Strategy, depending on the BDBE scenario, will utilize Raw Water of progressively lower quality, including in the extreme case Raw Seawater as is considered for this Base Case, where the injection is controlled in a Subcooled Flow Boiling regime that precludes Bulk Boiling to prevent the buildup of minerals. This is achieved by controlling the injection at 2x Boil-Off Rate to preclude bulk boiling within the vessel, with the heated liquid and vapor mixture discharging via the open SRVs to the Wetwell. This may be considered as operating a Boiler with a Nominal 65% Blowdown Rate. There is mineral precipitation that occurs on the heat transfer surfaces, predominantly by Calcium Sulfate and similar precipitative compounds, but there would be a high tolerance to this surface fouling as described and evaluated in Calculation M1380. (Reference 3.16)

At 16 hours after shutdown it is calculated that the Torus will heat up to 280°F (Reference 3.16, 3.17). The torus vent AO-5025 will then be opened to provide containment heat removal (see Figure 4 and Figure

6). The Hardened Containment Vent System (HCVS) at PNPS which includes the 8" Air-Operated Butterfly Valve AO-5025 will be capable of venting the Wetwell (Torus) airspace to provide a means of Containment Heat Removal as part of the FLEX Strategy. The Torus steam venting rate will be equivalent to at least 60 GPM at these conditions (Reference 3.16, 3.17, 3.20). The Diesel powered FLEX Low Pressure Injection Pumps continue to provide Subcooled Flow Boiling of the core with heated liquid and vapor mixture flowing out the SRVs to the Torus. The appropriate flow rate required for Subcooled Flow Boiling will be continually reduced according to a schedule (Reference 3.16, 3.17, 3.20) and the flow totalizer readings. At this time, preparations are underway to power the station groundwater wells with a FLEX 20 kW or 86 kW DG and to begin adding water to completely fill the Water Storage FRAC Tank to prepare for a Phase 3, long-term reactor feedwater makeup and boiling strategy. (Reference 3.16, 3.17, 3.20)

Alternate Strategy Core Cooling

If the RCIC system should fail such that the CST line to the RCIC Pump suction flow path was not available, the alternate FLEX Hydraulic water source injection point will be to the RHR System at the existing Fire Water to RHR System Cross-Tie 8-inch connection via a removable spool in the Auxiliary Bay EL 23 ft Water Treatment Area via 8-inch Fire Water Manual Isolation Gate Valve 10-HO-511 that feeds into the RHR System 18-inch Cross-Tie. (Reference 3.25, 3.26).

A removable 8-inch FLEX spool piece connector with Victaulic Couplings would be installed to accept a 5-inch Hose Connector from the two diesel powered FLEX Low Pressure Pumps set up in tandem using 5” hoses with a suction lift from the UHS.

The pump discharge line includes a duplex strainer, flow rate meter and a totalizer. PNPS 5.3.26 (Reference 3.27) provides the guidance on providing a low pressure injection source for this scenario.

FLEX Groundwater Wells

The FLEX Groundwater Wells or other purified water source shall have a production capability that is based on the Reactor makeup water requirements at 72(+) Hours after Reactor shutdown, with an accounting for Recirc Pump seal leakage, plus the Spent Fuel Pool makeup water requirement, as follows:

Reactor Makeup for Boil-Off @ 75 PSIG
@ 72(+) Hrs after Shutdown = 52 GPM

Reactor Recirculation Pumps P-201A/B
Seal Leakage @ 75 PSIG = 16 GPM

Spent Fuel Pool Makeup for Boil-Off
@ 30 Days after RFO Shutdown = 12 GPM

Total Makeup Water Required = 80 GPM

This makeup rate is also equal to the bounding Refueling Outage requirements given above for the Boil-Off Rate @ 36 Hrs after Reactor shutdown and exceeds the Full Core Off-Load Boil-Off Rate at 150 Hours after Reactor shutdown as described in later sections for the Refueling Modes of operation.

Each FLEX Groundwater Well has the following rated capacity:

FLEX Groundwater Well Rated Capacity = 60 GPM @ 300 ft TH

Two FLEX Groundwater Wells can thereby provide a total of 120 GPM to either fulfil the FLEX Phase 2 makeup water requirements during the initial 72 Hours or to later provide the total feed flow to the Reverse Osmosis Water Treatment System, as-needed, to produce the necessary total makeup water requirements for FLEX Phase 3.

Primary Strategy to Repower Battery Chargers

To recharge the 125 and 250 VDC batteries AC power transfer switches disconnect the chargers from their 480 VAC electrical buses and provide a cable connector on the 480 VAC line side of each individual 125 and 250 VDC Station Battery Charger (Normal and Backup) to provide power directly to the battery chargers using FLEX portable 480 VAC 3-PH AC Power Generator(s). See Figure 7 and Figure 10. (References 3.20, 3.22, 3.28)

A 150 kW 480 VAC 3-PH AC diesel generator (DG) is pre-staged in Turbine Building Truck Lock area, a protected location that provides for rapid deployment. Two (2) 86 kW and two (2) 20 kW 480 VAC DGs are stored in the FLEX storage areas (one each per storage area).

The charger repowering strategy depends on which FLEX 480 VAC 3-PH generators are available after the event.

The initial strategy to repower equipment is based on the following priorities when there are one (1) 150 kW Generator and one (1) 86 kW Generator available (see Reference 3.29, Calculation PS262, FLEX Diesel Generator Loading, for an evaluation of the loading capabilities of the FLEX diesel generators):

FLEX 480 VAC 86 kW Generator #1 of 2:

- 125 VDC "A" Battery Charger
- Portable Ventilation Fan for "A" 125 VDC D1 Battery Room EL 37 ft
- 120 VAC Instrumentation Power to Panels Y3 and Y31

FLEX 480 VAC 150 kW Generator #2 of 2 (the FLEX 480 VAC 150 kW Generator has the capability to repower all three chargers plus the fans and 120 VAC panels listed below, Reference 3.29):

- 125 VDC "B" and 250 VDC Battery Chargers
- Portable Ventilation Fan for "B" 125 VDC D2 and 250 VDC D3 Battery Room EL 23 ft
- 120 VAC Instrumentation Power to Panels Y4 and Y41

If the 150 kW generator is not available, the strategy will use two (2) 86 kW Generators for either of the following two options

- When the 250 VDC System is desired:
    - FLEX 480 VAC 86 kW Generator #1 of 2:
        - 125 VDC "B" Battery Charger
        - Portable Ventilation Fan for "B" 125 VDC D2 and 250 VDC D3 Battery Room EL 23 ft
        - 120 VAC Instrumentation Power to Panels Y3 and Y31 OR Panels Y4 and Y41
    - FLEX 480 VAC 86 kW Generator #2 of 2:
        - 250 VDC Battery Charger

        - 120 VAC Instrumentation Power to Panels Y3 and Y31 <u>OR</u> Panels Y4 and Y41

- When the 250 VDC System is not needed:
    - FLEX 480 VAC 86 kW Generator #1 of 2:
        - 125 VDC "A" Battery Charger
        - Portable Ventilation Fan for "A" 125 VDC D1 Battery Room EL 37 ft
        - 120 VAC Instrumentation Power to Panels Y3 and Y31
    - FLEX 480 VAC 86 kW Generator #2 of 2:
        - 125 VDC "B" Battery Charger
        - Portable Ventilation Fan for "B" 125 VDC D2 and 250 VDC D3 Battery Room EL 23 ft
        - 120 VAC Instrumentation Power to Panels Y4 and Y41

During the initial stage of the FLEX Strategy, repowering the 125 VDC "A" and "B" Battery Chargers from the Pre-Staged FLEX 480 VAC 150 kW Single Generator #1 may be desired, if it is available, until such time that a 480 VAC 86 kW Generator #2 becomes available, with the exception that if the HPCI System is necessary to be operated for RPV Injection (rather than RCIC), in which case the alternate single generator strategy below is to be used:

FLEX 480 VAC 150 kW Single Generator #1 of 1 (two options):

- When using RCIC for RPV Injection:
    - 125 VDC "A" and "B" Battery Chargers
    - Portable Ventilation Fans for:
        - "A" 125 VDC D1 Battery Room EL 37 ft
        - "B" 125 VDC D2 and 250 VDC D3 Battery Room EL 23 ft

  - 120 VAC Instrumentation Power to Panels Y3 and Y31 <u>OR</u> Panels Y4 and Y41

- When using HPCI for RPV Injection:
  - 125 VDC "B" and 250 VDC Battery Chargers
  - Portable Ventilation Fan for "B" 125 VDC D2 and 250 VDC D3 Battery Room EL 23 ft
  - 120 VAC Instrumentation Power to Panels Y3 and Y31 <u>OR</u> Panels Y4 and Y41

<u>Alternate Strategy to Repower Battery Chargers</u>

The ability to power any of the Normal and Backup 125 and 250 VDC Station Battery Chargers using the various FLEX DG configurations discussed above, provides a diverse and flexible strategy to repower the 125 and 250 VDC Station Batteries. See <u>Figure 7</u> and <u>Figure 10</u>. (Reference 3.20, 3.22)

<u>FLEX Portable Diesel Generator Deployment Strategy</u>

Transition from Phase 1 (reliance on station batteries) to Phase 2 (repowering station battery chargers) will be made using FLEX 480 VAC 3-PH Portable DG(s) to supply power to any of the five (5) 125V and 250V DC Station Battery Chargers (Normal and Backup) that provide charging power to the 125V and 250V batteries (this action does not become time critical until after 8 hours). See the <u>Primary Strategy to Repower Battery Chargers</u> discussion above regarding the various FLEX 480 VAC DG configurations depending on which FLEX 480 VAC DGs are available following a BDBEE. It is anticipated that the decision to deploy the FLEX DG(s) will be made during the initial response phase. The operator is directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedures. Load shedding starts within 2 hours and is phased in based on equipment location and critically. For example the turbine emergency seal oil pump is maintain for up to 7 hours to prevent uncontrolled H2 release into the turbine. This ensures the station battery will have greater than 8 hours capability and will be available until the FLEX generators are placed in service on or before 8 hours (Reference 3.31, 3.32, 3.33). The two (2) required (N) FLEX 86 kW DGs will be maintained in on-site FLEX storage structures (Reference 3.20). The third (N+1) FLEX 150 kW DG will be pre-staged in the Turbine Building Truck Lock area, which is a protected area in close proximity to the Battery Charger and Switchgear Rooms. This will allow for more rapid deployment of the first FLEX DG for ELAP events where that is possible.

The intent is to return the battery chargers to service to support connected loads and start recharging the station batteries before they become depleted. A single 150 kW generator is capable of repowering two 125V battery chargers and the 250V battery chargers, with associated battery room ventilation and 120 VAC panels (Reference 3.29). If the pre-staged (N+1) FLEX 150 kW DG is not available, then two FLEX 86 kW DGs would be deployed to repower the chargers of both division simultaneously prior to the batteries becoming depleted.

The FLEX 86 kW DGs from the storage sites will be transferred and staged via haul routes and staging areas (see Figure 8 and Figure 9) evaluated for impact of external hazards (Reference 3.20, 3.34). Modifications were implemented to facilitate the connections and operational actions required to repower any of the Station Battery Chargers (Normal and Backup) directly from the FLEX DGs (see Figure 10). This will be accomplished utilizing AC Power Transfer Switches and Portable Cable Connections located in the A and B Switchgear Rooms and serve to completely disconnect from the normal 480 VAC bus source to allow the external 480 VAC feed from the FLEX 480 VAC DG(s) (References 3.20, 3.28). Electrical connection points for the 480 VAC FLEX DG(s) will be missile protected and enclosed within the Seismic Category 1 structure of the DC Power Battery Rooms and Switchgear. Programs and training will be implemented to support operation of FLEX DGs. Six hours has been used as a reasonable assumption for transferring and placing the FLEX portable DGs into service. All 480 VAC 3-PH 4-Conductor Cable requirements for Portable Generators will be provided with 4-Wire 100 Amp Plugs, Connectors, and Receptacles for 125 and 250 VDC Battery Chargers and Well Pumps (see Figure 10). The required cabling will be pre-staged in the vicinity of the Battery Charger and Switchgear Rooms.

2.3.3 Phase 3 Strategy

Primary Strategy

The intent of the PNPS FLEX Strategy is to transition from Phase 2 to Phase 3 long term cooling with no immediate reliance on equipment from the National Strategic Alliance for FLEX Emergency Response (SAFER) Response Centers (NSRC). However, backup NSRC equipment may be utilized as-needed for either the Phase 2 or 3 strategies long term. Figure 10 shows connection configurations for use of NSRC supplied generators.

The Torus cools down to 250°F at 72 hours after shutdown. The Torus Vent AO-5025 will still be open to provide containment heat removal. The Torus steam venting rate will be equivalent to a 60 GPM Torus makeup water flow rate. (Reference 3.16) The diesel powered FLEX Low Pressure Injection Pumps have been providing subcooled flow boiling conditions to the core with a heated liquid and vapor mixture flowing out the SRVs to the Torus, which may be approaching the maximum intended water level. At this time, if not already performed as the preferred Phase 2 water source, the station FLEX Groundwater Wells will be powered by a portable FLEX 20 kW or 86 kW DG (Reference 3.29) and the Well Pumps will be feeding the nominal 21,000 gallon capacity FRAC Tank. (Reference 3.20) The transition to Phase 3 will be completed by transferring the suction of the FLEX Pump to the FRAC Tank to provide reactor makeup with the FLEX Pump discharging to the RPV via the CST suction line (or alternate RHR injection point) to begin a long-term reactor feedwater makeup and boiling strategy (see Figure 5 and Figure 6). It is intended that the NSRC will also have provided and set up a 125 GPM capacity mobile skid-mounted Reverse Osmosis Water Treatment System to demineralize the water supplied to the FRAC Tank, but such water treatment is not immediately required for the FLEX Groundwater Well source as it is sufficiently low in mineral content to be used as RPV and SFP makeup water for at least the initial 30 day timeframe. The RPV will be flushed with subcooled water from the FRAC tank to the Torus (via SRVs) and then the RPV will be allowed to boil down to a stable water level. Once the Phase 3 configuration is established, the plant will be in a stable condition with outside resources available to maintain stable conditions indefinitely and there are no time-critical actions that are required to restore additional plant systems. (Reference 3.16, 3.17, 3.20, 3.30)

Alternate Strategy

The alternate long term core cooling strategy will be similar to Phase 2 alternate strategy where the RPV injection point will be thru the FLEX Hydraulic water source injection point to the RHR System at the existing Fire Water to RHR System Cross-Tie connection and the source of water being used will be from the Well Pumps supplying the FRAC Tank through the NSRC Skid-Mounted Water Treatment System as described above.

The equipment to be supplied from the NSRC to support long term FLEX strategies includes:

- 20,000 gallon collapsible water storage bladder (Qty 1)
- Skid-mounted Filtration and Reverse Osmosis Water Treatment System with 150 kW 480 VAC 3-PH Diesel Generator (Qty 1)

2.3.4 Systems, Structures, Components

2.3.4.1 Reactor Core Isolation Cooling (RCIC)

The RCIC System consists of a steam turbine-driven pump designed to supply water from the Condensate Storage Tank (CST) or the suppression pool to the vessel via a feedwater line and spargers. It utilizes reactor steam via Main Steam Line “C” to drive the turbine which is exhausted into the suppression pool.

The RCIC system automatically starts when reactor water level reaches the RPV Low-Low Water Level (-46.3 inches) following an ELAP / LUHS event. The RCIC suction is initially from the CST and operates to inject makeup water to the RPV, however, because the CST is not seismically qualified, it is considered unavailable for the BDBEE and the RCIC suction is manually switched to the Suppression Pool (Torus). RCIC pump injection rate is controlled by manual speed control of the RCIC turbine. The RCIC System operates completely independent of AC power.

The RCIC System is capable of delivering 400 gpm to the reactor vessel over a range of Reactor pressure from 150 psig to 1190 psig (Reference 3.52 Section 4.7.5). It has makeup capacity sufficient to prevent the Reactor Vessel water level from decreasing to the level where the core would be uncovered.

The turbine-pump assembly is located below the level of the Condensate Storage Tank and below the minimum water level in the Torus to ensure positive suction head to the pump.

Auto-initiation causes the following functions to occur:

- MO-1301-48, RCIC Pump Discharge Injection Valve #1, opens if closed.
- MO-1301-49, RCIC Pump Discharge Injection Valve #2, opens if closed.
- MO-1301-16, RCIC Steamline Inboard Isolation Valve, opens if closed.
- MO-1301-17, RCIC Steamline Outboard Isolation Valve, opens if closed.
- MO-1301-22, RCIC Pump Condensate Storage Tank Suction Valve, opens provided that MO-1301-25 and MO-1301-26, RCIC Pump Torus Suction Valves, are not fully open.
- MO-1301-62, RCIC Cooling Water Supply Valve, opens.
- P-222, RCIC Gland Seal Vacuum Pump, starts.
- MO-1301-61, RCIC Turbine Steam Inlet Valve, opens.
- MO-1301-60, RCIC Pump Minimum Flow Valve, opens; but will close on signal of high flow at 100 GPM.
- MO-1301-53, RCIC Full Flow Test Valve, will close if open.

During standby conditions, MO-1301-61, RCIC Turbine Steam Inlet Valve, is closed, the Trip and Throttle (T&T) Valve is open, and the governor valve is open. On low Reactor water level, MO-1301-61 will automatically open to start the turbine. The turbine is shutdown on Reactor high water level by the automatic closure of steam supply, MO-1301-61. Thus, the manually operated Trip and Throttle Valve remains open during the high level trip operation and the system is allowed to restart automatically upon receipt of a Reactor low-low water level signal.

The governor valve controls turbine speed by throttling the turbine inlet steam flow. The valve is positioned by means of a hydraulic actuator mounted on the valve. During auto system initiation, the control signals for the valve originate in the Main Control Room from the flow controller. The flow controller can be operated manually or in the automatic mode. The flow controller adjusts the turbine speed, by means of the governor valve, to obtain the required pump output flow. The governor valve, and thus turbine speed, can be controlled manually by using the flow controller in manual. (Reference 3.13)

The RCIC system can also be manually started and operated with a loss of AC and DC power in accordance with PNPS Procedure 5.3.26, RPV Injection During Emergencies (Reference 3.27).

2.3.4.2 Nuclear System Pressure Relief System

During an ELAP / LUHS event, with the loss of all ac power and instrument air, Relief Valves (SRVs) automatically cycle to initially control reactor pressure unless or until the Operations crew manually control RPV pressure by manually initiating SRV openings to maintain RPV pressure at approximately 900 to 1050 psig initially, which is procedurally controlled and preferred to automatic cycling.

At approximately six (6) hours after the reactor shutdown, the Torus will be at 170°F and a controlled reactor depressurization is commenced based on EOP-11 HCTL curve. The RPV will be depressurized by manually cycling the SRVs in conjunction with continued RCIC operation to reduce reactor pressure to 120 psig over a three hour period. The SRVs are remote manually opened as-needed to control and reduce reactor pressure.

At approximately hour 9, the RPV will be depressurized to approximately 50 psi above Torus pressure by opening the SRVs, and core cooling is transitioned to the FLEX diesel powered low pressure pumps with suction from the UHS. The final depressurization will be based on EOP-11 HCTL curve. The SRVs are manually held full open to depressurize the RPV for low pressure injection.

At approximately hour 16, the containment is vented for heat removal to maintain parameters within design temperature limits. The diesel powered FLEX Low Pressure Injection Pumps continue to provide subcooled flow boiling conditions to the core with a heated liquid and vapor mixture flowing out the SRVs to the Torus.

Main Steam Relief Valves (SRV) RV-203-3B and RV-203-3C are pilot-actuated to open either automatically or manually when required to support primary system depressurization. The Main Steam SRV pneumatic operators are normally supplied by the Essential Instrument Air System (System 31) which has its own backup N2 system that keep SRV Accumulator Tanks T-221B and T-221C charged upon loss of normal Essential Instrument Air. An additional new SRV Backup N2 supply station has been installed to provide an independent seismically qualified pneumatic motive force to extend the operating time of Main Steam SRVs RV-203-3B and RV-203-3C.

Since the FLEX event extends beyond the eight (8) hour period of time in which the accumulator tanks are designed to operate, an indefinite and reliable source of backup N2 is required for SRVs RV-203-3B and RV-203-3C. The existing backup SRV N2 supply station was modified to accommodate a second N2 station in the same location on the 23'-0" Elevation of the Reactor Building. The modification provided improvements for the purpose of configuration efficiency, ease of operation, system redundancy, and increased N2 capacity. Additionally, the modified configurations allows for Operations to change out N2 cylinders and engage the backup SRV supply stations without the use of tools.

2.3.4.3 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. Load shedding of non-essential equipment provides an estimated total service time of at least 8 hours of operation.

2.3.4.4 Pressure Suppression Chamber

The suppression pool (torus) is the heat sink for reactor vessel SRV discharges and RCIC turbine steam exhaust following a BDBEE. It is also the suction source for the RCIC pump for providing core cooling during the first 9 hours after shutdown caused by the BDBEE.

The design basis for the pressure suppression pool, which is contained in the pressure suppression chamber, is to initially serve as the heat sink for any postulated transient or accident condition in which the normal heat sink, main condenser, or Shutdown Cooling System is unavailable. Energy is transferred to the pressure suppression pool by either the discharge piping from the reactor pressure relief valves or the Drywell Vent System. The relief valve discharge piping is used as the energy transfer path for any condition which requires the operation of the relief valves. The Drywell Vent System is the energy transfer path for all energy releases to the drywell.

The pressure suppression pool receives this flow, condenses the steam portion of this flow, and releases the non-condensable gases and any fission products to the pressure suppression chamber air space. The condensed steam and any water carryover cause an increase in pool volume and temperature. Energy can be removed from the suppression pool when the Residual Heat Removal System (RHR) is operating in the suppression pool cooling mode. During a BDBEE energy is removed from the suppression pool by utilization of the torus vent which vents the torus to atmosphere.

The suppression pool is the primary source of water for the Core Spray and Low Pressure Coolant Injection (LPCI) Systems, and the secondary source of water for the Reactor Core Isolation Cooling (RCIC:) and High Pressure Coolant Injection (HPCI) Systems. The water level and temperature of the suppression pool are continuously monitored in the main control room.

The pressure suppression chamber is a steel pressure vessel in the shape of a torus below and encircling the drywell, with a centerline vertical diameter of 29 ft 6 in and a horizontal diameter of 131 ft 6 in. The pressure suppression chamber contains approximately 84,000 ft^3 of water and has a net air space above the water pool of approximately 120,000 ft^3. The suppression chamber will transmit seismic loading to the reinforced concrete foundation slab of the Reactor Building.

The suppression pool water volume is maintained between 84,000 ft^3 and 94,000 ft^3 per Limiting Conditions for Operation (LCO) 3.7 of the Technical Specifications.

2.3.4.5 Ultimate Heat Sink

At approximately hour 9, transition from RCIC to FLEX equipment (Phase 2) for the low pressure Core Cooling Function occurs by placing the diesel powered FLEX Low Pressure Pumps in service with injection from the UHS through a duplex strainer cart with flow monitoring and into the common CST suction line to the HPCI and RCIC Pumps. Two diesel powered FLEX Low Pressure Pumps are set up near the UHS in tandem using 5" hoses with a suction lift from the UHS.

The UHS for the site comes from Cape Code Bay and is provided to the Salt Water Service System which supplies coolant to the secondary sides of the heat exchangers of the Reactor Building and Turbine Building Closed Cooling Water Systems to remove heat produced during normal operation, shutdown, and accident conditions. Cooling water (seawater) is taken at the intake structure by the five service water pumps and discharged with the condenser circulating water. Cape Cod Bay is a broad, open mouthed water body formed by the eastward and then northward extension of Cape Cod out from the coast of Massachusetts. Cape Cod Bay has a surface area of approximately 430 mi^2 (nautical), or 365,000 acres. The volume of Cape Cod Bay is about 1.6×10^{12} ft^3.

2.3.4.6 Condensate Storage Tank (CST) Tank Vault

The CST valve pit is an underground concrete structure located and shared between the two CST units (T-105A/B). The pit provides protection and access to various valves connecting to each respective CST. The design will ensure the connections are available for applicable BDBEE (e.g., seismic, high wind/missiles).

A removable protective enclosure is provided for the above ground portion of the Primary Connection branch piping to provide protection against high wind/missile objects. The missile enclosure consists of two main parts; the inner missile enclosure and the outer missile enclosure. The inner missile enclosure is designed to withstand the impact of the vertical tornado generated missiles and tornado vertical uplift due to the differential pressure. All of the horizontal tornado generated impact is absorbed by the outer missile enclosure. The missile enclosure is attached to the CST vault concrete slab.

2.3.4.7 Condensate Storage Tanks (CSTs)

Following a BDBEE, when reactor water level reaches the RPV Low-Low Water Level, RCIC automatically starts with suction from the CST and operates to inject makeup water to the Reactor Pressure Vessel (RPV). Because the CST is not seismically qualified, it is considered unavailable for the BDBEE, and the RCIC suction will be manually switched to the Suppression Pool (Torus). If the CST were to remain available, the RCIC pump would remain aligned to the CST, until its supply is exhausted.

The two condensate storage tanks provide the preferred supply to the HPCI and RCIC systems. The torus water storage provides the backup emergency HPCI and RCIC systems supply. Each tank has a capacity of 275,000 gallons. Each condensate storage tank is designed to provide a reserve of approximately 75,000 gallons for HPCI and RCIC use. The other condensate tank service demands are physically isolated by use of suction lines raised to an elevation above this reserve. Because the volume of water that is usable by HPCI or RCIC within the reserve is reduced to maintain adequate suction nozzle submergence, an additional amount of volume in the CST is administratively controlled to ensure adequate inventory is available for HPCI and RCIC to support an 8 hour station blackout duration.

2.3.5 Primary Core Cooling Phase 2 Connection Point

Prior to transition to the Phase 2 core cooling strategy, at approximately 6 to 9 hours after shutdown, two diesel powered FLEX Low Pressure Pumps are set up in tandem, with the primary lift pump near the UHS using 5" hoses configured for a suction lift from the UHS. The tandem injection pump discharge line includes a duplex strainer, flow rate meter and a totalizer. The primary hydraulic tie-in location is in the Condensate Transfer System line 18"-HA-26 on plant side of valves 26-HO-78 and 26-HO-79 with a protected branch line routed through the concrete ceiling of the CST valve pit. An isolation valve is provided inside the CST valve pit near the tie in location so that the branch piping will not be a dead leg filled with condensate when not in use. A drain line is placed at a low point in the new branch line upstream of the new manual isolation valve. The drain valve will be OPEN during normal plant operation to ensure the standpipe is empty and protected from freezing. The connection terminates outside the pit with a flanged 5-inch Storz hose connection within a protective enclosure and tornado missile shield. A removable Storz elbow fitting with 5" Storz connections is utilized to orient the connection for the planned fire hose route during FLEX response. A removable two-way valve with 5" Storz hose connections may be installed either directly onto the elbow end connection or with a segment of fire hose during FLEX response to permit swapping flow paths without interruption. See Figure 3. A hydraulic calculation was performed to demonstrate the feasibility of the flowpath.

2.3.5.1 Alternate Core Cooling Phase 2 Connection Point

In the event that the primary Phase 2 core cooling strategy connection is not available, an alternate connection location is provided. The alternate hydraulic tie-in is in the Fire Protection to SSW/RHR Cross-Tie located in a protected area of the Auxiliary Bay Water Treatment Area at Elevation 23'-0" of the Reactor Building. A removable elbow connection is utilized that consists of a Victaulic Style grooved coupling fitting for attachment of the elbow that has a 5" Storz hose connection. The fixture will be oriented based on the planned fire hose route during FLEX response. A removable two-way valve with 5" Storz hose connections may be installed with a segment of fire hose during FLEX response to permit swapping flow paths without interruption. Existing procedure PNPS 5.3.26 provides the existing guidance on providing a low pressure injection source for this scenario.

2.3.5.2 Primary Electrical Connection

To recharge the 125 and 250 VDC batteries AC power transfer switches disconnect the chargers from their 480 VAC electrical buses and provide a cable connector on the 480 VAC line side of each individual 125 and 250 VDC Station Battery Charger (Normal and Backup) to provide power directly to the battery chargers using FLEX portable 480 VAC 3-PH AC Power Generator(s). See Figure 7 and Figure 10. (Reference 3.28)

A 150 kW 480 VAC 3-PH AC diesel generator (DG) is pre-staged in Turbine Building Truck Lock area, a protected location that provides for rapid deployment. Two (2) 86 kW and two (2) 20 kW 480 VAC DGs are stored in the FLEX storage areas (one each per storage area).

The charger repowering strategy depends on which FLEX 480 VAC 3-PH generators are available after the event. See the Primary Strategy to Repower Battery Chargers discussion in Section 2.3.2 regarding the various FLEX 480 VAC DG configurations depending on which FLEX 480 VAC DGs are available following a BDBEE.

2.3.5.3 Alternate Electrical Connection

The ability to power any of the Normal and Backup 125 and 250 VDC Station Battery Chargers using the various FLEX DG configurations discussed above, provides a diverse and flexible strategy to repower the 125 and 250 VDC Station Batteries. See Figure 7 and Figure 10.

2.3.6 Key Reactor Parameters

Instrumentation providing the following key parameters is credited for all phases of the RPV inventory and core heat removal strategy and RPV pressure boundary and pressure control:

- RPV Level - RPV narrow range level indication is available in the MCR on Panel C905, Cable Spreading Room instrument racks C2233A and B, and local instrument racks. RPV fuel zone level indication is available in the MCR on Panel C903 and Cable Spreading Room instrument racks C2233A and B.
- RPV Pressure - RPV pressure indication is available in the MCR on Panel C905, MCR PAM Panels C170 and C171, Cable Spreading Room Instrument racks C2233A and B, and local instrument racks.

The above instrumentation is available prior to and after load stripping of the dc and ac buses during Phase 1. Continued availability during Phases 2 and 3 will be maintained by repowering the 125 VDC battery chargers for the station 125 VDC batteries using FLEX Portable Diesel Generators. The repowering electrical connection to the Battery Chargers is facilitated by the use of installed 480 VAC 3-PH Manual Transfer Switches with plug connectors (see Figure 10) (Reference 3.28).

The 250 VDC System provides backup power to the Vital MG Set DC Drive Motor such that it provides uninterrupted 120 VAC Power to Vital AC Panel Y2 during a Station Blackout. ECCS Analog Monitoring and Trip System Racks C2233A and B, are located in the Cable Spreading (CS) Room and transmit certain Reactor Pressure and Water Level signals to the MCR Panels C903 and C905. CS Room Racks C2233A and B include dual power source feeds from 120 VAC Panels Y3 and Y4 and from 125 VDC Panels D36 and D37 to their respective 24 VDC Power Supplies that provide parallel 24 VDC Power Source Outputs, either of which can provide power to all of the C2233A and B connected instruments. These power sources supply all of the credited RPV essential instrumentation.

Capability is being provided to allow alternate power to 120VAC safeguard power supply panels (Y3/Y31 or Y4/Y41) from mobile FLEX 480 VAC 86 kW and/or 150 kW DGs having 120 VAC 1-PH output to maintain these systems operating indefinitely (see Figure 10) and safeguard 120/240VAC control power supply panels (Y13 or Y14) repowered as-needed from any available mobile FLEX or SAFER (NSRC) Diesel Generators with 120/240 VAC 1-PH outputs. . The repowering electrical connection to the 120/240 VAC 1-PH Panels is facilitated by the use of installed 120/240 VAC 1-PH Manual Transfer Switches with plug connectors located in the Cable Spreading Room, Vital MGset Room and PASS Area (References 3.35, 3.36).

Portable FLEX 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, operation experience, and expected equipment function in an ELAP.

In the event that 120 VDC and 120 VAC Vital Bus infrastructure is damaged, alternate FLEX strategy guidelines for obtaining the critical parameters locally is provided in an FSG in accordance with the guidelines of NEI 12-06 Section 5.3.3.1.

2.3.7 Thermal Hydraulic Analyses

The PNPS FLEX Strategy Timeline is based on a conservative simplified heat balance analysis (Reference 3.16); this analysis is the basis for ensuring adequate core cooling for the FLEX Strategy. Additionally, as part of the FLEX strategy development and detailed evaluation, a comprehensive MAAP4 Analysis (Reference 3.17) was performed that produced significantly more favorable results, which was considered to provide validation of the simplified calculation values that are used for the FLEX Strategy Timeline. These analyses support the FLEX strategies discussed in subsections 2.3.1, 2.3.2 and 2.3.3.

Utilization of the MAAP4 Code:

Case 1 of the MAAP4 analysis was the specific run selected to represent the scenario as described in Pilgrim's FLEX Strategy. The Pilgrim FLEX

Strategy is based on operators commencing a cooldown of the RPV at 6 hours in accordance with existing EOP Heat Capacity Temperature Limit Curves over a three hour period until a vessel pressure of approximately 120 psig is reached, followed by a final depressurization to allow FLEX low pressure injection. The Pilgrim Technical Specifications limit is 100 degF/hr. averaged over a period of one hour. The resulting plot of the RPV pressure from the MAAP4 analysis confirms this cooldown rate and the collapsed RPV water level remains over 2.5 ft above Top of Active Fuel (TAF) at its lowest point at the end of RCIC operation and depressurization, which is followed by RPV flooding.

MAAP4 Code benchmarking for the program's use in support of Post-Fukushima applications is discussed in detail in Section 5 of EPRI Report 3002001785 “Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications” (Reference 3.37), which includes MELCOR Code result comparisons as well as direct result comparisons to actual plant pressure and temperature data from Fukushima Dai-ichi Units 1, 2, and 3. The EPRI report concludes that the MAAP4 code is acceptable for use in support of the industry response to Order EA-12-049.

The PNPS MAAP4 analysis was performed in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper, EPRI Technical Report 3002001785.

Key modeling parameters cited in Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236, Reference 3.38) are specifically addressed in the MAAP4 Analysis (Reference 3.17). The reactor vessel and containment nodalization followed standard schemes that are described. The MAAP4 Code is readily capable of analyzing the two-phase flow conditions from the RPV, and validations were performed for the key parameters that are checked for these two-phase level and flow conditions. Modeling of heat transfer and losses from the RPV, decay heat, and the plant-specific inputs are also described and followed standard practices.

2.3.8 Recirculation Pump Seal Leakage

Recirculation Pump P-201A/B seal leakage has been assigned a value of 16 gpm at 75 psig for the purpose of evaluating FLEX total makeup water supply requirements after the RPV has been depressurized. The assumed values for Recirculation Pump P-201A/B seal leakage in the FLEX Calculation M1380 and MAAP4 Analysis have a different basis and the resulting seal leakage and its effects are represented in these analyses in the manner described below.

The MAAP4 Analysis (Reference 3.17) assumed an initial Primary System Leakage of 25 gpm at the normal Operating Pressure (1035 PSIG) for the Reactor Pressure Vessel (RPV). This 25 gpm value is the allowable PNPS Technical Specification Section 3.6 Primary System Coolant Total Leakage of 25 gpm that is the limit for any 24 Hour period (Reference 3.12). The primary system leakage is assumed to start at time zero and vary with reactor pressure. The RPV leakage location is set at the Reactor Recirculation (RR) Pump Suction Nozzle Elevation (ZSRR) and it was iteratively determined that a leakage area (ALOCA) of 3.81E-4 sq ft would provide the assumed initial leakage of 25 gpm at normal reactor pressure. The leakage is determined using an area in order to allow variations in the leakage value depending on primary side pressure conditions. This location and conditions would result in a single-phase liquid discharge that flashes to a liquid-vapor mixture that is representative of Recirculation Pump seal leakage. Upon exiting the Recirculation Pump, 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 that is included in the MAAP4 Model. This seal leakage that occurs during FLEX Phase 1 RCIC/HPCI System operation does not challenge the RPV makeup capabilities of these systems. It is included to account for potential steam leakage in the Drywell and the resulting temperature effects.

For FLEX Calculation M1380, Recirculation Pump P-201A/B total seal leakage is assigned a value of 16 gpm at 75 psig for the purpose of evaluating FLEX makeup water supply requirements after RPV depressurization has been performed. A leakage of 16 gpm at 75 psig would correspond to approximately 60 GPM at the normal Operating Pressure (1035 PSIG). This higher leakage value is to account for the potential seal leakage that occur after RPV depressurization due to internal seal component leakage (commonly referred to as "seal face hang-up"). Calculation M1380 transfers all Decay Heat to the

Suppression Pool (Wetwell) water such that there is no modeling of the Drywell, it is simply assumed to be a Saturated Steam conditions based on the Wetwell Saturation Temperature, which is maximized by this heat transfer.

2.3.9 Shutdown Margin Analysis

Not applicable to BWRs for FLEX.

2.3.10 Flex Pumps and Water Supplies

2.3.10.1 FLEX Low Pressure Injection Pumps

Consistent with NEI 12-06, Appendix C, RPV water injection capability is provided using portable FLEX pumps through a primary or alternate connection. When RPV pressure drops to approximately 50 psi above Torus pressure, core cooling will be transitioned (Phase 2) from RCIC operation to the diesel powered tandem FLEX Low Pressure Injection Pumps to providing subcooled flow boiling conditions to the core with a heated liquid and vapor mixture flowing out the SRVs to the Torus at minimum pressure. The flow thru the RPV will be maintained at twice the boil-off rate to preclude concentrating minerals from seawater in the RPV and to preclude any significant fouling of heat transfer surfaces. The initial FLEX flow rate during the final depressurization will be approximately 400 GPM to restore RPV level after which the flow will be reduced to approximately 180 GPM for continuous subcooled flow boiling conditions to the core at 10 hours, and steadily reduced after that at a prescribed rate that will be used to control the FLEX Low Pressure Injection Pump injection rate, via manual speed control of the pump. Torus water level will also be monitored and available in the MCR to evaluate the Torus inventory and water level and make adjustments as-needed.

The first of two tandem diesel driven FLEX Low Pressure Injection Pumps take suction from the UHS and feeds a pressurized suction to the second pump to achieve sufficient flow capacity and total head for RPV injection. The diesel pumps are operated under manual speed control to achieve the desired pressure and flow as read locally on the duplex strainer cart flow meter and totalizer. Once the diesel driven

FLEX Low Pressure Injection Pumps are deployed near the UHS, the engine-driven pumps are initiated, purged, and vented and flow is established through an open-ended discharge return hose to ensure the pumps are operating and ready to inject to the RPV. As the RPV depressurization is completed and the RCIC steam supply is isolated, the FLEX Low Pressure Injection Pumps, which are already running at idle speed with flow out the minimum flow return hose, are realigned and RPV injection is commenced, by flowing through the idle HPCI Pump flow path, or through the now idle RCIC Pump, and then into the normal pump discharge path to the RPV Feedwater lines.

The trailer mounted diesel driven centrifugal FLEX Low Pressure Injection Pumps are rated for 400 gpm @ 350 ft TDH. Two pumps are required to implement the Phase 2 reactor core cooling and heat removal strategy. A hydraulic calculation was performed to demonstrate the feasibility of the flow path (Reference 3.21) and confirmed that applicable performance requirements are met.

The required FLEX Low Pressure Injection Pumps will be maintained at the on-site FLEX storage locations. Four FLEX Low Pressure Injection Pumps are required to be stored onsite to satisfy the N+1 requirement. The trailer mounted FLEX Low Pressure Injection Pumps will be transferred and staged via haul routes and staging areas evaluated for impact from external hazards. Programs and training will be implemented to support the deployment and operation of the FLEX Low Pressure Injection Pumps.

2.3.10.2 Groundwater Wells

At approximately hour 16, preparations will commence to power the station Groundwater Wells with a portable FLEX 20 kW or 86 kW DG and to begin adding water to fill the FRAC tank (or a backup bladder tank) to prepare for a long-term reactor feedwater makeup and boiling strategy.

The Supply Wells are capable of providing a Total "N" Flow Rate of 120 GPM with a total quantity of "N+ l" Wells, each rated for 60 GPM @ 300 ft TH from a 6-inch well casing with a 10 HP Submersible 480 VAC 3-PH Pump. The Wells include readily accessible protected Well-Heads that are robust with respect to seismic events, floods, and high winds, and associated missiles.

The transition to long-term reactor feedwater makeup and boiling strategy will be completed by transferring the suction of one of the FLEX Low Pressure Injection Pumps to the pre-filled mobile water tank to provide reactor makeup with the FLEX Low Pressure Injection Pump discharging through a Skid-Mounted Demineralizer Vessel to the RPV via the CST suction line.

After transferring the FLEX Low Pressure Injection Pump suction to the Water Storage FRAC Tank, the RPV is flushed with water from the Water Storage FRAC Tank at an initial rate sufficient to continue sub-cooling and flushing the RPV with the heated liquid and vapor mixture discharging via the SRVs to the Torus. When ready, the FLEX Low Pressure Injection Pump injection rate is slowed down and the RPV is allowed to boil down to a stable water level with only makeup water added. The plant will be in a stable condition with outside (Phase 3) resources available to maintain stable conditions indefinitely. The transition from Phase 2 to Phase 3 is determined based on Torus inventory and is to be implemented before a net addition of 445,000 Gallons to the Torus, which is not expected to occur before 72 Hour after shutdown (flow is reduced is match boil off if minimize water addition to the torus). Once in long-term reactor feedwater makeup and boiling strategy, the plant can be maintained in a stable condition with the FLEX Low Pressure Injection Pump in service for injection to the RPV at a stable water level, and heat removal provided by the HCVS Torus Vent at a steadily reducing Torus temperature, pressure, and water inventory. There is no need to reject liquid water from the Torus at any time. There are no additional time critical actions for the next 30 days once this mode is established.

2.3.10.3 Makeup Water Supplies

Suppression Pool

Because the CST is not seismically qualified, it is considered unavailable for the BDBEE, and the RCIC suction will be manually switched to the Suppression Pool (Torus) at the initial onset of the event. The torus contains approximately 84,000 ft^3 of water. The Suppression Pool water volume is maintained between 84,000 ft^3 and 94,000 ft^3 per LCO 3.7 of the Technical Specifications.

The torus, which is part of the primary containment system, is located in the Reactor Building (RB). The RB is designed to withstand the maximum postulated seismic event. In addition, the RB is designed to provide protection for the engineered safeguards and nuclear safety systems located in the building from all postulated environmental events including tornadoes.

Groundwater Wells

The FLEX Groundwater Supply Wells are capable of providing a Total "N" Flow Rate of at least 80 GPM. The wells are permanently installed but require a FLEX 20 kW or 86 kW DG to power the pump 10 HP motors, thus classifying them as Phase 2 strategy equipment. There are three FLEX Groundwater Wells, each capable of at least 60 GPM flow rate; therefore any two of the three wells can provide the necessary 80 GPM capacity satisfying the “N+1” requirement per NEI 12-06. The wells are strategically located outdoors with a submersible pump located at the bottom of the well. Associated pump connections are installed on top of the well at surface level in the Well Field area (see Figure 8) to provide long term ground water replenishment into the nominal 21,000-gallon FRAC Tank (onsite Phase 2 equipment) or the collapsible 20,000 gallon bladder tank (Phase 3 equipment available from the NSRC) for Reactor and SFP Makeup following a BDBEE.

Ground water will be drawn from the well using a 6” Submersible Well Pump located in the well via 2 ½” standard Fire Hose with a 2 ½” NH/NST Fire Hose Threaded Connection for the Well Pump discharge at top of well, with the hose running from the pump connection fitting up the well casing to the top of the well at ground level.

Calculation M1384 (3.21) provides the hydraulic analysis for the groundwater well pump discharge to the water storage tanks. The calculation confirmed that the well pumps will provide required flow rates to the FRAC tank or the bladder tank from all well locations during the FLEX injection strategy.

See also section 2.3.10.2.

Water Storage FRAC Tank

A nominal 21,000 gallon, epoxy-coated steel water storage tank, referred to herein as the "FRAC Tank", will be pre-staged outside of the Secondary Access Point on the South end of the plant next to the Augmented Off Gas (AOG) Building to provide the necessary water management and processing for long term (Phase 3) FLEX mitigation strategy. The tank will be maintained at approximately 16,000 gallons (Reference 3.39). The tank inlet will have a 5" Storz connection point for insertion of a manifold which provides for multiple inlet and outlet hoses.

The FRAC Tank is seismically designed and is heavily reinforced and internally baffled to reduce sloshing effects, but is not specifically hardened for the most extreme tornado missile hazards. As an alternative, in the event the FRAC tank is unusable, there will be a backup, nominal 20,000 gallon, collapsible water storage bladder tank. The Bladder Tank will be provided by the National SAFER Response Center (NSRC) and will be capable of deployment within the 72 Hour period before its required usage for water storage and as the feed source for the FLEX Injection Pump.

Ultimate Heat Sink Reservoir

The UHS for the site is provided via the Salt Water Service System. Cape Cod Bay, an embayment of the Atlantic Ocean, is a source of water for the ultimate heat sink.

A trailer-mounted FLEX Low Pressure Injection Pump is deployed to a designated area near the Barge Landing Area.

The pump is parked just inside the outer security fence. The discharge hose of the pump is connected to a 5" Storz connector to a pre-installed 6" stainless steel (SS) buried pipe. The 6" SS buried pipe is routed underground approximately 75 feet below the inner security fence and up through the compacted soil at elevation 23'-0". From this FLEX connection point, there is a second FLEX Low Pressure Injection Pump that will pump seawater to the CST or Alternate RHR FLEX connection point. At the Barge Landing Area, the pump suction hose from the FLEX Low Pressure Injection Pump is connected to a 6" SS pipe that is already installed through the security fence. The hose will then be attached to a 5" Storz "wye" connector with valves to allow for dual suction points. The floating strainer is attached to each hose and deployed sufficiently far into the water using an Outhaul System as-needed to assist in the handling and sufficiently above the bottom to achieve adequate suction.

Also refer to Sections 2.3.4.5 and 2.15.

2.3.10.4 Borated Water Supplies

Not applicable to BWRs for FLEX.

2.3.11 Electrical Analysis

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 greater than 1 hour for the most limiting case where the pre-staged FLEX DG is not available. If the pre-staged FLEX DG is available, the time margin is greater than 5 hours.

Transition from Phase 1 (reliance on station batteries) to Phase 2 (repowering station battery chargers) will be made using FLEX 480 VAC 3-PH 86 kW and/or 150 kW portable trailer mounted DG(s) to supply power to any of the five (5) 125V and 250V DC Station Battery Chargers (Normal and Backup) that provide charging power to the 125V and 250V batteries. See the Primary Strategy to Repower Battery Chargers discussion in Section 2.3.2 regarding the various FLEX 480 VAC DG configurations depending on which FLEX 480 VAC DGs are available following a BDBEE. The two (2) required (N) FLEX 86 kW DGs will be maintained in on-site FLEX storage structures. The third (N+1) FLEX 150 kW DG will be pre-staged in the Turbine Building Truck Lock area, which is a protected area in close proximity to the Battery Charger and Switchgear Rooms. This will allow for more rapid deployment of the first FLEX DG for ELAP events where that is possible.

The 480 VAC 150 kW diesel generator is equipped with a 342 gallon diesel fuel tank which supports 29 hours run time at full load. The two 480 VAC 86 kW diesel generators are equipped with 147 gallon diesel fuel tanks which support 22 hours run time at full load. The four 480 VAC 20 kW diesel generators are equipped with 56 gallon diesel fuel tanks which support 31 hours run time at full load (Reference 3.22). See Section 2.9.4 and Reference 3.61 regarding refueling of diesel driven FLEX equipment and the assumed amount of fuel contained in each piece of essential diesel driven equipment at the beginning of the event.

Additional replacement 480 VAC generators are available from the NSRC for extending the Phase 2 and 3 strategies. The ratings for the NSRC equipment are listed in Table 5.

2.4 Spent Fuel Pool Cooling/Inventory

The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide makeup water to the SFP sufficient to maintain the SFP level at or above 33 feet (PNPS Technical Specifications LCO 3.10 minimum water level).

2.4.1 Phase 1 Strategy

Phase 1 strategy will be the use of plant design to maintain cooling for fuel in the SFP via the large inventory and heat capacity of water in the SFP. Water level in the SFP will be maintained at or above 33 feet depth.

The SFP will slowly heat up following the loss of the Normal SFP Cooling System due to loss of AC power. Calculations M588 "Fuel Pool Decay Heat and Heatup Times" and M907 "Refueling Outage Decay Heat Evaluation" (References 3.40 and 3.41 respectively) provide the design basis SFP heat loads, heatup times, boil-off rates and boil down times for the SFP following a 20-Day Refueling Outage and a Maximum Normal Spent Fuel Discharge, which is a conservative bounding condition for the SFP Heat Load. For the FLEX Strategy evaluation of the SFP heat load, it is conservatively assumed that the Reactor is operating at 100% power and that it has been only 30 days since the last Reactor shutdown for refueling. The SFP conditions at this point in time are then:

- Time-to-Boil @ 30 Days = 32 Hrs
  (125°F starting temp)
- Boil-Off Rate @ 30 Days = 12 GPM
- Boil-Down Time to SFPI Level 2
  SFP T.S. Minimum Water Level of 33 ft = 63 Hrs

For the FLEX Strategy planning, the bounding Refueling Outage time period to consider is the initial time period up to 36 Hours after Reactor shutdown, at which point the loss of all AC power and Shutdown Cooling is assumed to occur, with the following conditions:

- Time-to-Boil @ 36 Hrs = 1.9 Hrs
  (based on 125°F starting temp)
- Boil-Down Time to TAF = 11.2 Hrs
  (RPV water level from Top-of-Flange boil off down to Top-of-Active-Fuel)
- Boil-Off Rate @ 36 Hrs = 80 GPM
  (Ref Calc M907 Table 2)

The plant shutdown condition is also considered in which the Reactor full core has been off-loaded to the SFP, and the SFP Gate has been installed to allow complete or partial draining of the Reactor Basin, such as might be done for some type of major vessel internals repair activity.

Per Reference 3.20, the earliest time that this plant configuration could be accomplished is assumed to be at least 150 Hrs after Reactor shutdown. The SFP conditions at this point in time are then:

- Time-to-Boil @ 150 Hrs SFP Volume Only = 7.3 Hrs
  (Full Core Off-Load with 125°F starting temp)
- Boil-Off Rate @ 150 Hrs = 51 GPM
  (Full-Core Off-Load)

Based on these evaluations with no operator action following a loss of SFP cooling at the maximum Full-Core Off-Load design heat load, the SFP will reach 212°F in approximately 7.3 hours and will reach the level of the top of the spent fuel racks (NEI 12-02 Level 3) in 78 hours if no additional water is supplied to the SFP.

During non-outage conditions, the time to boiling in the pool is significantly longer typically greater than 32 hours and boil off to the Technical Specifications level of 33 feet will occur in 2.6 days and will reach the level of the top of the spent fuel racks (NEI 12-02 Level 3) in 13 days if no additional water is supplied to the SFP. The initial coping strategy for SFP cooling is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051.

2.4.2 Phase 2 Strategy

Makeup Strategy Method 1 (Hose)

An initial source of SFP makeup water may be provided by storage of demineralized water in the lower volume of the Dryer and Separator Storage Pool (below EL 97 ft). The capacity of this lower volume is approximately 34,000 Gal. (Reference 3.40). Transfer of water from the Dryer and Separator Storage Pool to the SFP will be via a hose connected to a portable FLEX Submersible Air-Powered Diaphragm Pump with a bottom suction and minimum capacity of 25 GPM. A portable FLEX Diesel Air Compressor (DAC) will provide motive power for the FLEX Submersible Air-Powered Diaphragm Pump. A usable volume of 30,000 gallons will provide a 42 Hr supply of makeup water at a boil-off rate of 12 GPM. The total heatup time to boiling and available makeup water supply is then 74 hours. (Reference 3.20)

One Air-Powered Diaphragm Pump and hoses will be pre-staged for use on the Reactor Building Refuel Floor. One 125 CFM 100 psig DAC will be stored within a protected location in the Auxiliary Bay to be more easily deployed to operate the SFP Air-Powered Diaphragm Pump from the RB Truck Lock. The alternate DAC will be in FLEX Storage.

SFPI Level 2 is defined as the EL 111 ft-3 inch Technical Specification 3/4.10.C Minimum SFP Water Level for a 33 ft Depth. There is no SFP Makeup Water required during the initial 72 Hour period for an ELAP Event, based on the total SFP Time-to-Boil and Boil-Down Time to SFPI Level 2.

The SFP boil down time during the initial 72 Hour period of FLEX Phase 2 is evaluated in Calculation M588 (References 3.40), where it is shown that the SFP Time-to-Boil is 32 Hours Minimum and the Boil-Down Time to SFPI Level 2 (SFP T.S. Minimum Water Level of 33 ft) is an additional 63 Hours Minimum, for a total of at least 95 Hours before a SFP makeup source must be provided to maintain the normal SFP water level requirements and nominal conditions for shielding and available boil-down volume above the top of the Spent Fuel Racks.

An initial source of SFP makeup water may thereby be provided by storage of demineralized water in the lower volume of the Dryer and Separator Storage Pool (below EL 97 ft) as described above, which would preclude any significant boil-down of the SFP during the initial 72 Hours of the FLEX Strategy Phase 2. Once FLEX Phase 3 is initiated (at 72 Hours), the FLEX Groundwater Wells will be capable of providing sufficient makeup water capacity for both the RPV and the SFP independent of whether any other makeup water was provided.

The SFP Time-to-Boil and Boil-Down Time to SFPI Level 2 or the use of the Dryer and Separator Storage Pool as initial makeup water provides adequate time for additional water supplies to be implemented including the FLEX Groundwater Wells that will be available for this purpose as the FLEX Phase 3 source for both RPV and SFP Makeup Water after the initial 72 Hours.

The FLEX Wells and FRAC Tank, if available for FLEX Phase 2, will be dedicated only to RPV Injection for Core Cooling. The FLEX Wells and FRAC Tank will not be used for Spent Fuel Pool (SFP) Makeup until after 72 Hours and only after RPV Injection has been successfully implemented and maintained, which then allows entry into FLEX Phase 3 when the FLEX Wells can support both RPV and SFP Makeup needs.

The basis for this approach is that RPV Core Cooling has the highest and utmost priority during the initial 72 Hours.

Makeup Strategy Method 2 (SFP cooling piping)

There will be a capability to supply makeup water to the SFP without accessing the refueling floor. This connection will be via the RHR to Fuel Pool Cooling System (RHR/FPC) Intertie from RHR System 6-inch valve 1001-104 (Reference 3.25) to 19-HO-166 (Reference 3.42) that connects to the Fuel Pool Cooling System 8-inch Return Header directly to the SFP as described in the Design Basis Report MDBR11 (Reference 3.44). If one of the FLEX Low Pressure FLEX Pumps is the source of makeup water, it will be connected to the RHR System via the Fire Water to RHR / SSW System Cross-Tie via 10-HO-511 (Reference 3.25, 3.43) in accordance with existing procedure PNPS 5.3.26 (Reference 3.27) that installs an 8" Victaulic to 2-1/2" fire hose adaptor to the lower flange of the Fire Water to RHR crosstie pipe connection at the Aux Bay EL 23 ft location (Reference 3.25, 3.26). The source for SFP makeup water will be from the FLEX Groundwater Wells or other preferred sources after 72 Hours and will satisfy the requirements for makeup water at a boil-off rate of 12 GPM. The piping used to provide makeup flow to the SFP from the RHR System is contained within the Reactor Building and Auxiliary Bay and is protected from all applicable external hazards. FLEX equipment will be provided with a Storage Strategy based on the use of seismically rugged, diverse, spatially separated locations to meet the requirements of NEI 12-06.

Makeup Strategy Method 3 (Spray)

The case that requires spray cooling for the SFP greater than the makeup rate will utilize existing equipment that is intended to support the Mitigating Strategies Requirements from previous NRC Order EA-02-026, Section B.5.b, and 10 CFR 50.54(hh)(2). The regulatory guidance contained in NRC Order EA-02-026, Section B.5.b, as noted in JLD-ISG-2012-01 continues to provide an acceptable means of meeting the requirement to develop, implement and maintain the necessary guidance and strategies for that subset of beyond-design-basis external events. (Reference 3.3, 3.4) The monitor spray nozzle and hoses needed to provide spray and/or makeup to the SFP are kept at an accessible and protected area of the Reactor Building and Refuel Floor. (Reference 3.45, 3.46)

2.4.3 Phase 3 Strategy

Additional capabilities will be available from the NSRC as a backup to the on-site FLEX equipment.

2.4.4 Structures, Systems, and Components

2.4.4.1 Primary Connection

Makeup Strategy Method 1 (Hose)

There are no connections associated with the Method 1 strategy; all equipment is portable and does not require any physical connections to permanent plant equipment, see the Method 3 (Spray) case below.

Makeup Strategy Method 2 (SFP cooling piping)

There will be a capability to supply makeup water to the SFP without accessing the refueling floor. This connection will be via the RHR to Fuel Pool Cooling System (RHR/FPC) Intertie from RHR System 6-inch valve 1001-104 to 19-HO-166 that connects to the Fuel Pool Cooling System 8-inch Return Header directly to the SFP.

If one of the FLEX Low Pressure FLEX Pumps is the source of makeup water, it will be connected to the RHR System via the Fire Water to RHR / SSW System Cross-Tie via 10-HO-511 in accordance with existing procedure PNPS 5.3.26 that installs an 8" Victaulic to 2-1/2" fire hose adaptor to the lower flange of the Fire Water to RHR crosstie pipe connection at the Aux Bay EL 23 ft location.

The piping used to provide makeup flow to the SFP from the RHR System is contained within the RB and Auxiliary Bay and is protected from all applicable external hazards. FLEX equipment will be provided with a Storage Strategy based on the use of seismically rugged, diverse, spatially separated locations.

Makeup Strategy Method 3 (Spray)

There are no new connections associated with the Method 3 strategy; all equipment is portable and does not require any physical connections to permanent plant equipment. The SFP spray strategy was previously developed for the B.5.b Strategy and is configured for more rapid deployment than the FLEX equipment. The PNPS FLEX Pumps are equivalent and interchangeable with the B.5.b Pump and provide additional capabilities. The FLEX Strategy also improves the ability to utilize the UHS as the water source for cases where all preferred water sources capable of delivering the spray flow needed are not available or viable at the time. The SFP Water Level Instrumentation also adds an independent means to monitor SFP Level from the Main Control Room under emergency conditions.

2.4.4.2 Alternate Connection

There are no alternate connections for the three methods described in Section 2.4.4.1 for supplying makeup to the SFP since each of the three methods are totally independent.

2.4.4.3 Ventilation

SFP bulk boiling will create adverse temperature, humidity, and condensation conditions in the RB. NEI 12-06 requires a ventilation vent pathway to exhaust the humid atmosphere from the EL 117 ft SFP / Refuel Floor Area with an outside air inlet at a lower elevation. This ventilation path is created by actions to open the Reactor Building Roof Access Air Lock and Roof Hatch at El. 158', which provides a high level outlet, while also opening a ground level ventilation inlet such as the Reactor Building Truck Lock (Reference 3.47). This action will be required to be performed prior to the onset of SFP boiling (as water temperature approaches 200°F).

2.4.5 Key Reactor Parameters

The key parameter for the SFP Make-up strategy is the SFP water level. The SFP water level is monitored by the instrumentation that was installed in response to Order EA-12-051, *Reliable Spent Fuel Pool level Instrumentation*.

2.4.6 Thermal-Hydraulic Analyses

An analyses was performed that determined that with no operator action following a loss of SFP cooling at the maximum refueling outage design heat load, the SFP will reach 212°F in approximately 7 hours and will reach the level of the top of the spent fuel racks (NEI 12-02 Level 3) in 78 hours if no additional water is supplied to the SFP. During non-outage conditions, the time to boiling in the pool is significantly longer, typically greater than 32 hours, and boil off to the Technical Specifications level of 33 feet will occur in 2.6 days and will reach the level of the top of the spent fuel racks (NEI 12-02 Level 3) in 13 days if no additional water is supplied to the SFP. The initial coping strategy for SFP cooling is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051.

A flow of 51 gpm will replenish the water being boiled for the most limiting refueling outage heat load case. Deployment of any of the SFP makeup strategies with a flow rate that exceeds the boil-off rate (51 gpm for the limiting case) will provide for adequate makeup to restore the SFP level and maintain an acceptable level of water for shielding purposes. The FLEX Low Pressure Injection Pumps credited for the SFP cooling piping makeup strategy are rated for 400 gpm @ 350 ft TDH. The existing B.5.b Strategy using the monitor spray nozzles has a makeup rate capability of 250 GPM.

Following a refueling outage, 12 gpm SFP makeup is required for the most limiting case immediately following the restart after refueling.

2.4.7 Flex Pump and Water Supplies

2.4.7.1 FLEX Low Pressure Injection Pump (Refer to 2.3.10.1)

For the SFP cooling piping method (method 2) for SFP makeup, the FLEX Low Pressure Injection Pump with suction from the Water Storage Tank (FRAC Tank) will be used to provide Core Cooling and SFP Makeup Water during the FLEX Phase 3 core cooling strategy. The FLEX Pump discharges through the Duplex Strainer 400 GPM Strainer Cart w/Flow Meter and Totalizer to the FLEX injection point for core cooling with a separately controlled line to the SFP connection. At that point or later, in the FLEX long term strategy, the FLEX Groundwater Pumps discharge to the NSRC Water Treatment Skid-Mounted Filtration and Reverse

Osmosis System and to the FRAC Tank. The FLEX Injection Pump takes suction from the FRAC Tank and discharges through the Duplex Strainer Cart to the FLEX injection point for RPV core cooling and separately, via a controlled Y-valve branch connection, for SFP makeup. A second, separate FLEX Pump may also be used to provide SFP makeup water from the FRAC Tank if desired.

A hydraulic calculation was performed to demonstrate the feasibility of the flow path and confirmed that applicable performance requirements are met (Reference 3.21).

The required FLEX Low Pressure Injection Pumps will be maintained at the on-site FLEX storage locations. Four FLEX Low Pressure Injection Pumps are required to be stored onsite to satisfy the N+1 requirement. The trailer mounted FLEX Low Pressure Injection Pumps will be transferred and staged via haul routes and staging areas evaluated for impact from external hazards. Programs and training will be implemented to support the deployment and operation of the FLEX Low Pressure Injection Pumps.

2.4.7.2 FLEX Submersible Air-Powered Diaphragm Pump

For the direct supply of makeup water to the SFP via hose method (Method 1), a FLEX Submersible Air-Powered Diaphragm Pump with a bottom suction and capacity of 25 GPM will be used to transfer water from the Dryer and Separator Storage Pool to the SFP. One Air-Powered Diaphragm Pump and hoses will be pre-staged for use on the RB Refuel Floor.

One 125 CFM 100 PSIG Diesel Air Compressor (DAC) is the required pneumatic pressure source for the Air-Powered Diaphragm Pumps used for Diesel Fuel Transfer, SFP Makeup Water, and General Dewatering Service. A single DAC can support these functions simultaneously. One 125 CFM 100 psig DAC will be stored within a protected location in the Auxiliary Bay to be more easily deployed to operate the SFP Air-Powered Diaphragm Pump from the Reactor Building Truck Lock. The alternate DAC will be in FLEX Storage facilities.

2.4.7.3 Dryer and Separator Storage Pool

The Dryer and Separator Storage Pool is the water source for direct supply of makeup water to the SFP via hose method (Method 1) for SFP makeup using the FLEX Submersible Air-Powered Diaphragm Pump. The Dryer and Separator Storage Pool will normally be maintained filled below EL 97 ft to provide makeup water for this purpose. The Pool has a nominal usable volume of 30,000 gallons.

2.4.7.4 Groundwater Wells

Groundwater wells are the water source for the Water Storage Tank (FRAC Tank) which is the water source for the SFP cooling piping method (method 2) for SFP makeup using a FLEX Low Pressure Injection Pump. The FLEX Groundwater Wells are powered by a FLEX Portable 480 VAC 3-PH 20 kW or 86 kW DG. See also subsection 2.3.10.2.

2.4.7.5 Ultimate Heat Sink

The ultimate heat sink (UHS) for the site is via the Salt Water Service System. Cape Cod Bay, an embayment of the Atlantic Ocean, is a source of water for the ultimate heat sink. The UHS can be used if other makeup sources are not available. Refer also to Section 2.15.

2.4.8 Electrical Analysis

The SFP will be monitored by instrumentation installed by Order EA-12-051. The SFP level instruments will be power from station 250V Battery via the Vital MGset or Y1 with backup power provided by a backup self-contained battery system.

2.5 Containment Integrity

During the BDBEE containment integrity is maintained by normal design features of the containment, such as the containment isolation valves and the Hardened Containment Vent System (HCVS). As the Torus heats up due to RCIC operation and relief valve operation, the containment will begin to heat up and pressurize. The PNPS FLEX Strategy is based on performing Torus Venting for Containment heat removal when the Drywell or Torus approaches the Design Temperature of 281°F, which corresponds to a Saturation Pressure of 35 psig which is well below the Primary Containment Pressure Limit (PCPL) of 60 psig. Permanently installed plant equipment / features are used to maintain containment integrity throughout the duration of the event; no non-permanently installed equipment is required to maintain containment integrity.

2.5.1 Phase I

During Phase 1, containment integrity is maintained by normal design features of the containment, such as the containment isolation valves and the Hardened Containment Vent System (HCVS). In accordance with NEI 12-06 (Reference 3.3), the containment is assumed to be isolated following the event. During the first 6 hours after shutdown, the reactor remains isolated and pressurized with RCIC providing core cooling drawing water from the suppression pool (Torus). As the Torus heats up due to RCIC operation, the containment will begin to heat up and pressurize. According to FLEX Strategy Thermal-Hydraulic Analysis the Torus temperature is the limiting factor for implementation of the ELAP strategy (Reference 3.16, 3.17). As discussed in the Phase 1 Core Cooling section (section 2.3.1), after 6 hours the Torus temperature will be at 170°F and a controlled reactor depressurization is commenced based on the EOP-11 HCTL (Reference 3.15).

When the Torus heats up to 280°F at 16 hours after shutdown, the Torus vent AO-5025 is opened to provide containment heat removal and begin a long term strategy of reactor feedwater makeup and boiling to protect the core and containment. The PNPS FLEX Strategy is based on performing Torus Venting for Containment heat removal when the Drywell or Torus approaches the Design Temperature of 281°F, which corresponds to a Saturation Pressure of 35 psig which is well below the Primary Containment Pressure Limit (PCPL) of 60 psig as given in EOP-11 Figure 4.

The FLEX strategies rely on the HCVS that was evaluated in EA-12-050 Reliable Hardened Containment Vents Gap Analysis (Reference 3.48) which was developed in response to NRC Order EA-12-050 (Reference 3.49). NRC Order EA-13-109 (Reference 3.50) rescinded the requirements of NRC Order EA-12-050; therefore, compliance with the requirements of NRC Order EA-12-050 is no longer required. The industry, through NEI and the owners' group, is addressing the new requirements provided in NRC Order EA-13-109. Because of the new order (NRC Order EA-13-109), there will be additional independent instrumentation improvements made to the hardened containment vent; however, the wetwell vent as described in Reference 3.48 is credited for the Containment Integrity strategy and is otherwise not changing (Reference 3.51).

The PNPS FLEX Strategy does not include Containment Venting until after Reactor depressurization and therefore will not affect the Containment Pressure available for RCIC or HPCI Pump NPSH during the time that these pumps may be operating (see Item 3.1 in the Hardened Containment Vent System (HCVS) Gap Analysis for NRC Order EA-12-050 (Reference 3.48)).

The containment design pressure is 56 psig, as noted in FSAR table 5.2-1 (Reference 3.52), which is at a Low-Low Torus Water Level and corresponds to 60 psig Torus Bottom Pressure. Containment pressure limits are not expected to be reached during the event as indicated by FLEX Strategy Thermal-Hydraulic Analysis (Reference 3.16, 3.17), because the HCVS is opened prior to exceeding any containment pressure limits. Thus, containment integrity is not challenged and remains functional throughout the event. Monitoring of Containment Drywell and Torus Pressure and Torus Water Level and Temperature will be available via normal plant instrumentation.

Phase 1 (i.e., the use of permanently installed plant equipment / features) of containment integrity is maintained throughout the duration of the event; no non-permanently installed equipment is required to maintain containment integrity. Therefore, there is no defined end time for the Phase 1 coping period for maintaining containment integrity. An alternative strategy for containment during Phase 1 is not provided, because containment integrity is maintained by the plant's design features.

The Phase 1 coping strategy for Containment involves monitoring Containment temperature and pressure using installed instrumentation. Control room or Cable Spreading Room indication for Low Range

Drywell Pressure, RCIC Pump Suction Pressure and HPCI Pump Suction Pressure will be retained for the duration of the ELAP.

2.5.2 Phase 2

Permanently installed plant equipment / features are used to maintain containment integrity throughout the duration of the event; no non-permanently installed equipment is required to maintain containment integrity. Therefore, there is no defined end time for the Phase 1 coping period for maintaining containment integrity. In addition to the instruments identified for Phase 1 containment integrity, AC powered instruments for Torus Bottom Pressure, Wide Range Primary Containment Pressure, Low Range Primary Containment Pressure, Torus Water Level, Torus Water Temperature, Hardened Containment Vent System instrumentation will be repowered in Phase 2 using FLEX Portable Diesel Generator(s).

2.5.3 Phase 3

Permanently installed plant equipment / features are used to maintain containment integrity throughout the duration of the event; no non-permanently installed equipment is required to maintain containment integrity. Therefore, there is no defined end time for the Phase 1 coping period for maintaining containment integrity.

2.5.4 Structures, Systems, Components

2.5.4.1 Hardened Containment Vent System (HCVS)

The Hardened Containment Vent System (HCVS) at PNPS includes an 8" Air-Operated Butterfly Valve AO-5025 capable of venting the Wetwell (Torus) airspace through an 8" branch line between the two Primary Containment Isolation Valves (PCIVs) AO-5042A and B from 20" Torus Penetration X-227. The Torus Vent flow path via AO-5042B and AO-5025 connects to the 20" discharge line downstream of the Standby Gas Treatment System (SGTS) filter trains. The vent flow path is isolated from the SGTS by Air-Operated Discharge Valves AO-N-108 and 112 on the SGTS outlet where the vent 8" piping connects to the 20" discharge piping to the plant's Main Stack that includes a buried piping run from the plant out to the Main Stack elevated release point. The valves which must be opened to establish the hardened vent flow path are capable of opening and closing at the Primary Containment Pressure Limit (PCPL) and Design Pressure of 56 PSIG.

The HCV System uses the station's 125 VDC battery power system (maintained for the duration of the event by the repowered chargers from the FLEX DG(s)) and pneumatic pressure normally provided by three parallel sources, with the source at the highest pressure at any particular time providing the source of gas, as follows:

- Liquid Nitrogen Make-Up System (N2 Vaporizers)
- Essential Instrument Air System branch of the Compressed Air System
- Backup Nitrogen Cylinder Supply (N2 Gas HP Cylinders)

Additionally, a local Nitrogen High Pressure Multiple Cylinder Regulated 90 PSIG 24 Hour Supply and Local Manual Pneumatic Control Station are provided at the TIP Room Location for AO-5025 and AO-5042B. The Nitrogen pneumatic supply is connected in parallel with the other three pneumatic supplies via 31-CK-482 and 483 for remote operation from the MCR. The Local Manual Pneumatic Control Station includes a Manual Override Valve with tubing connections directly to the AO actuators for manual override operation of both valves.

Position Indication is provided at the Local Manual Control Station in addition to Main Control Room Panels C7 and C904.

The HCVS meets ASME B&PV Code (1980 Edition with Winter 1980 Addenda), Section III, Subsection NC for Nuclear Class 2 requirements up to and including the isolation valve. The piping downstream of the isolation valve meets ANSI B31.1 (1977 Edition through Winter 1979 Addenda) requirements.

2.5.5 Key Containment Parameters

The Phase 1 coping strategy for Containment integrity involves monitoring Containment temperature and pressure using the following installed instrumentation and is available for the duration of the ELAP:

- Drywell Pressure – Drywell low range pressure indication is available in the Cable Spreading Room instrument racks C2233A and B,
- RCIC Pump Suction Pressure - RCIC pump suction pressure indication is available in the MCR on Panel C904.
- HPCI Pump Suction Pressure - HPCI pump suction pressure indication is available in the MCR on Panel C903.

The above instrumentation is available prior to and after selective load shedding of dc loads during Phase 1. Availability of these instruments during Phases 2 and 3 will be maintained by repowering Class 1E battery chargers for both divisions of station batteries using FLEX Portable Diesel Generator(s).

In addition to the instruments identified for use during the Phase 1 containment integrity coping strategy, the following AC powered instruments are available once the power is restored by the Phase 2 FLEX Portable 480 VAC and 120 VAC Diesel Generator(s).

- Torus Bottom Pressure - Torus bottom pressure indication is available in the MCR on Panel C903.
- Containment Pressure - Wide range primary containment pressure indication is available in the MCR on PAM Panels C170 and C171. Low range primary containment pressure indication is available in the MCR on PAM Panels C170 and C171.
- Torus Water Level - Torus water level indication is available in the MCR on PAM Panels C170 and C171.
- Torus Water and Airspace Temperature - Torus water local and bulk temperature indication is available and torus airspace temperature indication is available.

Capability is being provided to allow alternate power to 120VAC safeguard power supply panels (Y3/Y31 or Y4/Y41) from mobile

FLEX 480 VAC 86 kW and/or 150 kW DGs having 120 VAC 1-PH output to maintain these systems operating indefinitely (see Figure 10) and safeguard 120/240VAC control power supply panels (Y13 or Y14) repowered as-needed from any available mobile FLEX or SAFER (NSRC) Diesel Generators with 120/240 VAC 1-PH outputs. (References 3.35, 3.36)

2.5.6 Thermal-Hydraulic Analyses

Conservative evaluations have concluded that Containment temperature and pressure will remain below Containment design. Refer to Section 2.3.7 regarding the use of the MAAP4 computer code.

2.5.7 FLEX Pump and Water Supplies

As discussed in Section 2.5.1, when the Torus heats up to 280°F at 16 hours after shutdown, the Torus vent AO-5025 is opened to provide containment heat removal and begin a long term strategy of reactor feedwater makeup and boiling to protect the core and containment.

2.5.8 Electrical Analysis

Power requirements for the HCVS and containment critical instrumentation is provided by the station batteries. FLEX portable diesel generators are used to repower station battery chargers and to repower ac powered instrumentation.

2.6 Characterization of External Hazards

2.6.1 Seismic

From the PNPS FSAR (Reference 3.52) Section 2.5.3.3.2, the Safe Shutdown Earthquake (SSE) maximum horizontal ground acceleration is 0.15 g.

The possibility for soil liquefaction that could impede movement following a seismic event was evaluated according to FSAR Section 2.5.3.2. It was concluded that it is highly unlikely that liquefaction of the foundation material would occur under the postulated earthquake conditions at PNPS.

In accordance with the NRC Request For Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Reference 3.53), a seismic hazard and screening evaluation was performed for PNPS (Reference 3.54). A Ground Motion Response Spectra (GMRS) was developed solely for purpose of screening for additional evaluations in accordance with NRC endorsed EPRI Report 1025287, "Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic." Based on the results of the screening evaluation, PNPS screens-in for a risk evaluation, a SFP evaluation, and a High Frequency Confirmation.

2.6.2 External Flooding

The PNPS Site general elevation of 23 ft above mean sea level (msl) places it in the category of "dry sites" according to NEI 12-06, Section 6.2.1, based on the following design basis flood level from PNPS FSAR (Reference 3.52) Section 2.4.4.2 "Tide Levels".

- Extreme Storm Tide = +13.5 ft msl
- Extreme Low Tide = -10.1 ft msl

The datum relationship at the site is that msl is 4.8 ft above mean low water (mlw) level. It has been calculated that the 100 year storm could produce a still water level of +15.8 ft mlw. This is a combination of storm surge combined with astronomical high tide. The hydrometeorological section of the U.S. Weather Bureau has established a standard northeaster for New England. Using this storm, the peak storm surge, having a return frequency of 1,000 years, is 6.6 ft.

The concurrence of peak storm surge with an astronomical high tide of (+)11.7 ft mlw would give an extreme storm tide level of (+)18.3 ft mlw, such that +18.3 ft mlw = +13.5 ft msl, with a probability of occurrence of once every 4,000 yr. Additionally the climatological precipitation quantities in eastern Massachusetts show that the region does not have a wet or a dry season. Monthly averages vary from about 3 in to 4 1/2 inches at Plymouth. The maximum 24 hour rainfall is 6.88 inches from FSAR table 2.3-16. All Class I structures are designed for flood protection in the event of a maximum probable flood (Reference 3.52).

Therefore, because PNPS is built above the design basis flood level and is considered a "dry" site by the NEI 12-06, Section 6.2.1 guidance, PNPS is not required to evaluate flood-induced challenges.

Since the original submittal of the Integrated Plan, Entergy has completed and submitted the Flooding Hazard Reevaluation Report (Reference 3.8) for Pilgrim requested by the 10 CFR 50.54(f) letter dated March 12, 2012 (Reference 3.55). The reevaluation represents the most current flooding analysis for Pilgrim.

The flooding reevaluation determined that there were no feasible flood hazards at the site due to:

- Flooding in Streams and Rivers;
- Dam Breaches and Failures;
- Seiche;
- Tsunami;
- Ice Induced Flooding, and;
- Channel Migration and Diversion

The flooding reevaluation determined that PNPS was considered potentially exposed to the flood hazards listed below. In some instances, an individual flood-causing mechanism (e.g., storm surge) was also addressed in the combined effect flood scenario:

- Local Intense Precipitation (LIP)

  Precipitation induced flooding is not currently addressed in the current licensing basis (CLB); however, the PMP event was evaluated as part of the IPEEE.

- Probable Maximum Storm Surge (PMSS) due to the Probable Maximum Hurricane or the Probable Maximum Wind Storm.

  The flood hazard addressed in the CLB is an extreme storm tide level of 13.5 feet MSL resulting from either the peak storm surge from a nor'easter and an astronomical high tide, or from a maximum hurricane produced storm surge.

- Combined Effect Flood scenario consisting of the Probable Maximum Storm Surge and wave effects.

  The flood hazard due to combined effects was addressed as part of the CLB by performing a series of wave action model studies to assist in the design of PNPS waterfront structures.

A comparison of the CLB elevations and the re-evaluated flood elevations is provided in Table 1.

Table 1

Flood Elevation Comparison

Mechanism	CLB Flood Height	Re-Evaluated Flood Height	Difference
Local Intense Precipitation	22.5 feet MSL along north side of plant buildings	23.3 to 23.5 feet MSL (at important locations on north and west sides of plant)	+0.8 to + 1.0 feet MSL
	24.5 feet MSL along south side of plant buildings	25.2 feet MSL (at important locations on south side of plant)	+0.7 feet MSL
	Roof ponding of approx. 0.5 feet [Note: PMP was evaluated as part of the IPEEE.]	Not Applicable	Not Applicable
PMF in Rivers and Streams	Not Defined	Screened	Not Applicable
Dam Breaches and Failures	Not Defined	Screened	Not Applicable

Table 1

Flood Elevation Comparison

Mechanism	CLB Flood Height	Re-Evaluated Flood Height	Difference
Storm Surge	13.5 feet MSL	15.8 feet MSL [max. water surface elevation (i.e., still water plus wave setup)] [Note: Station grade is at 23 feet MSL.]	+2.3 feet
Seiche	Not Defined	Screened	Not Applicable
Tsunami	Not Defined	Screened	Not Applicable
Ice Induced Flooding	Not Defined	Screened	Not Applicable
Channel Migration or Diversion	Not Defined	Screened	Not Applicable
Combined Effect	Not Defined	22.1 feet MSL (near Reactor Building in site yard between buildings and shore revetment) [Note: Station grade is 23 feet MSL]	Not Applicable

Note: "Not Defined" indicates that this flood mechanism was not defined or addressed in CLB documents. As a result, no comparison can be made to re-evaluated results.

Flooding due to LIP or the combined effect flood are the only flood mechanisms which could cause inundation of the PNPS site in the vicinity of SSCs important to safety.

In response to the re-evaluated flood elevations resulting from the LIP and the combined effect flood which consists of wind-generated waves in conjunction with the PMSS, an assessment was performed to determine the impact of inundation at affected locations due to the LIP and due to the combined effect flood. The results of this evaluation indicate that there are no impacts to equipment important to safety as a result of the re-evaluated flood elevations. As a result, no interim flood mitigating measures are planned.

The area where there could be the most water ingress into a process building is the turbine building truck bay roll up door, door 102, due to local intense precipitation (LIP), not the hurricane storm surge. Due to LIP, that door was re-evaluated to experience 2.5 ft of water. Due to the strength of the door for wind pressure and the bottom steel support, this door would not fail. Leakage that could exist (as the door is credited to not fail and is not a moisture barrier) would be limited to the area directly adjacent. Previously it was evaluated through IPEEE and probable maximum precipitation (PMP) to experience 1.5 ft.

2.6.3 Severe Storms with High Wind

Pilgrim does not screen out for Hurricanes; rather Pilgrim`s unique location on South west coast of Cape Cod Bay has historically sheltered the site. Pilgrim is subject to hurricanes, with the highest sustained wind value being 87 mph. Therefore, PNPS design basis does not meet the NEI 12-06 definition of "sites with the potential to experience severe winds from hurricanes based on winds exceeding 130 mph." The applicable wind hazards are bounded by the tornado event. The maximum 5 Minute sustained wind speed of 87 mph was due to the Hurricane of 1938 from PNPS FSAR (Reference 3.52) Table 2.3-18.

Severe tornado activity in eastern Massachusetts is not common. The proximity to the ocean and the terrain in the vicinity of the site are unfavorable to severe tornado activity. The Tornado Design Criteria for PNPS is included in Appendix H of the FSAR and is summarized as follows:

Per the FSAR, the velocity components are applied as a 300 mph horizontal wind applied over the full height of the structure. The pressure differential is applied as a 3 psi positive (bursting) pressure occurring in 3 seconds. The missiles are applied, as follows:

- A 4 inch x 12 inch x 12 ft long wood plank (108 lb) traveling end-on at 300 mph over the full height of the structure.
- A 3 inch diameter Schedule 40 pipe 10 ft long traveling end-on at 100 mph over the full height of the structure.
- A passenger auto (4,000 lb) traveling end-on at 50 mph with a contact area of 20 ft^2 and at a height not greater than 25 ft above ground.

Pilgrim conservatively uses its design values for tornados which bounds the NEI 12-06 criteria. The FLEX strategy considers high winds and complies with the requirements of NEI 12-06 and ASCE 7-10 for structures that store FLEX equipment. PNPS is within the zone defined per NEI-12-06 where the tornado wind is established as 165 mph.

Pilgrim conservatively uses its design values for tornados which bounds the NEI 12-06 criteria.

2.6.4 Ice, Snow and Extreme Cold

The guidelines provided in NEI 12-06 (Section 8.2.1) determine that an assessment of extreme cold conditions must be performed for sites above the 35th parallel. PNPS is located above the 35th parallel; therefore, the effects of snow, ice, and extreme cold have been considered for the storage and deployment of FLEX equipment. The design bases winter outdoor condition is 10°F dry bulb, which corresponds to the 97.5% exceedance values for the site location with an extreme minimum of (-)14°F as described in FSAR Table 10.9-1. During the winter months of December, January, and February, there will be approximately 54 hours at or below the 97.5% value based on the ASHRAE design standards. The PNPS site historical lowest recorded temperature is also noted to be (-)14°F from FSAR Table 2.3-15. The PNPS historical low seawater temperature is 28°F from FSAR Figure 2.4-2. The maximum 24 hour snowfall is 16 inches from FSAR Table 2.3-17. As noted in FSAR 2.3.6 a few times each winter a weather situation favorable for ice glaze formation develops. The coastal location of the site reduces the likelihood of a glaze forming storm compared to nearby inland locations. During the period of record 1928 to 1936, the site area experienced between six and eight storms which deposited ice glaze 0.25 in thick or more.

2.6.5 High Temperatures

The design bases temperature for HVAC System design ambient temperature is 88°F from TDBD-110 (Reference 3.57), and this represents a standard 1% exceedance value with a short-term peak design temperature of 102°F as described in FSAR Table 10.9-2. The 1% value would be expected to be exceeded for a total of 30 hours during the summer months (June to September) based on the ASHRAE design standards. The PNPS site historical highest recorded temperature is also noted to be 102°F from FSAR Table 2.3-15. The FLEX equipment will be procured to function in high temperatures and consideration will be given to the impacts of these high temperatures on equipment storage and deployment; however, 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.

2.7 Planned Protection of Flex Equipment

Pilgrim has two spatially separated FLEX Equipment Storage Areas, approximately 2200 feet apart. The FLEX equipment staged in these areas is redundant. Either storage area may therefore be lost to a BDBEE, leaving the second area with adequate equipment to implement the FLEX Strategy. The storage areas are in a North-South alignment per NEI 12-06 and the individual sea van axial alignment is in the order of 90 degrees for additional benefit of orientation. The storage areas support the location of nine (9) FLEX Storage Sea-Land Container in each area.

PNPS Calculation C15.0.3642 (Reference 3.58) performs the wind-loading analysis of the FLEX Storage Sea-Land Container storage configuration. The containers were evaluated to demonstrate no effects for sustained wind speeds of 105 mph based on hurricane wind loading, and shown to have capabilities to withstand significantly higher intermittent winds up to 180 mph. The close grouping and alignment of storage containers is such that individual tie-downs are not required. The potential for more damaging tornado conditions is addressed by having two widely separated redundant FLEX storage sites. The pumps, compressors, generators, and other equipment within the Sea-Land Containers are tied down with high capacity cargo straps or otherwise restrained or containerized to resist seismic loading (Reference 3.59).

There are three FLEX DGs available for repowering the station battery chargers.

- One portable FLEX 86 kW 480 VAC DG is stored in the north FLEX storage area.
- One portable FLEX 86 kW 480 VAC DG is stored in the south FLEX storage area.
- The portable FLEX 150 kW 480 VAC DG is stored inside of the turbine building truck lock. If called upon to operate, it would be rolled outside of the truck lock, with only the electrical leads being run under the truck lock door.

The two (north and south) FLEX storage areas are on the edges of existing paved parking lots. The equipment is sheltered, maintained dry, and protected from wind, snow, and/or ice.

The wheel loader is normally stored outside in a designated area to preclude damage from seismic interaction with surrounding components, and/or structures. The PNPS FLEX Strategy includes sheltering of the debris removal vehicles in the reactor and turbine building truck-locks during predicted severe weather events to ensure their availability.

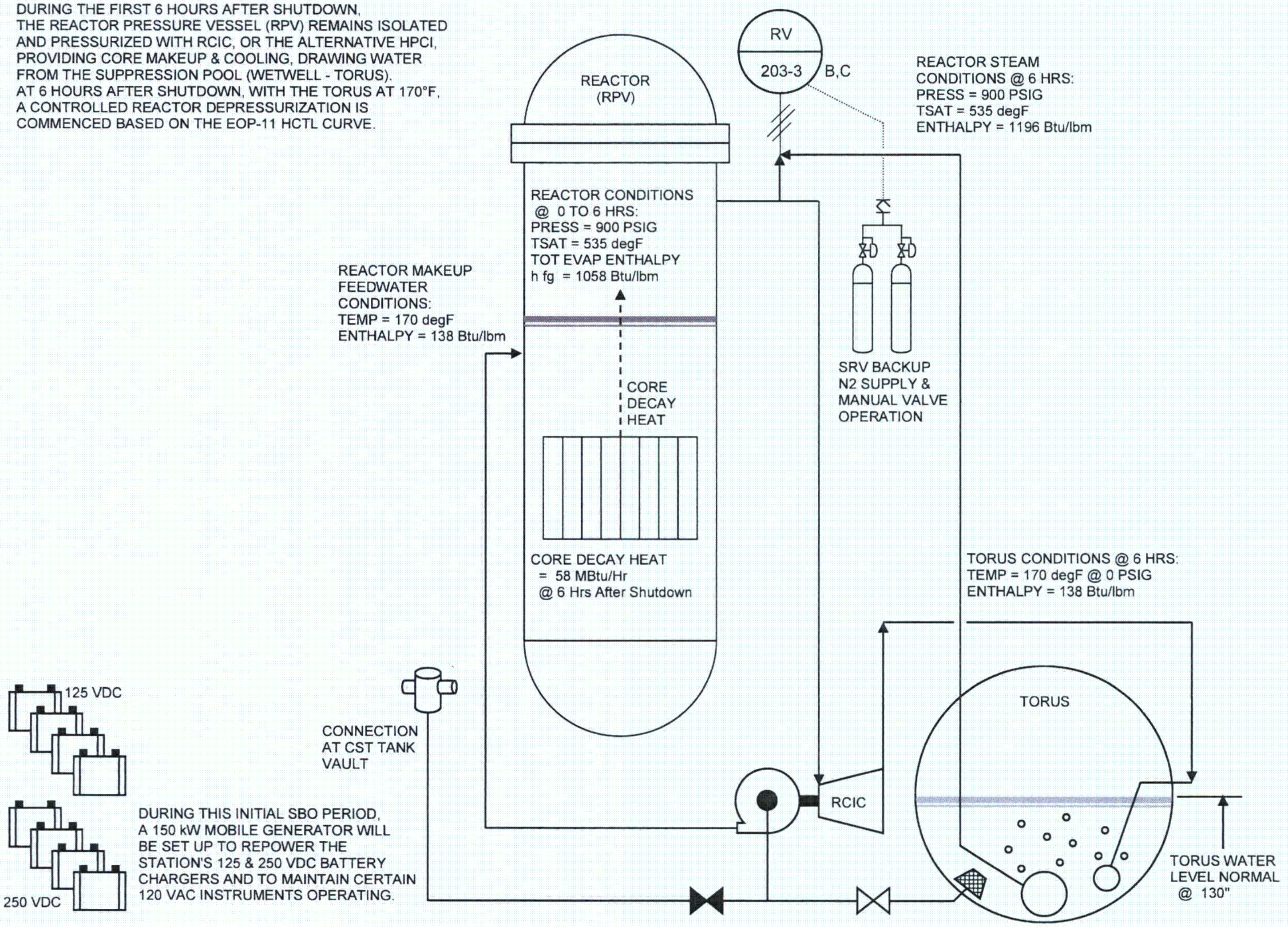
The FLEX Portable Equipment is stored in a manner that withstands seismic events. The equipment that is in Sea-Land Containers (ISO Cargo Containers) is secured to not displace or dislodge from seismic motion within the limited confined space of these containers that inherently limit movement. Equipment that is pre-staged within the plant is in low profile Job-Boxes that are secured as-needed. Very large mobile equipment, such as the pre-staged 150 kW Generator in the Turbine Building Trucklock and the Debris Removal Wheel Loader, are situated to preclude potential affects by the movement or damage of surrounding structures or debris sources.

Deployments of the FLEX and debris removal equipment from the FLEX storage areas are not dependent on off-site power.

REACTOR / TORUS CONDITIONS DURING FIRST 6 HOURS

FIGURE 1

DURING THE FIRST 6 HOURS AFTER SHUTDOWN, THE REACTOR PRESSURE VESSEL (RPV) REMAINS ISOLATED AND PRESSURIZED WITH RCIC, OR THE ALTERNATIVE HPCI, PROVIDING CORE MAKEUP & COOLING, DRAWING WATER FROM THE SUPPRESSION POOL (WETWELL - TORUS). AT 6 HOURS AFTER SHUTDOWN, WITH THE TORUS AT 170°F, A CONTROLLED REACTOR DEPRESSURIZATION IS COMMENCED BASED ON THE EOP-11 HCTL CURVE.



REACTOR STEAM CONDITIONS @ 6 HRS:
PRESS = 900 PSIG
TSAT = 535 degF
ENTHALPY = 1196 Btu/lbm

REACTOR CONDITIONS @ 0 TO 6 HRS:
PRESS = 900 PSIG
TSAT = 535 degF
TOT EVAP ENTHALPY
h fg = 1058 Btu/lbm

REACTOR MAKEUP FEEDWATER CONDITIONS:
TEMP = 170 degF
ENTHALPY = 138 Btu/lbm

CORE DECAY HEAT
= 58 MBtu/Hr
@ 6 Hrs After Shutdown

TORUS CONDITIONS @ 6 HRS:
TEMP = 170 degF @ 0 PSIG
ENTHALPY = 138 Btu/lbm

DURING THIS INITIAL SBO PERIOD, A 150 kW MOBILE GENERATOR WILL BE SET UP TO REPOWER THE STATION'S 125 & 250 VDC BATTERY CHARGERS AND TO MAINTAIN CERTAIN 120 VAC INSTRUMENTS OPERATING.

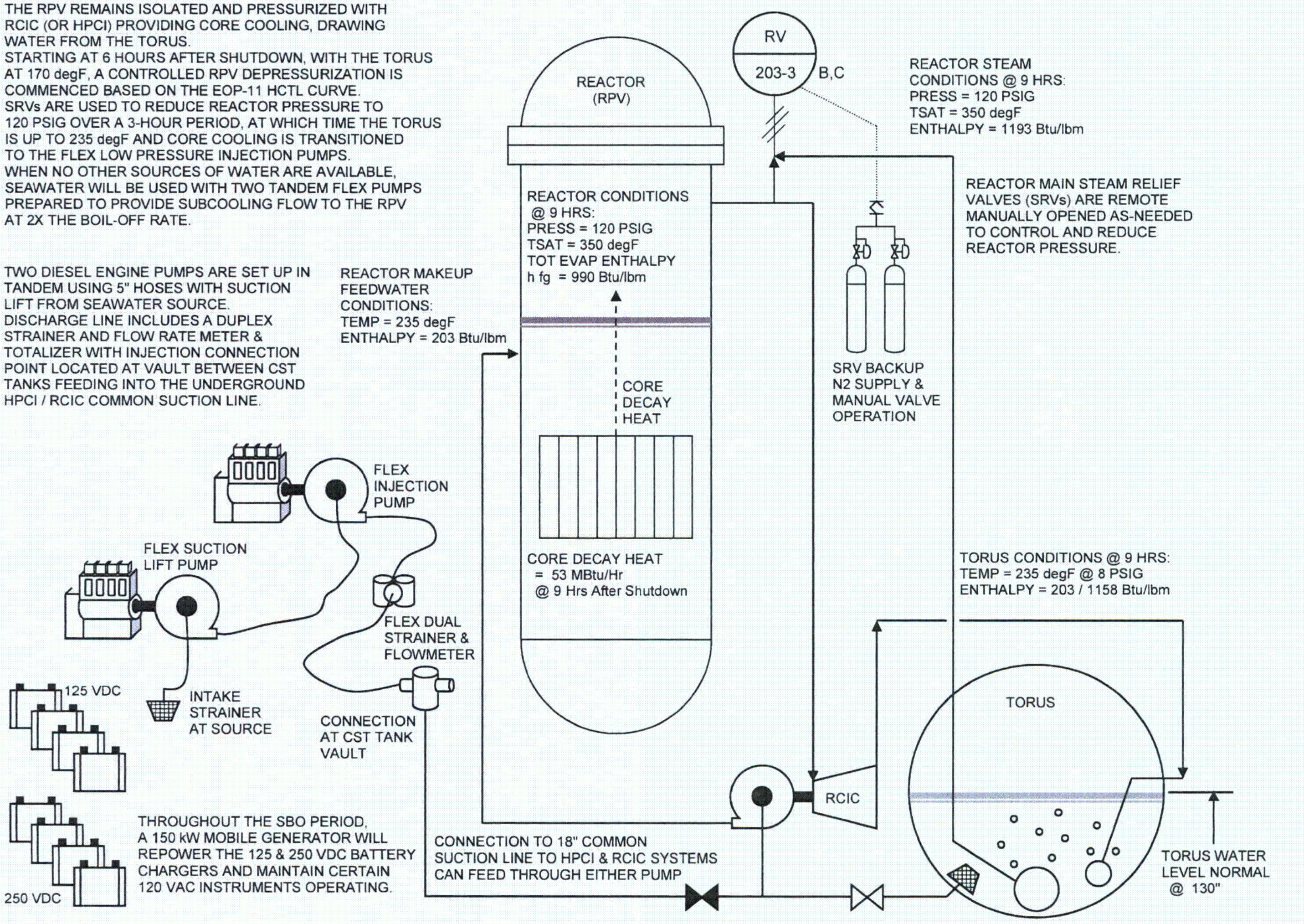
REACTOR / TORUS CONDITIONS DURING REACTOR DEPRESSURIZATION FROM 6 TO 9 HOURS

FIGURE 2

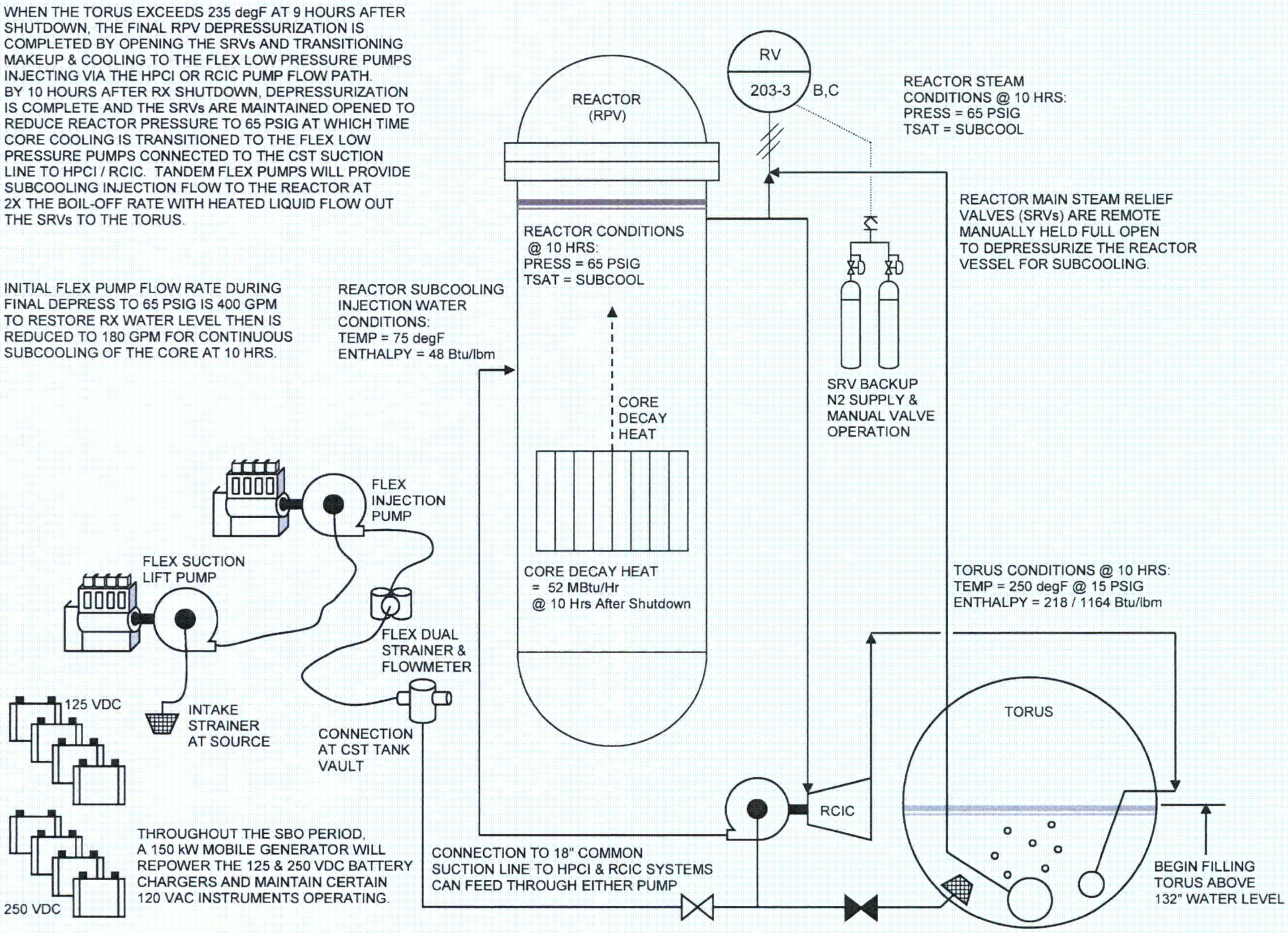
DURING THE PERIOD 6 TO 9 HOURS AFTER SHUTDOWN, THE RPV REMAINS ISOLATED AND PRESSURIZED WITH RCIC (OR HPCI) PROVIDING CORE COOLING, DRAWING WATER FROM THE TORUS.
STARTING AT 6 HOURS AFTER SHUTDOWN, WITH THE TORUS AT 170 degF, A CONTROLLED RPV DEPRESSURIZATION IS COMMENCED BASED ON THE EOP-11 HCTL CURVE.
SRVs ARE USED TO REDUCE REACTOR PRESSURE TO 120 PSIG OVER A 3-HOUR PERIOD, AT WHICH TIME THE TORUS IS UP TO 235 degF AND CORE COOLING IS TRANSITIONED TO THE FLEX LOW PRESSURE INJECTION PUMPS.
WHEN NO OTHER SOURCES OF WATER ARE AVAILABLE, SEAWATER WILL BE USED WITH TWO TANDEM FLEX PUMPS PREPARED TO PROVIDE SUBCOOLING FLOW TO THE RPV AT 2X THE BOIL-OFF RATE.

TWO DIESEL ENGINE PUMPS ARE SET UP IN TANDEM USING 5" HOSES WITH SUCTION LIFT FROM SEAWATER SOURCE. DISCHARGE LINE INCLUDES A DUPLEX STRAINER AND FLOW RATE METER & TOTALIZER WITH INJECTION CONNECTION POINT LOCATED AT VAULT BETWEEN CST TANKS FEEDING INTO THE UNDERGROUND HPCI / RCIC COMMON SUCTION LINE.

THROUGHOUT THE SBO PERIOD, A 150 kW MOBILE GENERATOR WILL REPOWER THE 125 & 250 VDC BATTERY CHARGERS AND MAINTAIN CERTAIN 120 VAC INSTRUMENTS OPERATING.



REACTOR / TORUS CONDITIONS DURING REACTOR FINAL DEPRESSURIZATION FROM 9 TO 10 HOURS **FIGURE 3**



WHEN THE TORUS EXCEEDS 235 degF AT 9 HOURS AFTER SHUTDOWN, THE FINAL RPV DEPRESSURIZATION IS COMPLETED BY OPENING THE SRVs AND TRANSITIONING MAKEUP & COOLING TO THE FLEX LOW PRESSURE PUMPS INJECTING VIA THE HPCI OR RCIC PUMP FLOW PATH.
BY 10 HOURS AFTER RX SHUTDOWN, DEPRESSURIZATION IS COMPLETE AND THE SRVs ARE MAINTAINED OPENED TO REDUCE REACTOR PRESSURE TO 65 PSIG AT WHICH TIME CORE COOLING IS TRANSITIONED TO THE FLEX LOW PRESSURE PUMPS CONNECTED TO THE CST SUCTION LINE TO HPCI / RCIC. TANDEM FLEX PUMPS WILL PROVIDE SUBCOOLING INJECTION FLOW TO THE REACTOR AT 2X THE BOIL-OFF RATE WITH HEATED LIQUID FLOW OUT THE SRVs TO THE TORUS.

INITIAL FLEX PUMP FLOW RATE DURING FINAL DEPRESS TO 65 PSIG IS 400 GPM TO RESTORE RX WATER LEVEL THEN IS REDUCED TO 180 GPM FOR CONTINUOUS SUBCOOLING OF THE CORE AT 10 HRS.

REACTOR SUBCOOLING INJECTION WATER CONDITIONS:
TEMP = 75 degF
ENTHALPY = 48 Btu/lbm

REACTOR CONDITIONS @ 10 HRS:
PRESS = 65 PSIG
TSAT = SUBCOOL

REACTOR STEAM CONDITIONS @ 10 HRS:
PRESS = 65 PSIG
TSAT = SUBCOOL

REACTOR MAIN STEAM RELIEF VALVES (SRVs) ARE REMOTE MANUALLY HELD FULL OPEN TO DEPRESSURIZE THE REACTOR VESSEL FOR SUBCOOLING.

CORE DECAY HEAT
= 52 MBtu/Hr
@ 10 Hrs After Shutdown

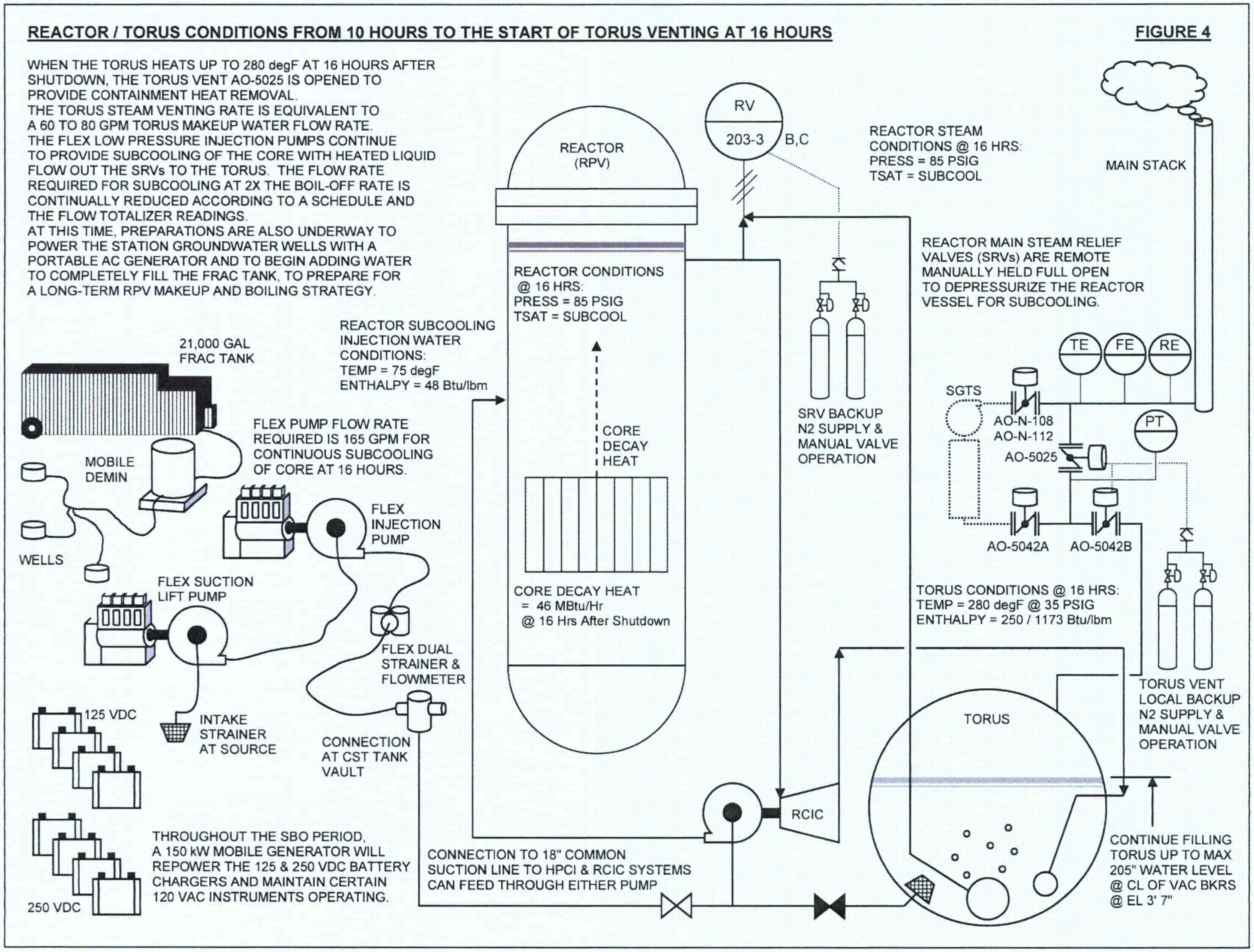
TORUS CONDITIONS @ 10 HRS:
TEMP = 250 degF @ 15 PSIG
ENTHALPY = 218 / 1164 Btu/lbm

THROUGHOUT THE SBO PERIOD, A 150 kW MOBILE GENERATOR WILL REPOWER THE 125 & 250 VDC BATTERY CHARGERS AND MAINTAIN CERTAIN 120 VAC INSTRUMENTS OPERATING.

CONNECTION TO 18" COMMON SUCTION LINE TO HPCI & RCIC SYSTEMS CAN FEED THROUGH EITHER PUMP

Note: TE, FE PE, PT - Future instrumentation (installed per NRC Order EA-13-109).

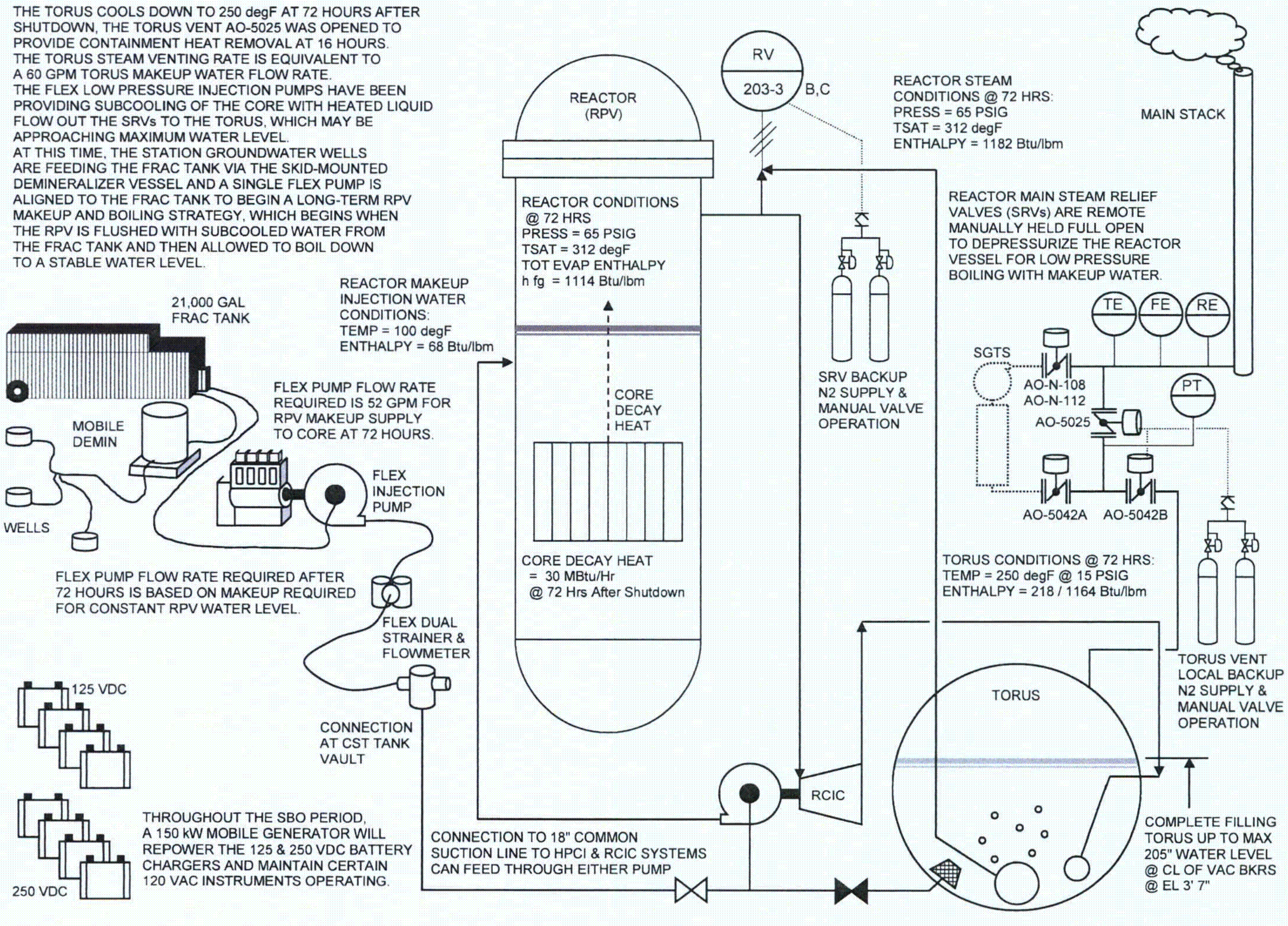
REACTOR / TORUS CONDITIONS FROM 10 HOURS TO THE START OF TORUS VENTING AT 16 HOURS **FIGURE 4**



WHEN THE TORUS HEATS UP TO 280 degF AT 16 HOURS AFTER SHUTDOWN, THE TORUS VENT AO-5025 IS OPENED TO PROVIDE CONTAINMENT HEAT REMOVAL.
THE TORUS STEAM VENTING RATE IS EQUIVALENT TO A 60 TO 80 GPM TORUS MAKEUP WATER FLOW RATE.
THE FLEX LOW PRESSURE INJECTION PUMPS CONTINUE TO PROVIDE SUBCOOLING OF THE CORE WITH HEATED LIQUID FLOW OUT THE SRVs TO THE TORUS. THE FLOW RATE REQUIRED FOR SUBCOOLING AT 2X THE BOIL-OFF RATE IS CONTINUALLY REDUCED ACCORDING TO A SCHEDULE AND THE FLOW TOTALIZER READINGS.
AT THIS TIME, PREPARATIONS ARE ALSO UNDERWAY TO POWER THE STATION GROUNDWATER WELLS WITH A PORTABLE AC GENERATOR AND TO BEGIN ADDING WATER TO COMPLETELY FILL THE FRAC TANK, TO PREPARE FOR A LONG-TERM RPV MAKEUP AND BOILING STRATEGY.

Note: TE, FE PE, PT - Future instrumentation (installed per NRC Order EA-13-109).

REACTOR / TORUS CONDITIONS DURING TORUS VENTING AFTER 16 HOURS TO MAKEUP MODE AT 72 HOURS **FIGURE 5**



THE TORUS COOLS DOWN TO 250 degF AT 72 HOURS AFTER SHUTDOWN, THE TORUS VENT AO-5025 WAS OPENED TO PROVIDE CONTAINMENT HEAT REMOVAL AT 16 HOURS. THE TORUS STEAM VENTING RATE IS EQUIVALENT TO A 60 GPM TORUS MAKEUP WATER FLOW RATE. THE FLEX LOW PRESSURE INJECTION PUMPS HAVE BEEN PROVIDING SUBCOOLING OF THE CORE WITH HEATED LIQUID FLOW OUT THE SRVs TO THE TORUS, WHICH MAY BE APPROACHING MAXIMUM WATER LEVEL. AT THIS TIME, THE STATION GROUNDWATER WELLS ARE FEEDING THE FRAC TANK VIA THE SKID-MOUNTED DEMINERALIZER VESSEL AND A SINGLE FLEX PUMP IS ALIGNED TO THE FRAC TANK TO BEGIN A LONG-TERM RPV MAKEUP AND BOILING STRATEGY, WHICH BEGINS WHEN THE RPV IS FLUSHED WITH SUBCOOLED WATER FROM THE FRAC TANK AND THEN ALLOWED TO BOIL DOWN TO A STABLE WATER LEVEL.

REACTOR MAKEUP INJECTION WATER CONDITIONS:
TEMP = 100 degF
ENTHALPY = 68 Btu/lbm

REACTOR CONDITIONS @ 72 HRS
PRESS = 65 PSIG
TSAT = 312 degF
TOT EVAP ENTHALPY
h fg = 1114 Btu/lbm

REACTOR STEAM CONDITIONS @ 72 HRS:
PRESS = 65 PSIG
TSAT = 312 degF
ENTHALPY = 1182 Btu/lbm

REACTOR MAIN STEAM RELIEF VALVES (SRVs) ARE REMOTE MANUALLY HELD FULL OPEN TO DEPRESSURIZE THE REACTOR VESSEL FOR LOW PRESSURE BOILING WITH MAKEUP WATER.

FLEX PUMP FLOW RATE REQUIRED IS 52 GPM FOR RPV MAKEUP SUPPLY TO CORE AT 72 HOURS.

FLEX PUMP FLOW RATE REQUIRED AFTER 72 HOURS IS BASED ON MAKEUP REQUIRED FOR CONSTANT RPV WATER LEVEL.

CORE DECAY HEAT
= 30 MBtu/Hr
@ 72 Hrs After Shutdown

TORUS CONDITIONS @ 72 HRS:
TEMP = 250 degF @ 15 PSIG
ENTHALPY = 218 / 1164 Btu/lbm

COMPLETE FILLING TORUS UP TO MAX 205" WATER LEVEL @ CL OF VAC BKRS @ EL 3' 7"

CONNECTION TO 18" COMMON SUCTION LINE TO HPCI & RCIC SYSTEMS CAN FEED THROUGH EITHER PUMP

THROUGHOUT THE SBO PERIOD, A 150 kW MOBILE GENERATOR WILL REPOWER THE 125 & 250 VDC BATTERY CHARGERS AND MAINTAIN CERTAIN 120 VAC INSTRUMENTS OPERATING.

Figure 6

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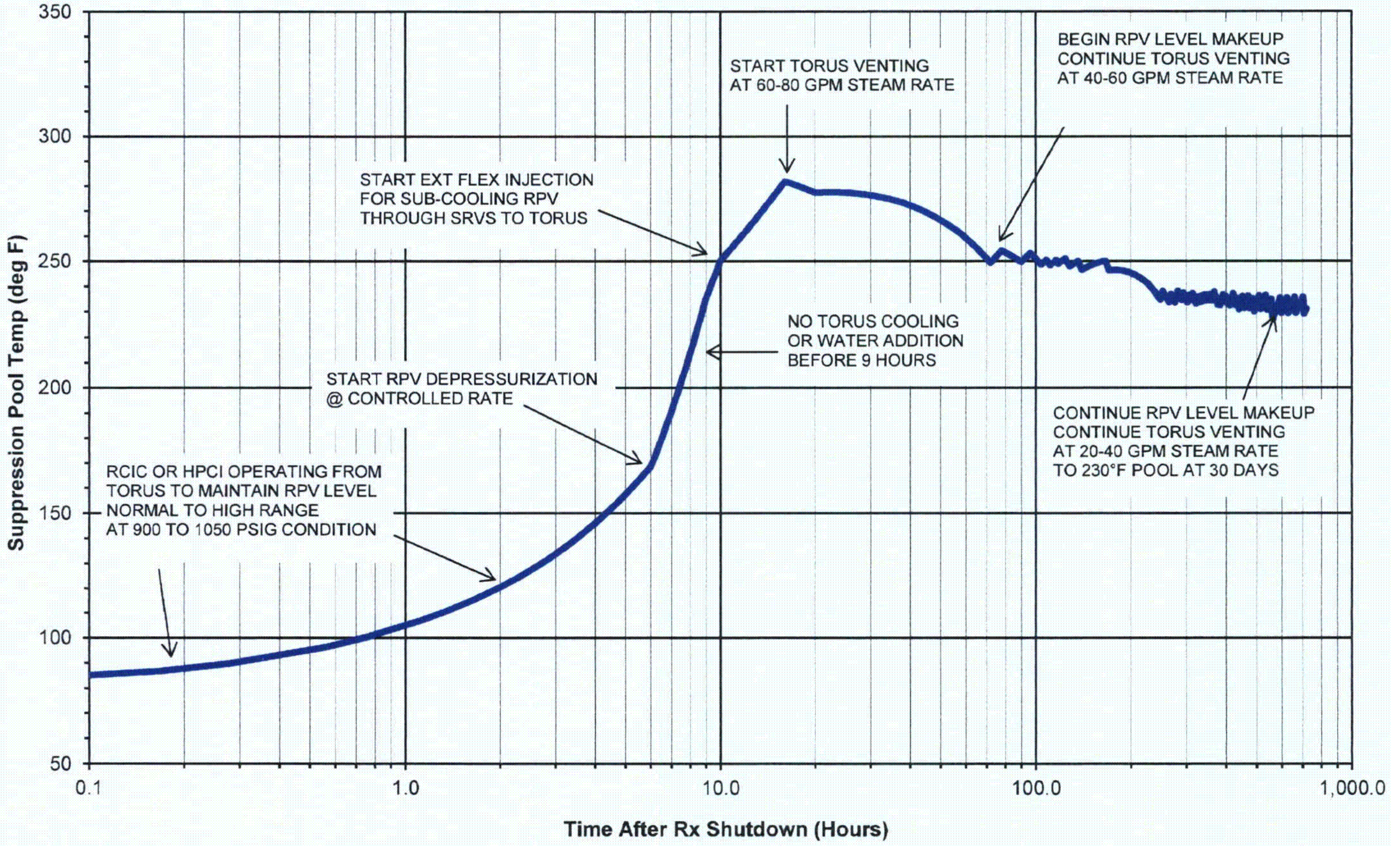
CASE #1
Suppression Pool Heatup with Loss of AC Power & No Preferrred Water Sources Available
RPV Depressurization @ 6 - 10 Hours w/ Ext Sub-Cooling Injection & WW Venting @ 16 Hrs



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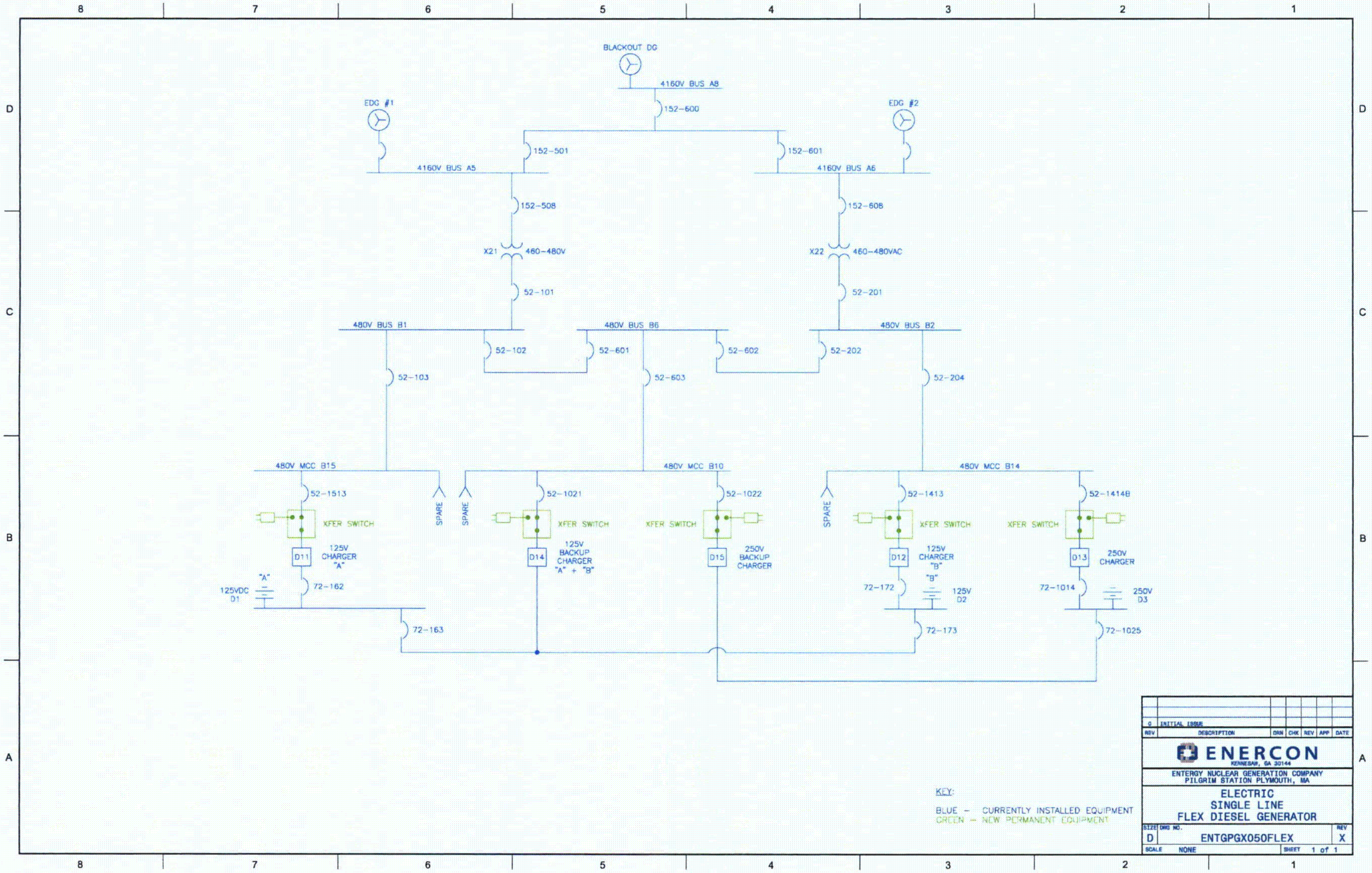

8
7
6
5
4
3
2
1
D
C
B
A
BLACKOUT DG
4160V BUS A8
152-600
EDG #1
EDG #2
152-501
152-601
4160V BUS A5
4160V BUS A6
152-508
152-608
X21
460-480V
X22
460-480VAC
52-101
52-201
480V BUS B1
480V BUS B6
480V BUS B2
52-102
52-601
52-602
52-202
52-103
52-603
52-204
480V MCC B15
480V MCC B10
480V MCC B14
52-1513
SPARE
SPARE
52-1021
52-1022
SPARE
52-1413
52-1414B
XFER SWITCH
XFER SWITCH
XFER SWITCH
XFER SWITCH
XFER SWITCH
D11
125V
CHARGER
"A"
D14
125V
BACKUP
CHARGER
"A" + "B"
D15
250V
BACKUP
CHARGER
D12
125V
CHARGER
"B"
D13
250V
CHARGER
"A"
125VDC
D1
72-162
72-163
"B"
72-172
125V
D2
72-1014
250V
D3
72-173
72-1025
0
INITIAL ISSUE
REV
DESCRIPTION
DRN
CHK
REV
APP
DATE
ENERCON
KENNESAW, GA 30144
ENTERGY NUCLEAR GENERATION COMPANY
PILGRIM STATION PLYMOUTH, MA
ELECTRIC
SINGLE LINE
FLEX DIESEL GENERATOR
SIZE
D
DWG NO.
ENTGPGX050FLEX
REV
X
SCALE
NONE
SHEET
1 of 1
KEY:
BLUE - CURRENTLY INSTALLED EQUIPMENT
GREEN - NEW PERMANENT EQUIPMENT

Figure 7

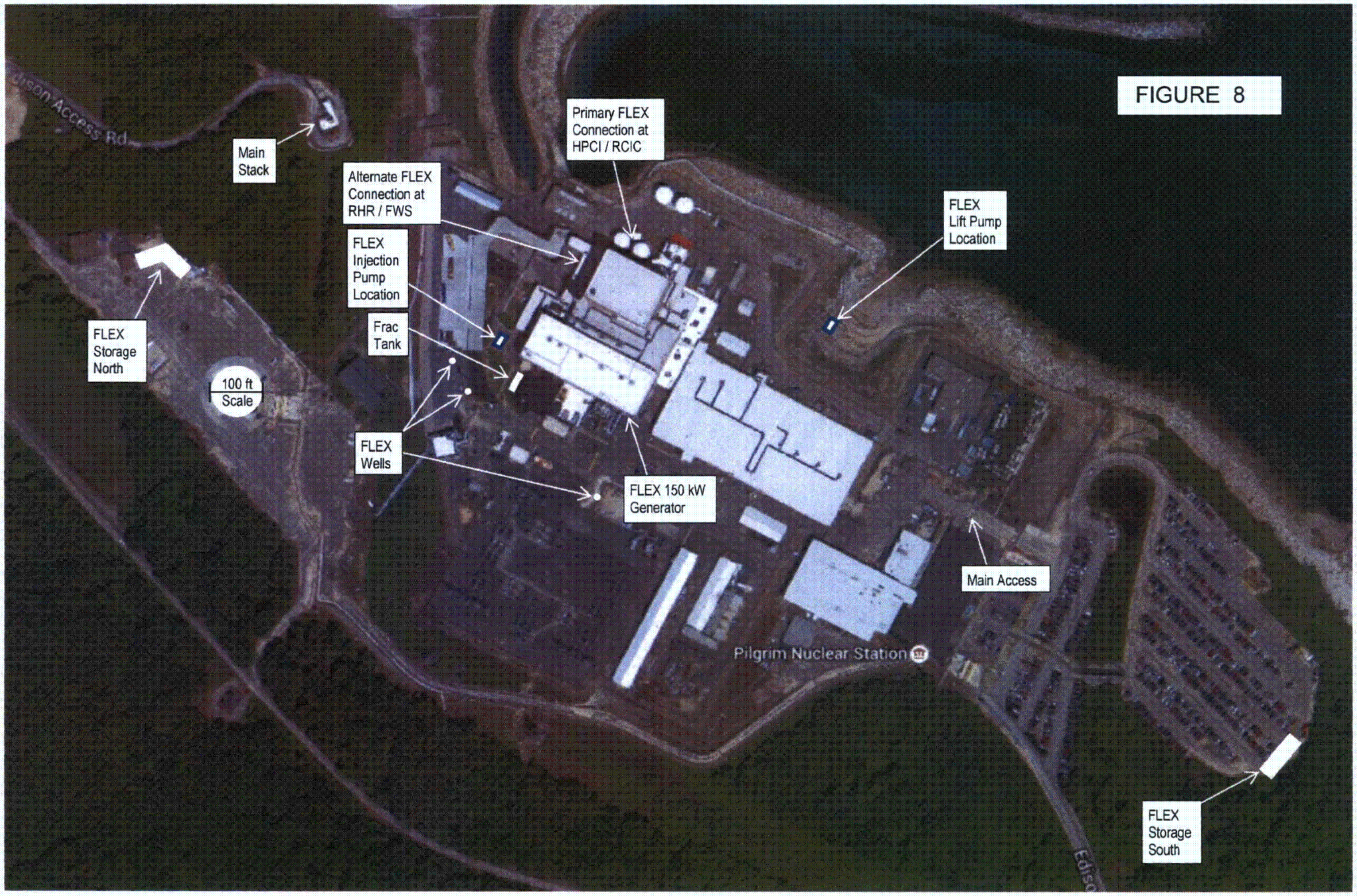
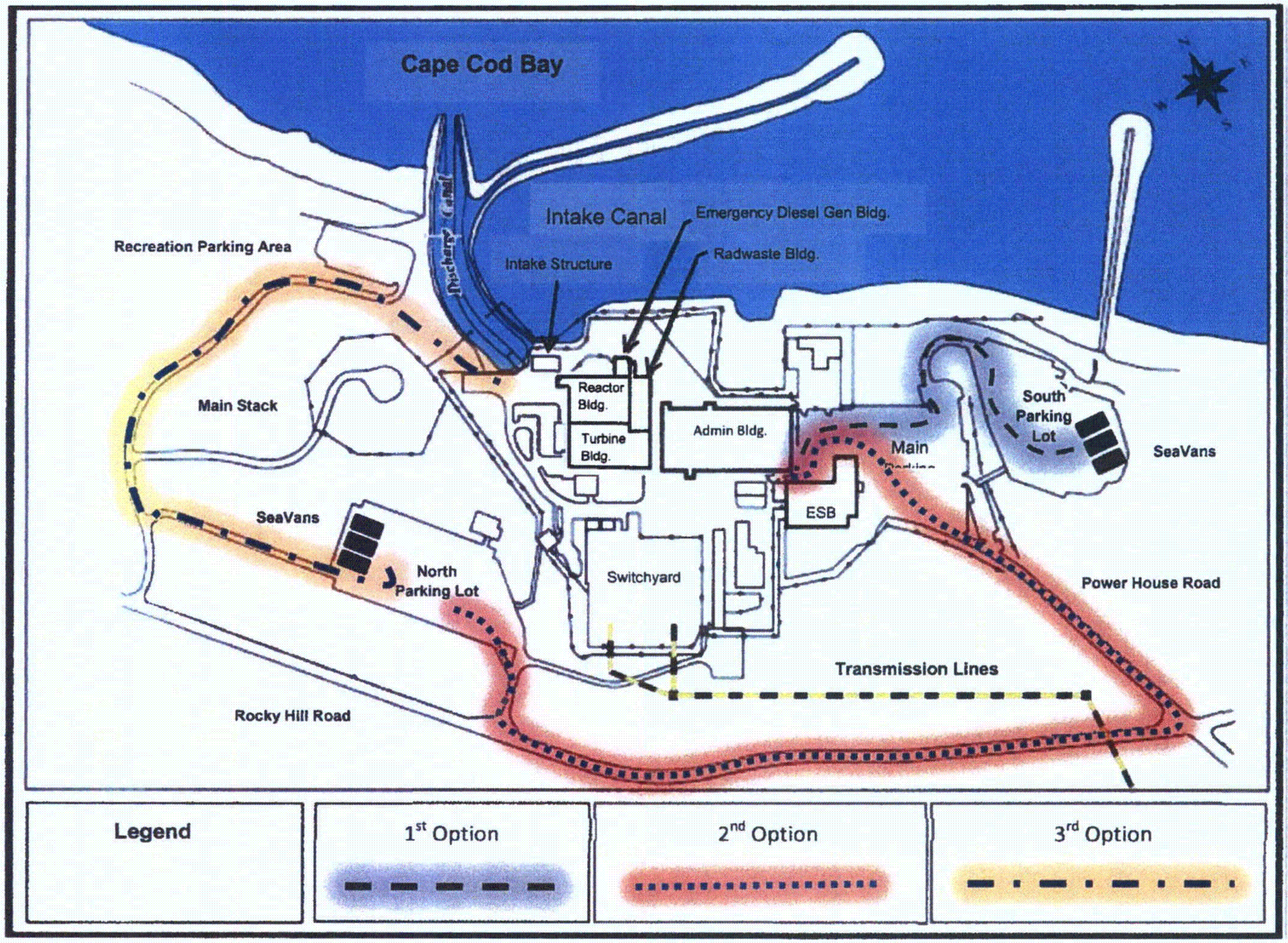


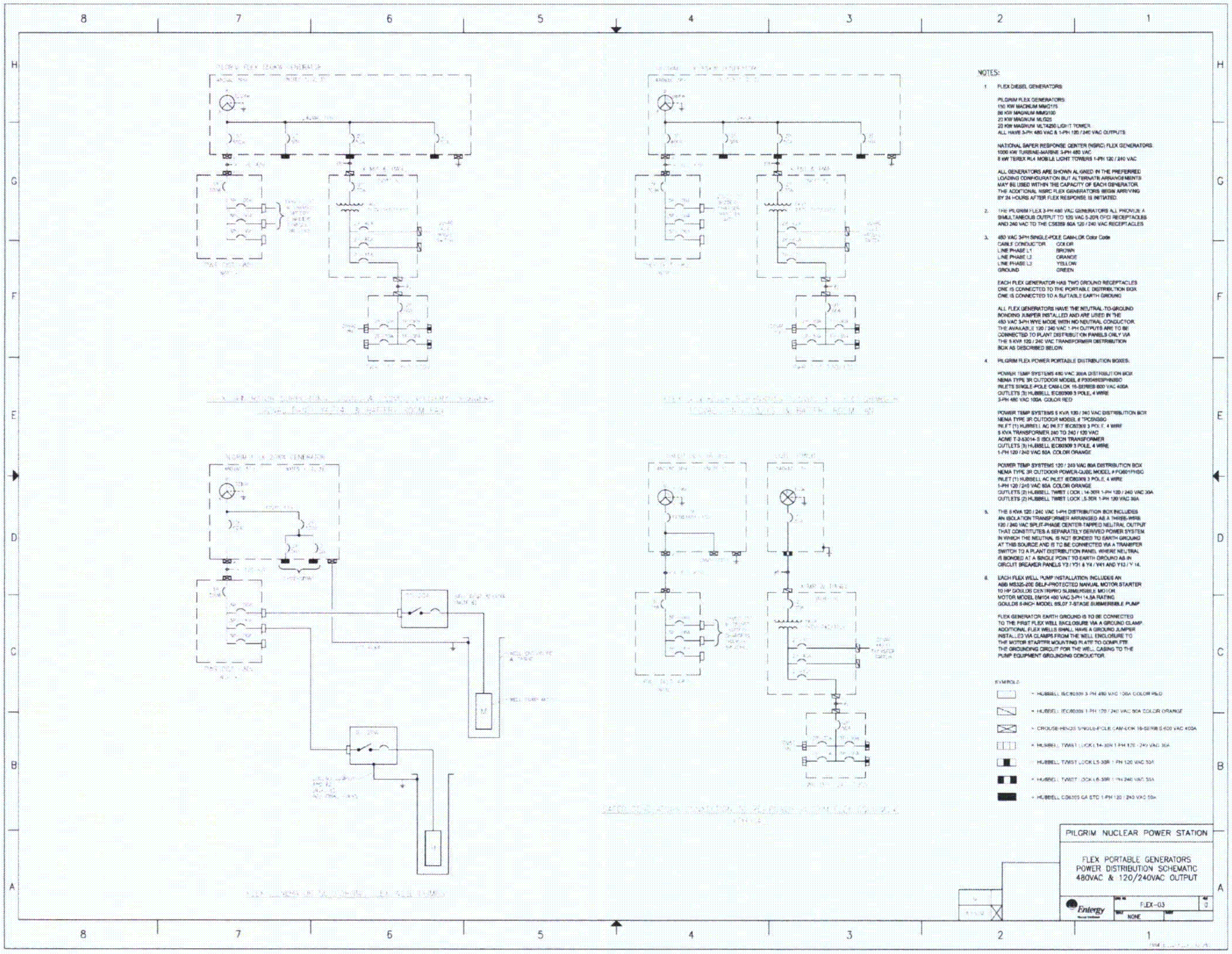
FIGURE 8
Main Stack
Edison Access Rd
Primary FLEX Connection at HPCI / RCIC
Alternate FLEX Connection at RHR / FWS
FLEX Injection Pump Location
FLEX Lift Pump Location
Frac Tank
FLEX Storage North
100 ft Scale
FLEX Wells
FLEX 150 kW Generator
Main Access
Pilgrim Nuclear Station
FLEX Storage South
Ediso

Figure 8

Figure 9

PREFERRED ACCESS ROUTES





NOTES:

1. FLEX DIESEL GENERATORS

PILGRIM FLEX GENERATORS
150 KW MAGNUM MMG175
80 KW MAGNUM MMG100
20 KW MAGNUM MLG25
20 KW MAGNUM MLT4250 LIGHT TOWER
ALL HAVE 3-PH 480 VAC & 1-PH 120 / 240 VAC OUTPUTS

NATIONAL SAFER RESPONSE CENTER (NSRC) FLEX GENERATORS
1000 KW TURBINE-MARINE 3-PH 480 VAC
6 KW TEREX RL4 MOBILE LIGHT TOWERS 1-PH 120 / 240 VAC

ALL GENERATORS ARE SHOWN ALIGNED IN THE PREFERRED LOADING CONFIGURATION BUT ALTERNATE ARRANGEMENTS MAY BE USED WITHIN THE CAPACITY OF EACH GENERATOR. THE ADDITIONAL NSRC FLEX GENERATORS BEGIN ARRIVING BY 24 HOURS AFTER FLEX RESPONSE IS INITIATED.

2. THE PILGRIM FLEX 3-PH 480 VAC GENERATORS ALL PROVIDE A SIMULTANEOUS OUTPUT TO 120 VAC 5-20R GFCI RECEPTACLES AND 240 VAC TO THE CS6369 50A 120 / 240 VAC RECEPTACLES.

3. 480 VAC 3-PH SINGLE-POLE CAM-LOK Color Code

CABLE CONDUCTOR	COLOR
LINE PHASE L1	BROWN
LINE PHASE L2	ORANGE
LINE PHASE L3	YELLOW
GROUND	GREEN

EACH FLEX GENERATOR HAS TWO GROUND RECEPTACLES. ONE IS CONNECTED TO THE PORTABLE DISTRIBUTION BOX. ONE IS CONNECTED TO A SUITABLE EARTH GROUND.

ALL FLEX GENERATORS HAVE THE NEUTRAL-TO-GROUND BONDING JUMPER INSTALLED AND ARE USED IN THE 480 VAC 3-PH WYE MODE WITH NO NEUTRAL CONDUCTOR. THE AVAILABLE 120 / 240 VAC 1-PH OUTPUTS ARE TO BE CONNECTED TO PLANT DISTRIBUTION PANELS ONLY VIA THE 5 KVA 120 / 240 VAC TRANSFORMER DISTRIBUTION BOX AS DESCRIBED BELOW.

4. PILGRIM FLEX POWER PORTABLE DISTRIBUTION BOXES:

POWER TEMP SYSTEMS 480 VAC 300A DISTRIBUTION BOX
NEMA TYPE 3R OUTDOOR MODEL # P3054603PHN3SO
INLETS SINGLE-POLE CAM-LOK 16-SERIES 600 VAC 400A
OUTLETS (3) HUBBELL IEC60309 3 POLE, 4 WIRE
3-PH 480 VAC 100A, COLOR RED

POWER TEMP SYSTEMS 5 KVA 120 / 240 VAC DISTRIBUTION BOX
NEMA TYPE 3R OUTDOOR MODEL # TPC5N3SO
INLET (1) HUBBELL AC INLET IEC60309 3 POLE, 4 WIRE
5 KVA TRANSFORMER 240 TO 240 / 120 VAC
ACME T-2-53014-S ISOLATION TRANSFORMER
OUTLETS (3) HUBBELL IEC60309 3 POLE, 4 WIRE
1-PH 120 / 240 VAC 50A, COLOR ORANGE

POWER TEMP SYSTEMS 120 / 240 VAC 60A DISTRIBUTION BOX
NEMA TYPE 3R OUTDOOR POWER-CUBE MODEL # PC601PHSO
INLET (1) HUBBELL AC INLET IEC60309 3 POLE, 4 WIRE
1-PH 120 / 240 VAC 60A, COLOR ORANGE
OUTLETS (2) HUBBELL TWIST LOCK L14-30R 1-PH 120 / 240 VAC 30A
OUTLETS (2) HUBBELL TWIST LOCK L5-30R 1-PH 120 VAC 30A

5. THE 5 KVA 120 / 240 VAC 1-PH DISTRIBUTION BOX INCLUDES AN ISOLATION TRANSFORMER ARRANGED AS A THREE-WIRE 120 / 240 VAC SPLIT-PHASE CENTER-TAPPED NEUTRAL OUTPUT THAT CONSTITUTES A SEPARATELY DERIVED POWER SYSTEM IN WHICH THE NEUTRAL IS NOT BONDED TO EARTH GROUND AT THIS SOURCE AND IS TO BE CONNECTED VIA A TRANSFER SWITCH TO A PLANT DISTRIBUTION PANEL WHERE NEUTRAL IS BONDED AT A SINGLE POINT TO EARTH GROUND AS IN CIRCUIT BREAKER PANELS Y3 / Y31 & Y4 / Y41 AND Y13 / Y14.

6. EACH FLEX WELL PUMP INSTALLATION INCLUDES AN ABB MS325-20E SELF-PROTECTED MANUAL MOTOR STARTER
10 HP GOULDS CENTRIPRO SUBMERSIBLE MOTOR
MOTOR MODEL 6M104 480 VAC 3-PH 14.8A RATING
GOULDS 6-INCH MODEL 6SL07 7-STAGE SUBMERSIBLE PUMP

FLEX GENERATOR EARTH GROUND IS TO BE CONNECTED TO THE FIRST FLEX WELL ENCLOSURE VIA A GROUND CLAMP. ADDITIONAL FLEX WELLS SHALL HAVE A GROUND JUMPER INSTALLED VIA CLAMPS FROM THE WELL ENCLOSURE TO THE MOTOR STARTER MOUNTING PLATE TO COMPLETE THE GROUNDING CIRCUIT FOR THE WELL CASING TO THE PUMP EQUIPMENT GROUNDING CONDUCTOR.

SYMBOLS:

= HUBBELL IEC60309 3-PH 480 VAC 100A COLOR RED
= HUBBELL IEC60309 1-PH 120 / 240 VAC 50A COLOR ORANGE
= CROUSE-HINDS SINGLE-POLE CAM-LOK 16-SERIES 600 VAC 400A
= HUBBELL TWIST LOCK L14-30R 1-PH 120 / 240 VAC 30A
= HUBBELL TWIST LOCK L5-30R 1-PH 120 VAC 30A
= HUBBELL TWIST LOCK L6-30R 1-PH 240 VAC 30A
= HUBBELL CS6369 CA STC 1-PH 120 / 240 VAC 50A

PILGRIM NUCLEAR POWER STATION

FLEX PORTABLE GENERATORS
POWER DISTRIBUTION SCHEMATIC
480VAC & 120/240VAC OUTPUT

Entergy

FLEX-03

0

NONE

Figure 10: FLEX Portable Generators Power Distribution Schematic 480VAC & 120/240VAC Output

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Paths and Accessibility

Deployment routes to be utilized to transport FLEX equipment are via the normal site roadways and access points as shown in Figure 8 and Figure 9. An alternate haul path exists via the shorefront. The paths will be accessible during all modes of operation and comply with NEI 12-06, Section 5.3.2. This strategy is included within an administrative program in order to keep pathways clear.

Pre-determined, preferred haul paths have been identified and documented in the FLEX Support Guidelines (FSGs). Figure 9 shows the haul paths from the FLEX storage areas to the deployment location. These haul paths have been reviewed for potential soil liquefaction and have been determined to be stable following a seismic event. Debris removal equipment is protected from the severe storm and high wind hazards such that the equipment remains functional and deployable to clear obstructions from the pathway between the FLEX storage areas and its deployment location.

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 BDBEE and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables to be run through various barriers in order to connect FLEX equipment to station fluid and electric systems. For this reason, certain barriers (gates and doors) will be opened and remain open. Access to the Protected Area during a BDBEE is addressed in the FLEX Support Guidelines (FSGs) and FSG Support Procedures. In particular Attachment 1, of FSG-5.9.5 Initial Assessment and FLEX Equipment Staging (Reference 3.60), addresses security implementation of FLEX Strategies including suspension of the Security Plan under provisions of 10CFR50.54(x) and the use of security personnel in response to the BDBEE. This suspension of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies.

The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms are barriers of concern. The Security force will initiate an access contingency upon loss of 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.

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

Vehicle access to the Protected Area is via the double gated sally-port at the Security Building. As part of the Security access contingency, the sally-port gates will be manually controlled to allow delivery of FLEX equipment (e.g., generators, pumps) and other vehicles such as debris removal equipment into the Protected Area.

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 could be used to support debris removal to facilitate road access to the site.

2.9 Deployment of strategies

2.9.1 RCS Primary Makeup Strategy

Prior to transition to Phase 2, at approximately 6 to 9 hours after shutdown, two diesel powered FLEX Low Pressure Pumps are set up near the UHS (Cape Cod Bay) in tandem using 5" hoses with a suction lift from the UHS. The first of two tandem diesel driven FLEX Low Pressure Injection Pumps take suction from the UHS and feeds a pressurized suction to the second pump to achieve sufficient flow capacity and total head for RPV injection. The diesel pumps are operated under manual speed control to achieve the desired pressure and flow as read locally on the duplex strainer cart flow meter and totalizer. Once the diesel driven FLEX Low Pressure Injection Pumps are deployed near the UHS, the engine-driven pumps are initiated, purged, and vented and flow is established through an open-ended discharge return hose to ensure the pumps are operating and ready to inject to the RPV. The pump discharge line includes a duplex strainer, flow rate meter and a totalizer with an injection connection point located at the vault between the CST tanks feeding into the underground HPCI/RCIC common suction line as shown on Figure 3. The HPCI/RCIC common suction line in the CST vault location has a removable protective housing to facilitate connection and provide hardened protection.

The required FLEX Low Pressure Injection Pumps will be maintained at the on-site FLEX storage locations. Four FLEX Low Pressure Injection Pumps are required to be stored onsite to satisfy the N+1 requirement. The trailer mounted FLEX Low Pressure Injection Pumps will be transferred and staged via haul routes and staging areas evaluated for impact from external hazards. Programs and training will be implemented to support the deployment and operation of the FLEX Low Pressure Injection Pumps.

At 16 hours, preparations are underway to power the station groundwater wells with portable a FLEX 20 kW or 86 kW DG and to begin adding water to completely fill the Water Storage FRAC Tank to prepare for a Phase 3, long-term reactor feedwater makeup and boiling strategy.

The Atlantic Ocean via Cape Code Bay (i.e., the UHS) provides an indefinite supply of water, as makeup, to the suction of the portable diesel powered FLEX Low Pressure Pumps. The UHS will remain available for any of the external hazards listed in Section 2.6.

2.9.2 Alternate RCS Makeup Strategy

The alternate FLEX Hydraulic water source injection point will be to the RHR System at the existing Fire Water to RHR System Cross-Tie 8-inch connection via a removable spool in the Auxiliary Bay EL 23 ft Water Treatment Area via 8-inch Fire Water Manual Isolation Gate Valve 10-HO-511 that feeds into the RHR System 18-inch Cross-Tie. A removable 8-inch FLEX spool piece connector with Victaulic Couplings would be installed to accept a 5-inch Hose Connector from the two diesel powered FLEX Low Pressure Pumps set up in tandem using 5" hoses with a suction lift from the UHS. The pump discharge line includes a duplex strainer, flow rate meter and a totalizer. PNPS 5.3.26 provides the guidance on providing a low pressure injection source for this scenario.

This alternate strategy uses the same two diesel powered FLEX Low Pressure Pumps credited for the primary strategy.

2.9.3 Electrical Strategy

Transition from Phase 1 (reliance on station batteries) to Phase 2 (repowering station battery chargers) will be made using FLEX 480 VAC 3-PH 86 kW and/or 150 kW portable trailer mounted DG(s) to supply power to any of the five (5) 125V and 250V DC Station Battery Chargers (Normal and Backup) that provide charging power to the 125V and 250V batteries. See the Primary Strategy to Repower Battery Chargers discussion in Section 2.3.2 regarding the various FLEX 480 VAC DG configurations depending on which FLEX 480 VAC DGs are available following a BDBEE. It is anticipated that the decision to deploy the FLEX DG(s) will be made during the initial response phase. The operator is directed to take steps to minimize the load on the station batteries by shedding unnecessary loads in accordance with station SBO procedures; load shedding starts within 2 hours ensuring the station battery will have greater than 8 hours capability and will be available until the FLEX generators are placed in service on or before 8 hours (Reference 3.31, 3.32, 3.33). The two (2) required (N) FLEX 86 kW DGs will be maintained in on-site FLEX storage structures. The third (N+1) FLEX 150 kW DG will be pre-staged in the Turbine Building Truck Lock area, which is a protected area in close proximity to the Battery Charger and Switchgear Rooms. This will allow for more rapid deployment of the first FLEX DG for ELAP events where that is possible.

The intent is to begin recharging the batteries well before they become fully depleted if the pre-staged (N+1) FLEX DG is available after the event. A single 150 kW generator is capable of repowering two 125V battery chargers and the 250V battery chargers, with associated battery room ventilation and 120VAC panels. If the pre-staged (N+1) FLEX DG is not available, then two FLEX 86 kW DGs would be deployed to repower the chargers of both division simultaneously prior to the batteries becoming depleted.

The FLEX 86 kW DGs from the storage sites will be transferred and staged via haul routes and staging area (see Figure 8 and Figure 9) evaluated for impact of external hazards (Reference 3.20, 3.34). Modifications were implemented to facilitate the connections and operational actions required to repower any of the Station Battery Chargers (Normal and Backup) directly from the FLEX DGs (see Figure 10). This will be accomplished utilizing AC Power Transfer Switches and Portable Cable Connections located in the A and B Switchgear Rooms and serve to completely disconnect from the normal 480 VAC bus source to allow the external 480 VAC feed from the FLEX 480 DG(s) (References 3.20, 3.28). Electrical connection points for the 480 VAC FLEX DG(s) will be missile protected and enclosed within the Seismic Category 1 structure of the DC Power Battery Rooms and Switchgear. Programs and training will be implemented to support operation of FLEX DGs. Six hours has been used as a reasonable assumption for transferring and placing the FLEX portable DGs into service. All 480 VAC 3-PH 4-Conductor Cable requirements for Portable Generators will be provided with 4-Wire 100 Amp Plugs, Connectors, and Receptacles for 125 and 250 VDC Battery Chargers and Well Pumps (see Figure 10). The required cabling will be pre-staged in the vicinity of the Battery Charger and Switchgear Rooms.

One of the FLEX 480 VAC DGs may be utilized to power the station Groundwater Wells and can power the portable battery room exhaust fans (which can also be powered from the FLEX120/240 DGs).

Each Groundwater Supply well is equipped with a 6” submersible well pump with motor. Each motor has a #12 AWG lead cable supplied. The motor starter and electrical connectors are mounted in a NEMA 4X box where the FLEX 480 VAC generator will be connected.

2.9.4 Fueling of Equipment

The FLEX strategies for maintenance and/or support of safety functions involve several elements including the supply of fuel to necessary diesel powered generators, pumps, hauling vehicles, compressors, etc. The general coping strategy for supplying fuel oil to diesel driven portable equipment, i.e., pumps and generators, being utilized to cope with an ELAP / LUHS, is to draw fuel oil out of any available existing diesel fuel oil tanks on the Pilgrim site. (Reference 3.61)

Pilgrim has nominally 48,000 gallons in two EDG underground storage tanks, 36,000 gallons in two SBO underground storage tanks, and 1,000 gallons in two EDG above ground day tanks. The underground storage tanks are equipped with waterproof fill heads, and their integrity is routinely verified in accordance with existing PMs. The EDG and SBO tanks are below grade (23`el). The day tanks are above grade, but within the Class 1 EDG building.

The primary source of fuel oil for portable equipment will be the emergency diesel generator (EDG) Fuel Oil Day Tanks (T-124A/B). These two diesel tanks are maintained with a minimum of 444 gallons of diesel fuel each (a total of 888 gallons) and are seismically mounted and housed in the tornado protected EDG rooms. The contents are accessible via manway located on top of the tank. The elevation of the manway is significantly higher than the maximum postulated flood level on the north side of the site.

A second source for fuel oil will be the two EDG Underground Diesel Fuel Oil Storage Tanks (T-126A/B). Each tank is maintained with a minimum of 19,800 gallons. These tanks are protected from high wind tornado missile by virtue of the underground location and are also protected from seismic and flooding events. The contents are accessible via flanges on top of the tanks. The elevation of these access locations is at or slightly above the maximum postulated flood level on the north side of the site. The temporary maximum flooding levels would not significantly affect these tanks or the quality of the diesel fuel.

A third source are the SBO Diesel Generator Fuel Oil Storage Tanks (T-160A/B). The minimum fuel storage maintained is 36,800 gallons. The contents are accessible via flanges on top of the tanks. The elevation of these access locations is below the maximum postulated flood level on the south side of the site. Therefore, these tanks are not the preferred source of diesel fuel but are available and would not be significantly compromised by minor water intrusion.

Diesel fuel will be pumped from one or more of these tanks into a truck mounted 100 gallon (nominal) fuel tank and transported to the equipment locations (see Figure 11). The fuel will then be pumped from the truck mounted tank into the fuel tanks of the essential equipment using a truck mounted 12VDC electric pump. For refueling non-essential equipment, it is anticipated that the truck mounted tank and pump will be used to fill a smaller wheeled tank which may then be transported and utilized by personnel responsible for this equipment. Fuel transfer carts and pumps are stored in the FLEX storage areas.

Diesel fuel in the fuel oil storage tanks is routinely sampled and tested to assure fuel oil quality is maintained to ASTM standards (Technical Specification Surveillance Requirements 4.9.A.1.e, Reference 3.12). This sampling and testing surveillance program also assures the fuel oil quality is maintained for operation of the station Emergency Diesel generators. Fuel oil in the fuel tanks of portable diesel engine driven FLEX equipment will be maintained in the Preventative Maintenance program in accordance with the EPRI maintenance templates.

Based on a fuel consumption study (Reference 3.61), an 8-hour refueling cycle is feasible and adequate to ensure operation of the FLEX equipment. On-site fuel resources are more than adequate to support the continuous operation of FLEX equipment and support vehicles well beyond 72 hours. The 8-hour cycle includes one or two refills of essential equipment based on run time. It also includes two refills of the portable wheeled tank and concludes that these two refills of the smaller tank are adequate to supply non-essential equipment. Essential diesel driven FLEX equipment will be kept fueled during storage. The fuel consumption study (Reference 3.61) conservatively assumes that the essential diesel driven equipment fuel tanks are maintained at a minimum specified level at the beginning of the event (e.g., the 150 kW DG fuel tank is assumed to be ≥75% full). The following provides the minimum initial operating times of essential diesel driven equipment based on the minimum levels maintained in storage:

Equipment	Minimum Initial Operating Times
150 kW Generator	23 hours
86 kW Generator	17 hours
20 kW Generator	15 hours
20 kW Generator w/ Light Tower	23 hours
Suction Pump	14 hours
Injection Pump	17 hours
Air Compressors	6 hours

It is anticipated that the 8-hour refueling cycle may be required for an indefinite period. For the first 72 hours after deployment, calculated diesel fuel usage is approximately 2900 gallons. There is in excess of 40,000 gallons of protected stored diesel fuel in the DG Fuel Oil Day and Storage Tanks which could provide onsite diesel driven FLEX equipment diesel fuel for > 30 days.

2.10 Offsite Resources

2.10.1 Regional Response Center

The industry has establish two (2) National SAFER Response Centers (NSRCs) to support utilities during BDBEEs. Entergy has established contracts with the Pooled Equipment Inventory Company (PEICo) to participate in the process for support of the NSRCs as required. Each NSRC holds five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. In addition, on-site FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC. In the event of a BDBEE and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area established by the SAFER team. FLEX Strategy requests to the Regional Response Center (RRC) will be directed by FLEX Procedures.

For PNPS, Staging Area ‘B’ (2) is located at the I&S parking lot (North) and the employee parking lot (South). If these are not accessible, Staging Area ‘C’ is located at the New Bedford Airport.

From Staging Area C, equipment can be taken to the PNPS site and staged at Staging Area ‘B’ by helicopter if ground transportation is unavailable. Communications will be established between the PNPS plant site and the SAFER team via satellite phones and required equipment moved to the site as needed. First arriving equipment will be delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in the PNPS "Regional Response Plan."

2.10.2 Equipment List

For PNPS, the only equipment that is planned to be provided from the NSRC are the mobile water treatment skids and a collapsible water storage bladder tank that is required for the Phase 2 to Phase 3 transition at 72 hours post event. This equipment is within the air-lift capability of the NSRC. The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE is listed in Table 5. Table 5 identifies the equipment that is specifically credited in the FLEX strategies for Pilgrim but also lists the equipment that will be available for backup/replacement for on-site Phase 2 equipment. Since all the equipment will be located at the local assembly area, the time needed for the replacement of a failed component will be minimal. The NSRC may also be used to replenish commodities including additional fuel and food after 72 hours.

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

Following a BDBEE and subsequent ELAP event at Pilgrim, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment will be lost. Per the guidance given in NEI 12-06, FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDBEE resulting in an ELAP/LUHS. The primary concern with regard to ventilation is the heat buildup which occurs with the loss of forced ventilation in areas that continue to have heat loads. A loss of ventilation analysis was performed to quantify the maximum steady state temperatures expected in specific areas related to FLEX implementation to ensure the environmental conditions remain acceptable for personnel habitability or accessibility and within equipment limits.

The key areas identified for all phases of execution of the FLEX strategy activities are the MCR, RCIC room, and battery rooms.

GOTHIC analysis (Reference 3.62) of the MCR over a period of 72 hours following an extended loss of AC power shows that by opening Door 145

"Main Control Room to Stairway 8" within 30 minutes, the MCR temperature will be kept under 110°F, the limit for unrestricted human performance as specified in NUMARC-87-00 (Reference 3.9). The GOTHIC analysis uses the conservative assumptions of a 102°F outside temperature and loss of offsite power heat loads for the MCR (Reference 1). No other actions or modifications are required for MCR Accessibility.

It is not anticipated that the RCIC room will require occupation by personnel during the event. The only case where personnel would be required to enter the RCIC room will be during Phase 1 if remote operation fails. The PNPS Probabilistic Safety Assessment (Reference 3.64) contains evaluations of RCIC room heatup for station blackout conditions. One evaluation was performed using GOTHIC (Reference 3.64 App M2); another evaluation was performed by General Electric as part of a Station Blackout study (Reference 3.64 App F7). The GOTHIC results indicate temperatures of 124.5°F for the RCIC Pump quadrant, 137.7°F for the RCIC Pump Quadrant Mezzanine, and 121.8°F for the RCIC Valve Station at 10 hrs. The GE evaluation indicates temperatures of 112°F for a realistic 10 lbm/hr steam leakage rate and 137.5°F for an extreme 70 lbm/hr leakage rate at 10 hrs. The RCIC isolation valves will not close in the first 10 hrs, but if personnel access is required, mitigating actions such as using portable fans, water sprays, self-contained breathing equipment, and reduced stay times will be used.

An additional ventilation concern applicable to Phase 2 is the potential buildup of hydrogen in the battery rooms. Off-gassing of hydrogen from batteries is only a concern when the batteries are charging. Once a 480 VAC power supply is restored in Phase 2 and the station Class 1E batteries begin re-charging, power is also provided to two FLEX portable ventilation fans, one in each DC Power System Battery Room, to prevent any significant hydrogen accumulation.

2.11.2 Heat Tracing

The PNPS FLEX Strategy does not have dependency on heat tracing for any required equipment after the initiation of the event. The FLEX equipment is protected from low temperatures and freezing during normal plant operation using electric heaters. Such heaters are provided for diesel engine block heaters and for the nominal 21,000 gallon water storage FRAC tank.

2.12 Personnel Habitability

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

2.13 Lighting

Following the BDBEE, emergency lighting is retained for the MCR. For the first 8 hours, the emergency lights are fed from the station batteries; after 8 hours the battery chargers are powered from a FLEX DG which carries the DC loads. If additional load shedding is performed to extend the125V "A" Battery System even longer, for at least the first seven hours the emergency lighting is maintained off of the 125V "A" Battery System, then after 7 hours emergency lighting could be transferred to 125V "B" Battery System in order to extend the 125V "A" Battery System life (Reference 3.66).

Several Emergency Lighting Units (ELU) are located throughout the plant to illuminate pathways and Alternate Shutdown Panels. However, Operations personnel are instructed to have a flashlight as a backup in the event an ELU is not operating.

Existing plant procedures (Reference 3.67) include guidance for when normal lighting is not available to accomplish tasks outside of the MCR; this same strategy would apply to a BDBEE. Alternate Shutdown Toolboxes are staged in the elevation 23' and 37' Switchgear Rooms. These contain keys, tools, flashlights, and other gear necessary for the Operators to carry out their required tasks. In addition, sufficient numbers of walkie-talkies will be available to provide communications between the various locations throughout the plant.

There are two FLEX storage depots. Each location will contain:

- Three 110VAC fixtures.
- 5 battery powered lights.
- A trailer mounted light tower, with four light fixtures powered by an integral diesel generator.
- Three 7.5 KW diesel driven generators.

In summary; there are total of six LED light fixtures, 6 diesel generators, 1200` of cord, plus two diesel powered light towers, 10 portable battery powered LED lights and two pickup trucks with directionally mounted LED flood lights for area setup.

There will be 14 LED portable battery powered lighting distributed between the Control Room Annex, EDG Rooms, Battery areas, TSC, OSC, Trucklock, and the Switchgear Room access. Each of these lights has three detachable individual units.

In addition, an assessment of installed emergency lighting demonstrates that adequate lighting is available for access to the torus vent controls.

2.14 Communications

The Pilgrim communication plans are discussed in depth in letters to the NRC (References 3.68, 3.69).

The Pilgrim 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.

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

On site:

Existing plant procedures include guidance for when normal communication means are not available. Alternate Shutdown Toolboxes are staged in the elevation 23' and 37' Switchgear Rooms. These contain keys, tools, flashlights, and other gear necessary for the Operators to carry out their required tasks. In addition, sufficient numbers of walkie-talkies will be available to provide communications between the various locations throughout the plant.

Radio Communication equipment used in normal plant operations (Fire Brigade and PNPS Operations Radio Communications) will also be used in an emergency to communicate with mobile units. The Radio System consists of repeaters, antennas and portable radios, which provide communication between the TSC, dispatched in-plant teams and the PNPS Control Room. A UHF (Ultra High Frequency) radio repeater system provides communications via handheld radios, to the operators during implementation of the alternate shutdown procedure. Satellite receivers are installed on the exterior side of the North Wall of the Reactor Building. The two receivers are connected to a radio transmitter located in the SAP. A UHF directional antenna is installed on the roof of the SAP to direct a radio signal back towards the Reactor Building.

Uninterruptible Power Supplies (UPS) are provided to the credited communication components (i.e. credited equipment) for a minimum period of

24 hours following a BDBEE. Hand-held equipment (radios and satellite phones) will have adequate spare batteries to provide for 24 hours. After the initial minimum 24-hour period, portable FLEX and EP communication generators will provide continuous power to the credited equipment. The credited equipment includes: satellite phones and the Radio Control Console for the Fire Brigade channel in the MCR, Bridge and voter to support the Operations channel radios and the Fire Brigade Base Station in the ESB Telephone Equipment Room and SAP Locker Room and a desk top radio in the TSC.

Off-Site:

Existing telephone communications are assumed to be inoperable following a BDBEE and therefore are not credited. Communication links are assumed to be established via satellite phones and use of the credited site radio channel(s). Satellite phones are the only reasonable 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. A total of 26 satellite phones are available for offsite communications. These phones are distributed between the MCR, the TSC, and EOF. Additionally, all of the local Offsite Response Organizations (OROs) are being provided a satellite phone if they are within a 25 mile radius of the Pilgrim site.

2.15 Water sources

2.15.1 Secondary Water Sources

FLEX Raw Water (Seawater) Strategy Considerations:

The PNPS FLEX Strategy is, by necessity, a "Raw Water" Strategy, that is, in the extreme case of losing all preferred sources of RPV makeup water, the Ultimate Heat Sink (UHS) Raw Seawater source may be used in accordance with guidance for handling such low quality but plentiful water sources. This Strategy is in accordance with NEI and BWROG guidance.

NEI 12-06 Rev 0 (Reference 3.3) Section 3.2.2, Minimum Baseline Capabilities states:

> Under certain Beyond-Design-Basis Conditions, the integrity of some water sources may be challenged. Coping with an ELAP / LUHS may require water supplies for multiple days. Guidance should address alternate water sources and water delivery systems to support the extended coping duration. 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 assumed to be available in an ELAP / LUHS at their nominal capacities.
>
> Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

GEH NEDC-33771P (Reference 3.70), Section 7.7, Water Sources (Installed And Staged) includes the following guidance:

> If the plant needs to rely on raw water or seawater for part of the planned response, consideration should be given to performing RPV low pressure injection at a rate that provides core cooling without boiling. This will help prevent heat transfer surface fouling and can be done by bleeding water through the SRVs to the suppression pool. The site-specific evaluation will have to include a determination of how long this can continue before the maximum Suppression Pool level is reached as well as what flow rate will be required to preclude boiling. When the Suppression Pool maximum level is reached, other means of core cooling must be provided, or an acceptable method of suppression pool draining must be established.

In accordance with the above guidance, the PNPS FLEX Strategy will employ the use of Raw Water sources when all preferred sources are unavailable (Reference 3.22).

For Subcooling the RPV or for Flooding Containment, where there is no Bulk Boiling in the RPV, the use of Raw Water with only Straining/Filtering is allowed. The base case FLEX Strategy scenario utilizes Subcooled Flow Boiling at a nominal 2x RPV Boil-Off Flow Rate for up to 72 Hours, while Containment Flooding fills the Drywell at the fastest rate possible using any available Water Sources.

Considerations are also necessary for the Corrosion and potential Stress-Corrosion mechanisms that affect Nickel and Ferrous Alloy materials when exposed to high levels of Chlorides and dissolved Oxygen. These corrosion effects are longer term concerns and are not considered to preclude the successful completion of the FLEX Strategy during and following the BDBE followed by a Recovery Phase during which the RPV Core is off-loaded and the water in Primary Containment can be treated and processed as necessary to complete the Recovery Phase.

All FLEX Strategies eventually result in a low pressure RPV Feed and Bleed Boiling with Makeup Water and this is the point at which Treated Water is needed for indefinite coping. The objective is to provide Makeup Water that does not cause fouling or scaling of the heat transfer surfaces of the RPV Core, or plug any passageways with sediment or debris. At 3 Hours after Shutdown, the Decay Heat is at 1% of rated power and drops to under 0.5% at 72 Hours, so there is well over 100 times the surface area required for overall heat transfer, which allows for significant scaling to occur. The Water Quality requirements for RPV Makeup Water have been evaluated (Reference3.16).

<u>FLEX Raw Water (Well Water) Strategy Considerations:</u>

The transition to long term will be completed by transferring the suction of the FLEX Pump to the FRAC Tank to provide reactor makeup with the FLEX Pump discharging to the RPV via the CST suction line (or alternate RHR injection point) to begin a long-term reactor feedwater makeup and boiling strategy (see Figure 5 and Figure 6). A Water Treatment System from the NSRC will be utilized to demineralize the makeup water, but is not initially required for the FLEX Groundwater Well source based on its sufficiently low mineral content. The RPV will be flushed with subcooled water from the FRAC tank to the Torus (via SRVs) and then the RPV will be allowed to boil down to a stable water level. The plant will be in a stable condition with outside resources available to maintain stable conditions indefinitely.

<u>FLEX Dryer and Separator Storage Pool Strategy Considerations:</u>

The initial source of SFP makeup water may be provided by storage of demineralized water in the lower volume of the Dryer and Separator

Storage Pool (below EL 97 ft). The capacity of this lower volume is a nominal 34,000 Gal. A usable volume of 30,000 gallons will provide a 42 hour supply of makeup water at a boil-off rate of 12 GPM. The total heatup time to boiling and available makeup water supply is then 74 hours. At 72 Hours, the FLEX Phase 3 source of makeup water from the FLEX Groundwater Wells will be used for both the RPV and SFP makeup water requirements, unless other preferred sources are also available.

Table 3 provides a list of potential water sources that may be used to provide cooling water to the RPV or the SFP, their capacities, and an assessment of availability following the applicable hazards identified in Section 2.6. As noted in Table 3, at least four water sources (three for core cooling and one additional for SFP) would survive all applicable hazards for Pilgrim and are credited for use in FLEX strategies.

2.16 Shutdown and Refueling Analysis

Pilgrim will abide by the Nuclear Energy Institute position paper entitled "Shutdown/Refueling Modes" (ML13273A514) addressing mitigating strategies in shutdown and refueling modes. This paper has been endorsed by the NRC Staff (ML13267A382). Therefore, Entergy will incorporate the supplemental guidance provided in the NEI position paper to enhance the shutdown risk process and procedures. The approach for incorporation of the supplemental guidance is provided below.

In order to further reduce shutdown risk, the shutdown risk process and procedures will be enhanced through incorporation of the FLEX equipment. Consideration will be given in the shutdown risk assessment process to:

- Maintaining FLEX equipment necessary to support shutdown risk processes and procedures readily available, and
- How FLEX equipment could be deployed or pre-deployed/pre-staged to support maintaining or restoring the key safety functions in the event of a loss of shutdown cooling.

In cases where FLEX equipment would need to be deployed in locations that would quickly become inaccessible as a result of a loss of decay heat removal from an ELAP event, pre-staging of that equipment is required.

FLEX mitigating strategies available during shutdown and refueling modes are summarized below.

The Hot and Cold Shutdown conditions (other than Refueling Modes) are bounded by the FLEX Strategy for Power Operation. The FLEX Strategy response times for an event that occurs while already in Hot or Cold Shutdown are longer than for the Power Operation condition because the RPV is initially repressurized to allow use of the steam-driven RCIC or HPCI Systems for Core Cooling. The subsequent Phase 1, 2, and 3 actions are the same as for Power Operation, but occur later as the decay heat is lower and heatup times longer, dependent on the elapsed time since shutdown.

The most limiting shutdown condition event occurs during the early Reactor disassembly stages while in the Refueling Mode. After achieving Cold Shutdown and entering the Refueling Mode, the Drywell Head is removed and the RPV head detensioning process is begun (Reference 3.20). Once the detensioning process has progressed to the Second Pass, typically no earlier than 36 Hours after Reactor shutdown, it would not be prudent to allow any significant repressurizing of the RPV if Shutdown Cooling were lost. For the FLEX Strategy planning, the bounding Refueling Outage time period to consider is at 36 hours after Reactor shutdown, at which point the loss of all AC power and Shutdown Cooling is assumed to occur, with the following conditions (Reference 3.20 3.41, 3.71):

- Time-to-Boil @ 36 hours = 1.9 hours
  (based on 125°F starting temperature)
- Boil-Off Rate @ 36 hours = 80 GPM
- Boil-Down to TAF @ 36 hours = 11.2 hours
  (RPV Flange to TAF)

Prior to the start of the Reactor disassembly stages of a refueling outage, procedures (Reference 3.72) will confirm that no extreme weather events are imminent and certain FLEX equipment will be pre-staged to provide more rapid implementation of the elements of the FLEX Strategy that are appropriate. The pre-staging will include the following activities:

- Providing or staging AC power and hose connections to the FLEX Groundwater Wells with sufficient capacity to provide 80 GPM total makeup water to the portable storage tank.
- Providing or staging hose connections to the FLEX Pump, to Duplex Strainer, and final discharge hose connection to the Hydraulic Connection Point at the CST Vault that is connected to the 18" HPCI / RCIC Suction Line.

- In the event of a BDBEE the pre-staged equipment will be placed in service and core cooling will immediately transition to Phase 2, if needed.

If a BDBEE were to occur during the Early Refueling condition (as stated above this is the most limiting Shutdown case) the FLEX equipment to power the station groundwater wells, the FLEX Pump and connection to the CST line to prepare for a long-term reactor feedwater makeup and boiling strategy will have been pre-staged and will be placed in service within the time period for RPV heatup to boiling. RPV cooling flow will be initiated from the FLEX Pump operating at the maximum available flow rate sufficient, at a minimum, to provide saturated makeup, and preferably to sub-cool the RPV via either of the following methods, depending on the status of the RPV head detensioning at the time (Reference 3.20, 3.71).

- If the detensioning has progressed past the point where repressurizing the RPV would not be prudent, then flow will be established into the Reactor Basin with sub-cooled water discharging through the 4" Reactor Head Nozzle N8 Adapter Flange.
- If the detensioning progress does not prevent repressurizing of the RPV, then the SRVs are opened and the RPV allowed to repressurize to approximately 50 psig to discharge to the Torus and begin a long term reactor feedwater makeup and boiling strategy. (Reference 3.20)

For SFP cooling considerations, refer to Section2.4.

CALCULATION M1394 ATTACHMENT A:

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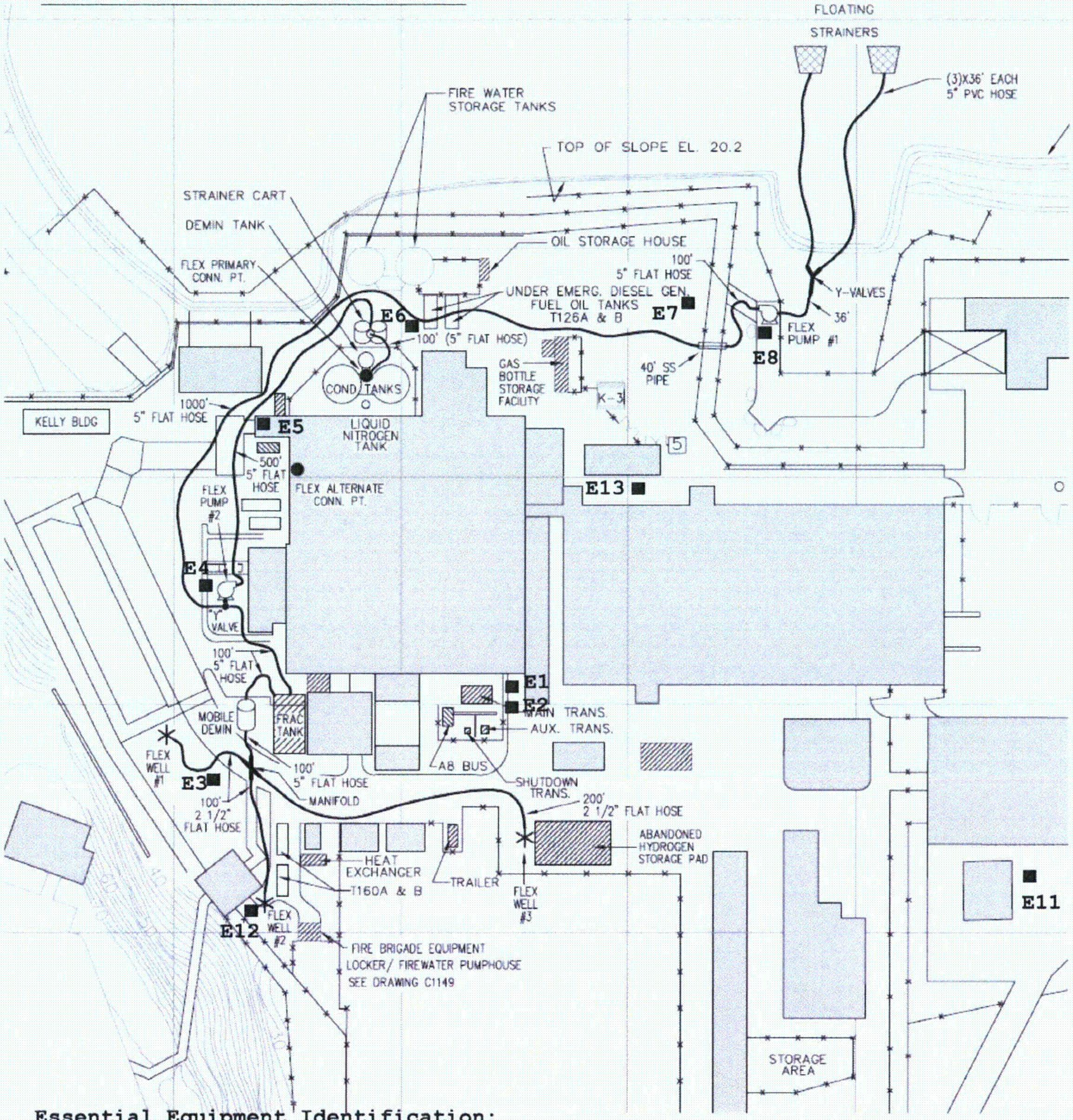

Essential Equipment Identification:

E1: 150 or 86 kW Generator
E2: 86 kW Generator
E3: 20 kW Generator
E4: Trailer Mounted Pump, HL110M
E5: Air Compressor
E6: Air Compressor
E7: Light Tower
E8: Trailer Mounted Pump, HL100M

Non-Essential Equipment Identification:

E11: EP Generator
E12: EP Generator
E13: EP Generator
E14: 6 kW Generator (not shown)
E15: 12 kW Generator (not shown)

EQUIPMENT LAYOUT
PHASE 2

Figure 11: Engine Driven Portable FLEX Equipment General Layout

2.17 Sequence of Events

The Table 2 below presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS event at Pilgrim. A Fleet Timeline assessment and tabletop, which is part of the NEI FLEX Validation Process, has been completed (Reference 3.73). A debris removal assessment based on site reviews and the location of the FLEX storage areas will be performed to determine a reasonable time needed to clear debris to allow FLEX equipment deployment to support the Phase 2 and beyond strategies. Debris removal equipment is sheltered in the reactor and turbine building truck-locks during predicted severe weather events to ensure their availability.

Additional technical basis details regarding the identified time critical actions follow the table and are indexed by the table "Action Item" number.

Table 2
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
	0	**Event Starts**	**NA**	Plant @100% power
1	60 sec	RCIC/HPCI starts	N	Reactor operator initiates or verifies initiation of reactor water level restoration with steam driven high pressure injection.
2	2 min	RCIC suction manually swapped to the Torus and HPCI secured.	N	HPCI will trip automatically when reactor level reaches the high level setpoint.
3	1 hr	Attempts to start EDGs have been unsuccessful. Enter ELAP Procedure	Y	Entry into ELAP provides guidance to operators to begin DC load shedding.

Table 2 Sequence of Events Timeline				
Action item	**Elapsed Time**	**Action**	**FLEX Time Constraint Y/N**	**Remarks / Applicability**
4	2 hr	DC Load shed starts	Y	A limited controlled load shed is started within two hours. This is a phased approach based on location of breakers and critically and potential usefulness of equipment. DC buses are readily available for operator access and breakers will be appropriately identified (labeled) to show which are required to be opened. .
5	2 hr	Commence deployment of the Pre-staged FLEX 150 kW or an 86 kW 480 VAC 3-PH Diesel Generator (DG) for repowering two 125V battery chargers or one 125V and the 250V battery chargers as soon as possible. Note: This action will be taken based on any extended loss of AC power condition, well before battery depletion, to commence active battery recharging and to maintain the station DC Power Systems operating indefinitely. Additionally, commence deployment of the two diesel powered FLEX Low Pressure Pumps for core cooling.	N	It is the intent to begin recharging the batteries well before they become fully depleted if the first pre-staged AC Diesel Generator (DG) is available after the event.
6	4 hr	Pre-staged FLEX 150 kW or an 86 kW 480 VAC 3-PH Diesel Generator in Turbine Bldg. deployed and available to repower two 125V battery chargers or one 125V and the 250V battery chargers.	N	The FLEX 150 kW Diesel Generator has the capability to power three chargers and AC Panels Y3/31 and/or Y4/41 if required.
7	6 hr	Manually Depressurize RPV to 120 psig when Torus temperature reaches 170 deg F (based on EOP-11 HCTL curve). Requires intermittent operation of SRVs. Maintain auto control of RCIC.	Y	This is based on PNPS calculation (Station Blackout Flex Strategy With No Preferred Water Sources For 72 Hrs) and validated thru MAAP analysis.

Table 2
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
8	8 hr	Transition from Phase 1 to Phase 2. At this time, FLEX 86 kW 480 VAC 3-PH DGs and/or 150 kW 480 VAC 3-PH DG will have been deployed to repower the 125 and 250 VDC Battery Chargers to maintain the station DC Power Systems operating indefinitely. Additionally the 120V panels are repowered.	Y	Battery durations are calculated to last greater than 8 hours. FLEX 480VAC DG(s) will be staged beginning at approximately 2-8 hrs.
9	9 hr	Transition from RCIC steam-driven operation to FLEX portable equipment for the Core cooling function by placing the FLEX diesel powered pumps in service for low pressure injection from the UHS through a duplex strainer cart to the isolated CST common suction line to the HPCI and RCIC Pumps, while SRVs are opened to complete the depressurization to its minimum value of approximately 50 psig SRV backpressure. The injection flow rate is run sufficiently high (approximately 400 GPM) to sub-cool the vessel and raise water level to begin a heated liquid and vapor mixture discharge to the Torus for continued vessel subcooled flow boiling at a flow rate that is slowly reduced over the subsequent hours.	Y	FLEX Pumps will be staged beginning at approximately 6 – 9 hour time frame. Torus temperature is calculated to be at 235°F at 9 hours.

Table 2
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
10	16 hr	When Torus heats up to 280°F, open the Hardened Containment Vent System (HCVS), which includes an 8" Air-Operated Butterfly Valve AO-5025 capable of venting the Wetwell (Torus) airspace through an 8" branch line between the two Primary Containment Isolation Valves (PCIVs) AO-5042A and B from 20" Torus Penetration X-227. The HCVS Torus Vent is opened per EOPs to provide Containment Heat Removal, and this action, taken at this time, will prevent additional rise in Torus temperature. The diesel powered FLEX Low Pressure Injection pumps continue to provide subcooled flow boiling for the core with heated liquid and vapor mixture flowing out the SRVs to the Torus. The sub-cooled flow boiling flow rate is slowly reduced based on procedure guidance that provides flow required versus time, as well as the actual Torus Water Level, and pump Flow Totalizer readings to control the net Torus inventory addition within the 445,000 gallon maximum.	Y	The constraint can be met because HCVS is a fully qualified Safety-Related system and is powered by 125 VDC with pneumatic pressure supplied from independent Nitrogen bottles to operate the HCVS valves. Torus water temperature of 280°F is calculated to occur at 16 hours after shutdown by PNPS calculation and validated by MAAP analysis.
11	16 hr	Preparations will commence to power the station Groundwater Wells with a FLEX portable AC Diesel Generator and to begin adding water to fill the FRAC tank (or a backup bladder tank) to prepare for a long-term Phase 3 reactor feedwater makeup and boiling strategy.	N	The Groundwater Wells are installed with protected well-head AC power from a FLEX DG, and connections for 2-1/2" hoses to discharge to the FRAC tank. The FRAC tank inventory is maintained at approximately 16,000 gallons (Reference 3.39).

Table 2
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
12	24 hr	The SRV Backup N2 System is normally in a standby ready configuration with the Manual Isolation Valves 9-HO-378 & 379 Closed and the N2 Cylinder Tubing disconnected and Cylinder Valves Closed and Capped. By 24 Hours, the N2 Cylinders are connected to the Backup N2 Pressure Regulators and the Isolation Valves are opened to begin providing makeup flow to the SRV Accumulators T-122B & C that were providing pneumatic pressure to the RV-203-3B & 3C up to this time.	Y	This simple manual activity requires no tools and may be performed at any time during the first 24 Hours, while accessibility to Reactor Building EL 23 ft location of the SRV Backup N2 System is completely unrestricted.
13	32 hr	Begin makeup to SFP as necessary to maintain essentially normal full water level in the SFP. (Boiling under design basis conditions begins at 32 hours and requires 12 GPM makeup). There is no SFP Makeup Water required during the initial 72 Hour period for an ELAP Event, based on the total SFP Time-to-Boil and Boil-Down Time to SFPI Level 2. There is a total of at least 95 Hours before a SFP makeup source must be provided. A source of makeup water may be taken from the Dryer and Separator Storage Pool that will normally be maintained filled below EL 97 ft to provide makeup water for this purpose. The Pool has a usable nominal volume of 30,000 Gallons which will provide a 42 Hr supply of makeup water at a boil-off rate of 12 GPM. A pre-staged Submersible Air-Powered Diaphragm Pump with a bottom suction and capacity up to 120 GPM will be used and the initial volume of 30,000 Gallons will provide a 42 Hr supply of makeup water at a boil-off rate of 12 GPM.	Y	An initial source of SFP makeup water will normally be provided by storage of demineralized water in the lower volume of the Dryer and Separator Storage Pool (below EL 97 ft). This is calculated to provide a preferred source of cooling and makeup water until +74 hours.

Table 2
Sequence of Events Timeline

Action item	Elapsed Time	Action	FLEX Time Constraint Y/N	Remarks / Applicability
14	32 hr	Establish natural free convection ventilation to exhaust the humid atmosphere from the EL 117 ft SFP/Refuel Floor Area with an outside air inlet at a lower elevation though the Reactor Building Truck Lock at EL 23 ft.	Y	Procedural guidance will be provided for Operations to open the Reactor Bldg. Hatch while also opening a ground level ventilation inlet. This action is required to be performed prior to the SFP boiling.
15	72 hr	Transition from Phase 2 to Phase 3 for Core Cooling function by maintaining the station Groundwater Wells in service feeding the water storage FRAC tank, and drawing this water for injection via the FLEX diesel powered Pump through a demineralizer skid and duplex strainer cart to the RPV to begin a long-term makeup and boiling strategy at constant water level. There are no additional time critical actions for the next 30 days once this mode is established.	Y	The transition from Phase 2 to Phase 3 is determined at a time based on Torus inventory and is to be implemented before a net addition of 445,000 Gallons to the Torus, which is not expected to occur before 72 Hour after shutdown. Once in Phase 3, the plant can be maintained in a stable condition with FLEX Pumps in service for injection to the RPV at a stable water level, and heat removal provided by the HCVS Torus Vent at a steadily reducing Torus temperature, pressure, and water inventory. There is no need to reject liquid water from the Torus at any time.

2.18 Programmatic Elements

2.18.1 Overall Program Document

The PNPS Program Document provides a description of the Diverse and Flexible Coping Strategies (FLEX) Program for Pilgrim. The key program elements provided in the Program Document include:

- Description of the FLEX strategies and basis
- Provisions for documentation of the historical record of previous strategies and the basis for changes
- The basis for the ongoing maintenance and testing programs chosen for the FLEX equipment
- Designation of the minimum set of parameters necessary to support strategy implementation

In addition, the program description includes a list of the FLEX basis documents that will be kept up to date for facility and procedure changes.

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.

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

2.18.2 Procedural Guidance

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

Guidelines (EDGMs) will direct the entry into and exit from the appropriate FSG procedure.

FLEX Support Guidelines will provide available, pre-planned FLEX strategies for accomplishing specific tasks in the EOPs or APs. FSGs will be used to supplement (not replace) the existing procedure structure that establishes command and control for the event.

Procedural Interfaces have been incorporated into Procedure 5.3.31, Station Blackout, to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, procedural interfaces have been incorporated into the following APs to include appropriate reference to FSGs:

- 5.2.1, “Earthquake”
- 5.2.2, “High Winds (Hurricane)”

FSG maintenance will be performed by Operations. In accordance with site administrative procedures, NEI 96-07, Revision 1, Guidelines for 10 CFR 50.59 Implementation, and NEI 97-04, Revision 1, Design Bases Program Guidelines, are to be used to evaluate changes to current procedures, including the FSG, to determine the need for prior NRC approval. However, per the guidance and examples provided in NEI 96-07, Rev. 1, changes to procedures (EOPs, APs, EDMGs, SAMGs, or FSGs) that perform actions in response events that exceed a site's design basis should screen out. Therefore, procedure steps which recognize the ELAP/LUHS has occurred and which direct actions to ensure core cooling, SFP cooling, or containment integrity should not require prior NRC approval.

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

2.18.3 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 PNPS on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDBEE was performed (Reference 3.74). The results were provided to the NRC (Reference 3.75).

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

- an extended loss of ac power (ELAP)
- an extended loss of access to ultimate heat sink (UHS)
- impact on the unit (unit is operating at full power at the time of the event)
- impeded access to the unit 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, Operations Training, Radiation Protection, Chemistry, Security, Emergency Planning and FLEX Project Team personnel performed a tabletop in August 2014. The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft and approved 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 the estimated time to prepare for and perform the task.

The Phase 2 Staffing Assessment concluded that the current minimum on-shift staffing as defined in the PNPS Emergency Plan is sufficient to support the implementation of the mitigating strategies (FLEX strategies) as well as the required Emergency Plan actions, with no unacceptable collateral tasks assigned to the on-shift personnel during the first 6 hours. The assessment also concluded that the on-shift staffing, with assistance from augmented staff, is capable of implementing the FLEX strategies necessary after the 6 hour period within the constraints. It was concluded that the Emergency response function would not be degraded or lost.

The NRC reviewed Pilgrim's submittal and concluded (Reference 3.76):

> "The NRC staff reviewed your Phase 2 staffing submittal and confirmed that your existing emergency response resources, as described in your emergency plan, are sufficient to perform the required plant actions and emergency plan functions, and implement the event response strategies that were developed in response to NRC Order EA-12-049 without the assignment of collateral duties that would impact the performance of assigned emergency plan functions.
>
> As a result, the NRC staff concludes that your Phase 2 staffing submittal adequately addresses the response strategies needed to respond to a BDBEE using your procedures and guidelines. The NRC staff will verify the implementation of your staffing capabilities through the inspection program."

Subsequently, Revision 1 to the Staffing Assessment has been submitted to the NRC for review. Changes made in Revision 1 of the Phase 2 Staffing Assessment were limited to adjustments to task assignments and durations of tasks as detailed in the FLEX Implementation Timeline and the addition of references to the validation and verification process used to provide reasonable assurance the tasks could be performed as planned. The revision to the staffing assessment does not change the overall conclusions of the assessment as detailed in the original report.

2.18.4 Training

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

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 BDBEEs have received the necessary training to ensure familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints.

Care has been taken to not give undue weight (in comparison with other training requirements) for Operator training for BDBEE accident mitigation. The testing/evaluation of Operator knowledge and skills in this area has been similarly weighted.

ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training, certification of simulator fidelity is considered to be sufficient for the initial stages of the BDBEE scenario until the current capability of the simulator model is exceeded. Full scope simulator models will not be upgraded to accommodate FLEX training or drills.

2.18.5 Equipment List

The equipment stored and maintained at the Pilgrim FLEX Storage areas necessary for the implementation of the FLEX strategies in response to a BDBEE at Pilgrim is listed in Table 4. Table 4 identifies the quantity, applicable strategy, and capacity/rating for the major FLEX equipment components only. Details regarding fittings, tools, hose lengths, consumable supplies, etc. are not in Table 4.

2.18.6 Equipment Maintenance and Testing

Maintenance and testing of FLEX equipment is governed by the Entergy Preventive Maintenance (PM) Program as described in EN-DC-324. The Entergy PM Program is consistent with INPO AP-913 and utilizes the EPRI Preventive Maintenance Basis Database as an input in development of fleet specific Entergy PM Basis Templates. Based on this, the Entergy fleet PM program for FLEX equipment follows the guidance NEI 12-06, Section 11.5.

PMs have been developed for both the “Standby” condition and the "Deployed" condition for the FLEX Portable and Support Equipment.

The Entergy PM Basis Templates include activities such as:

- Periodic Static Inspections
- Operational Inspections
- Periodic functional verifications
- Periodic performance verification tests

The Entergy PM Basis Templates provide assurance that stored or pre-staged FLEX equipment is being properly maintained and tested. In those cases where EPRI templates were not available for the specific component types, 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.

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.

Work Management procedures will reflect AOT (Allowed Outage Times) as outlined above.

Table 3
Water Sources

Water Sources	Usable Volume (Gallons)	Applicable Hazard					Time Based on Decay Heat	Cumulative Time Based on Decay Heat
		Satisfies Seismic	Satisfies Flooding	Satisfies High Winds	Satisfies Low Temp	Satisfies High Temp		
Water sources and associated piping that fully meet ALL BDB external hazards, i.e., are FLEX qualified								
Suppression Pool (Torus)	628,364 (total)	Y	Y	Y	Y	Y	9 hrs (See Note 1)	9 hrs
UHS (Seawater) via FLEX Pump	-	Y	Y	Y	Y	Y	63 hrs (See Note 2)	72 hrs
Groundwater Wells (Phase 2&3)	-	Y	Y	Y	Y	Y	Indefinitely	Indefinitely
Dryer and Separator Storage Pool (SFP Makeup source only)	Nominal 30,000	Y	Y	Y	Y	Y	72 hrs (After 72 hrs, the makeup can be supplied from FLEX Wells indefinitely)	72 hrs (Includes 32 hours for time for SFP to begin boiling)
Water sources that PARTIALLY meet BDB external hazards and are not credited in FLEX strategy.								
CST (2)	150,000 (Total reserved for RCIC)	N	Y	N	Y	Y	18 hrs (See Note 3)	18 hrs

(1) Limited by suppression pool temperature.

(2) The transition from UHS to Groundwater Wells is determined based on Torus inventory and is to be implemented before a net addition of 445,000 Gallons to the Torus; is not based on limited UHS availability.

(3) Reference 3.16 case #4.

Table 4
BWR Portable Equipment Stored On-Site

Use and (Potential / Flexibility) Diverse Uses						Performance Criteria
List Portable Equipment	Core	Containment	SFP	Instrumentation	Accessibility	
Two (2) Godwin HL100M Dri Prime Diesel Pumps	X	X	X			400 GPM @ 350 ft TDH
Two (2) Godwin HL110M Dri Prime Diesel Pumps	X	X	X			400 GPM @ 350 ft TDH
One (1) 480 VAC Generator	X			X		480 VAC 3-PH 150 kW w/ 120/240 VAC 1-PH
Two (2) 480 VAC Generator	X			X		480 VAC 3-PH 86 kW w/ 120/240 VAC 1-PH
Two (2) 480 VAC Generator	X			X		480 VAC 3-PH 20 kW w/ 120/240 VAC 1-PH
Two (2) 480 VAC Generator (Magnum Light Tower)	X			X	X	480 VAC 3-PH 20 kW w/ 120/240 VAC 1-PH
Six (6) 120/240 VAC Generator				X		120/240 VAC 1-PH 7.5 kW
Three (3) Diesel Air Compressor			X			185 CFM @ 100 psig
Two (2) Sandpiper MSB2A-TB-3-A Large Air-Powered Diaphragm Pumps for Diesel Fuel Transfer, SFP Makeup Water, & General Dewatering Service	X		X			60 GPM @ 50 psig
Three (3) Sandpiper S1FB1ABWANS000 Small Air-Powered Diaphragm Pumps for Diesel Fuel Transfer, SFP Makeup Water & General Dewatering Service			X			25 GPM @ 50 psig
Four (4) Portable Ventilation Fans 12" Duct Intrinsically Safe for Battery Room Exhaust 120 VAC 1-PH Motor				X	X	2500 cfm
One (1) Primary Debris Removal Wheel Loader					X	
Two (2) Pickup Trucks 3/4-Ton with Trailer Towing Attachments and Bed-Mounted 100 Gallon Fuel Storage Tank with Transfer Pump.	X		X	X	X	Provide mobile refueling capability for FLEX diesel engine driven equipment.

Table 5
BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										Performance Criteria		Notes
List Portable Equipment	**Qty Req'd /Unit**	**Qty Provided / Unit**	**Power**	**Core Cool-ing**	**Cont. Cooling/ Integrity**	**SFP**	**Access**	**Instrumen-tation**	**RCS Inventory**			
Collapsible Water Storage Bladder	1	1	N/A	X					X		20,000 Gallons	Ref. 3.77 Section 8.9
Low Voltage Generator	0	1	Turbine	X	X			X	X	480 VAC	1000 KW	Ref. 3.77 Section 7.2 (1)
Air Compressor	0	1	Diesel			X				150#	300 scfm	Ref. 3.77 Section 8.6 (1)
Low Pressure / Medium Flow Pump	0	1	Diesel		X	X	X		X	300#	2500 GPM	Ref. 3.77 Section 7.5 (1)
Lighting Tower	0	1	Diesel				X				440,000 Lu	Ref. 3.77 Section 7.7 (1)

Table 5
BWR Portable Equipment From NSRC

Use and (Potential / Flexibility) Diverse Uses										Performance Criteria		Notes
List Portable Equipment	**Qty Req'd /Unit**	**Qty Provided / Unit**	**Power**	**Core Cool-ing**	**Cont. Cooling/ Integrity**	**SFP**	**Access**	**Instrumen-tation**	**RCS Inventory**			
Mobile Water Treatment System with Cyclone Separators and Backflushable Disc Filters with Reverse Osmosis Treatment and includes 150 kW 480 VAC 3-PH Diesel Generator.	1	1	Diesel	X					X		125 GPM	Ref. 3.77 Section 8.7
	Note 1 - NSRC Generic Equipment – Not required for FLEX Strategy – Provided as Defense-in-Depth.											

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3.28 Drawing E13 Rev 86 Single Line Relay and Meter Diagram 125V & 250V DC Systems

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