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0CAN011601

January 12, 2016

U.S. Nuclear Regulatory Commission
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SUBJECT: Notification of Full Compliance with NRC Order EA-12-049 Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (BDBEEs)
Arkansas Nuclear One – Units 1 and 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6

REFERENCES:

1. NRC letter to Entergy, NRC Order Number EA-12-049, *Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for BDBEEs*, dated March 12, 2012 (0CNA031206) (ML12054A736)
2. Entergy letter to NRC, *Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for BDBEEs (Order Number EA-12-049)*, dated February 28, 2013 (0CAN021302) (ML13063A151)
3. NRC letter to Entergy, Arkansas Nuclear One, Units 1 and 2 – *Interim Staff Evaluation Regarding Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0942 and MF0943)*, dated February 25, 2014 (0CNA021407) (ML14007A459)
4. NRC letter to Entergy, Arkansas Nuclear One, Units 1 and 2 – *Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0942, MF0943, MF0944, and MF0945)*, dated September 1, 2015 (0CNA091502) (ML15236A340)

Dear Sir or Madam:

The purpose of this letter is to notify the NRC that Entergy Operations, Inc. (Entergy) is in compliance with Order EA-12-049 for Arkansas Nuclear One (ANO) Units 1 and 2. On March 12, 2012, the NRC issued Order EA-12-049, *Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for BDBEEs*, (Reference 1). Reference 1 was immediately effective and directed Entergy to develop and implement strategies and guidance to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities in the event of a BDBEE.

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Order EA-12-049, Section IV.A.2, requires full implementation 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 report to the NRC when full compliance is achieved. The ANO OIP for Order EA-12-049 was submitted by Reference 2. On November 13, 2015, ANO-2 entered Mode 2 (startup). ANO-1 and ANO-2 were in full compliance with Order EA-12-049 at that time.

In Reference 3, the NRC issued an interim staff evaluation (ISE) for Order EA-12-049, which identified open and confirmatory items requiring resolution by Entergy.

In Reference 4, the NRC issued a report for an audit conducted at ANO regarding implementation of mitigating strategies and reliable SFP instrumentation related to Orders EA-12-049 (Reference 1) and EA-12-051, *Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation*. The audit included a review of Entergy's responses for ANO to the ISE open and confirmatory items.

Attachment 1 summarizes ANO-1 and ANO-2 compliance with Order EA-12-049. Attachment 2 summarizes ANO-1 and ANO-2 compliance with the elements of the Order. Attachment 3 contains responses to the open items from the onsite audit. Attachment 4 contains responses to ISE open and confirmatory items. Attachment 5 contains the Final Integrated Plan for ANO-1 and ANO-2 which provides strategies to maintain or restore core cooling, containment, and SFP cooling capabilities in the event of a BDBEE for the ANO units.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Stephenie Pyle at 479.858.4704.

I declare under penalty of perjury that the foregoing is true and correct; executed on January 12, 2016.

Sincerely,

JGB/nbm

Attachments:
1. Compliance with Order EA-12-049
2. Order EA-12-049 Compliance Elements Summary
3. Audit Open Item Responses
4. Interim Staff Evaluation Open Item and Confirmatory Item Responses
5. Final Integrated Plan

cc: Mr. Marc L. Dapas
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Attachment 1 to

0CAN011601

Compliance with Order EA-12-049

Compliance with Order EA-12-049

On March 12, 2012, the NRC issued Order EA-12-049, *Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (BDBEEs).* This Order was effective immediately and directed sites to develop and implement strategies and guidance to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a BDBEE.

Entergy developed an Overall Integrated Plan (OIP) for documenting the diverse and flexible strategies (FLEX) in response to Order EA-12-049. The information provided herein documents full compliance with the Order for Arkansas Nuclear One, Unit 1 (ANO-1) and Unit 2 (ANO-2).

a. Interim Staff Evaluation (ISE) Open Items – Entergy has finalized responses to the ISE Open Items. See Attachment 3 and 4 for a summary of Entergy responses to the items.

b. ISE Confirmatory Items – Entergy has finalized responses to the ISE Confirmatory Items. See Attachment 3 and 4 for a summary of Entergy responses to the items.

c. Audit Questions/Audit Report Open Items – Entergy has finalized responses to the Audit Report Open Items which are summarized in Attachment 3.

<u>Milestone Schedule – Items Completed</u>

Milestone	Completion Date
Submit 60-day Status Report	Oct 2012
Submit Overall Integrated Implementation Plan	Feb 2013
Six-Month Status Updates	
Update 1	Aug 2013
Update 2	Feb 2014
Update 3	Aug 2014
Update 4	Feb 2015
Update 5	Aug 2015
Perform Staffing Analysis	Sept 2014
FLEX Equipment Procured	Oct 2015
FLEX Storage Buildings Installation	Nov 2015
Modifications Installation	Nov 2015
Procedures Issued	Nov 2015

Attachment 2 to

0CAN011601

Order EA-12-049 Compliance Elements Summary

Order EA-12-049 Compliance Elements Summary

The elements identified below are included in the Arkansas Nuclear One, Unit 1 (ANO-1) and Unit 2 (ANO-2) Final Integrated Plan (FIP) (Attachment 5) and demonstrate compliance with Order EA-12-049.

Strategies – Complete

ANO-1 and ANO-2 strategies are in compliance with Order EA-12-049 and are documented in the FIP. Entergy is providing responses to strategy-related Interim Staff Evaluation (ISE) Open Items, Confirmatory Items, and Audit Questions/Audit Report Open Items as documented in Attachments 3 and 4.

Modifications – Complete

The modifications required to support the diverse and flexible strategies (FLEX) strategies for ANO-1 and ANO-2 have been implemented in accordance with the station design control process.

Equipment – Procured and Maintenance & Testing – Complete

The equipment required to implement the FLEX strategies for ANO-1 and ANO-2 was procured in accordance with Nuclear Energy Institute (NEI) 12-06 (Reference 1), Sections 11.1, *Quality Attributes*, and 11.2, *Equipment Design*, initially tested/performance verified in accordance with NEI 12-06, Section 11.5, *Maintenance and Testing*, received at ANO, and is available for use.

As discussed in the FIP, maintenance and testing is conducted through the use of the ANO preventive maintenance program such that equipment reliability is achieved.

Protected Storage – Complete

The storage facilities required to implement the FLEX strategies for ANO-1 and ANO-2 have been completed and provide protection from the applicable site hazards, as discussed in the FIP. The equipment required in order to implement the FLEX strategies for ANO-1 and ANO-2 is stored in its protected configurations.

Procedures – Complete

FLEX Support Guidelines (FSGs) for ANO-1 and ANO-2 have been developed, and integrated with existing procedures. The FSGs and procedures have been validated per NEI 12-06, Section 11.4.3, *Development Guidance for FSGs*, and have been issued for use in accordance with the site procedure control program.

Training – Complete

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

Staffing - Complete

The staffing study for ANO has been completed in accordance with 10 CFR 50.54(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 (Reference 2). The staffing study was submitted on September 22, 2014 (Reference 3).

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 offsite facility coordination. PEICo is ready to support ANO 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 activities in accordance with industry developed guidance to assure required tasks and manual actions for FLEX strategies are feasible and may be executed within the constraints identified in the Overall Integrated Plan and the FIP for Order EA-12-049.

FLEX Program Document – Established

The ANO-1 and ANO-2 FLEX program documents (EN-OP-201 Diverse and Flexible Coping Strategies (FLEX) Fleet Program Document and EN-OP-201-01 ANO FLEX Program Document) have been developed in accordance with the requirements of NEI 12-06.

References:

1. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, August 2012

2. NRC 10 CFR 50.54(f) letter, *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 (0CNA031206) (ML12056A046)

3. Entergy Operations, Inc. letter to NRC, *Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 9.3, Emergency Preparedness - Staffing, Requested Information Items 1, 2, and 6 - Phase 2 Staffing Assessment*, dated September 22, 2014 (0CAN091402) (ML14268A076)

Attachment 3 to

0CAN011601

Audit Open Item Responses

Audit Open Item Responses

A NRC onsite audit of the implementation of Orders EA-12-049 and EA-12-051 was conducted at Arkansas Nuclear One, Unit 1 (ANO-1) and Unit 2 (ANO-2) during the week of April 20, 2015. As documented in Attachment 3 of the audit report[1], 17 audit items required additional licensee input, and four audit items were under NRC review which did not require further licensee input. Entergy Operations, Inc. (Entergy), provided responses to the 17 items via the ePortal. Per NRC email, dated November 13, 2015, an additional item was added to this list. Summaries of the Entergy responses to these audit items are provided below.

Audit Item Reference Open Item (OI) 3.2.1.D

SE Tracker Notes

The NRC staff has reviewed the ANO approach that uses the ANO-2 charging pump to supply makeup to the ANO-1 Reactor Coolant System (RCS) for inventory control but has not concluded that this approach is acceptable. The staff has identified a number of concerns that need to be addressed regarding the proposed RCS inventory control strategy. Therefore, this open item tracks completion of the development of an acceptable integrated RCS makeup strategy that meets the requirements of Order EA-12-049.

Licensee Input Needed to Close the Item

Provide RCS injections paths (primary and alternate) for both units.

Response

The ANO-1 strategy uses the ANO-2 charging pumps and a series of hoses to establish RCS injection. The primary suction sources for the ANO-2 charging pumps are the ANO-2 boric acid makeup tanks (BAMTs) and then the ANO-2 refueling water tank (RWT), both of which rely on installed piping. Alternatively, the borated water storage tank (BWST) can be connected to the common suction header of the ANO-2 charging pumps via FLEX tie-ins and hoses. There are two available FLEX connections on the discharge of the charging pumps, both of which can be fed by any charging pump and are sufficient for the RCS makeup requirements. The primary strategy is to connect to a FLEX tie-in on line 2CCD-10-1½" while the alternate strategy is to connect to the threaded connection on the drain line downstream of the charging pump selected for use following a beyond-design-basis external event (BDBEE). Each charging pump is capable of isolation from the main charging pump piping header. Between the charging pump and its discharge isolation valve is a 1" drain line with a threaded connection. Any of these discharge tie-ins can be connected with high pressure hose to the new cross-tie that spans between the ANO-2 and ANO-1 Auxiliary Buildings. The ANO-1 side of the crosstie can be connected with high pressure hose to either of two available tie-ins in the ANO-1 high pressure injection (HPI)/makeup and purification (MUP) system piping. The primary tie-in is located at plant Elevation 335' downstream of the primary makeup pumps on line CCD-16-1½" and

[1] NRC letter, "Arkansas Nuclear One, Units 1 and 2 – Report for the Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0942, MF0943,MF0944, and MF0945," dated September 1, 2015 (ADAMS Accession No. ML15236A340).

connects to the Loop B HPI line. The alternate connection is located in the upper north piping penetration room (Room 79) upstream of CV-1220 on line CCD-17-2½" and connects to the Loop A HPI line. The installed piping and tie-in locations are protected from BDBEEs (e.g., flood, seismic, wind, extreme temperatures). Calculation CALC-13-E-0005-11, Revision 1, determined the hydraulic criteria (e.g., net positive suction head (NPSH), total developed head (TDH), etc.) to assure adequate RCS makeup during a BDBEE.

The primary strategy to provide RCS injection to ANO-2 is through the existing charging flow path. The alternate strategy is to align the charging header to provide flow to the high-pressure safety injection (HPSI) system through manual valve manipulations. Aligning the charging pump discharge header to the HPSI system is an existing flow path and does not require any modifications. In addition, two tie-in connections in the HPSI system are installed to provide FLEX strategy capability of RCS inventory makeup and cooling. To ensure diversity on these two connections, one tie-in connection is installed in the HPSI Pump A (2P-89A) discharge line, and the second tie-in connection is installed in the HPSI Pump B (2P-89B) discharge line. The two HPSI FLEX tie-in connections are located in the upper south piping penetration room of the auxiliary building at the 362' elevation. The primary function of these tie-ins is to provide a flow path in lower modes (i.e., Modes 5 and 6). However, these tie-ins are compatible with the National SAFER Response Center (NSRC) equipment and may be used to provide RCS injection in Modes 1 through 4 after NSRC equipment is delivered to the site following an extended loss of alternating current (AC) power (ELAP). The suction sources are identical to those discussed in the ANO-1 injection strategy.

Audit Item Reference Confirmatory Item (CI) 3.2.1.A

SE Tracker Notes

Confirm that the atmospheric dump valves (ADVs) and associated piping at both units are sufficiently robust and will remain functional during and following a seismic event.

(a) **Clarify whether the ADVs or upstream associated piping is safety-related and protected from all external events such as tornado missiles. If not, address the following questions:**

(b) **Clarify whether damage to the ADV or upstream associated piping could occur during an ELAP that would result in an uncontrolled cooldown of the reactor coolant system and provide a basis.**

(c) **Clarify whether postulated damage would be limited to a single ADV and/or associated piping, or whether failures could be postulated resulting in an uncontrolled cooldown affecting both steam generators and provide a basis.**

(d) **If ELAP scenarios involving the uncontrolled cooldown of one or more steam generators may be postulated, describe key operator actions that would be taken to mitigate these events.**

(e) **If ELAP scenarios involving the uncontrolled cooldown of one or more steam generators may be postulated, provide analysis demonstrating that the intended mitigating actions would lead to satisfaction of the requirements of Order EA-12-049 for these cases.**

(f) **As applicable, if the operator actions to mitigate an ELAP event involving an uncontrolled cooldown results in an asymmetric cooldown of the reactor coolant system, address the consequences of the asymmetric cooldown on the mixing of boric acid that is added to the reactor coolant system to ensure sub-criticality.**

<u>Licensee Input Needed to Close the Item</u>

Provide reasonable protection justification for the ability of the ADVs and associated piping to survive a tornado event, including potential tornado missiles.

<u>Response</u>

The following is applicable to items a-f above.

Both ANO-1 and ANO-2 have safety-related main steam piping up to and including the main steam isolation valves (MSIVs) located above El. 404' in the respective auxiliary buildings that is *not enclosed within a tornado/missile-resistant structure. For each unit, this main steam piping* includes the main steam piping that is routed to the ADVs and the ADVs' safety-related block valves. In addition, this also includes the main steam safety valves. Neither unit's current licensing bases require these areas to be within tornado/missile-resistant enclosures.

<u>Main Steam Safety Valves (MSSVs)</u>

The MSSVs are credited for protecting the secondary side of the steam generator (SGs) and the RCS from over-pressurization by providing sufficient relief capacity and a heat removal path to the atmosphere. ANO-1 has eight MSSVs per SG (seven per SG are required to be operable at 100% power) and ANO-2 has five MSSVs per SG. The combined capacity of the operable MSSVs is sufficient to relieve greater than 100% of reactor thermal load with a loss of turbine load without simultaneous reactor trip for both units. The relieving capacity of each MSSV is greater than 7% for ANO-1 and approximately 10% for ANO-2 of the normal operating power reactor thermal load. In a FLEX event, the reactor trips and within seconds after that trip reactor thermal power load is reduced to less than 7% of normal operating power. Therefore, one MSSV per unit is sufficient to relieve the capacity of reactor thermal load following a trip. As it is highly unlikely that all of the MSSVs or all of the operable MSSVs per SG would be compromised due to tornado generated missile damage, the MSSVs would be able to relieve the required mass flow rate from the secondary side in a FLEX event.

<u>ANO-1 and ANO-2 ADVs and associated Motor Operated Valves (MOVs)</u>

The ANO-1 and ANO-2 licensing bases do not credit functionality of the ADVs following a missile strike; therefore, no credit can be taken for the manual operation of the ADVs. Engineering walkdowns were performed to determine the presence, or lack thereof, of intervening structures and systems that would provide reasonable protection from a missile strike to ANO-1 and ANO-2 ADVs, associated safety-related block valves, and access to the ADVs (i.e., ladders and access platforms). Information gathered from the walkdowns is documented in Engineering Report CALC-ANOC-CS-15-00004. The conclusions of CALC-ANOC-CS-15-00004 are based on engineering judgment regarding the observed surrounding structures' and systems' ability to impede a missile.

For ANO-1, given the limited exposure of the ADVs and associated safety-related block valves, the presence of intervening structures, piping, and pipe supports afford reasonable protection against a missile impact.

For ANO-2, the lower ADV and associated safety-related block valve is considered reasonably protected from tornado missiles given the very small exposure window and the presence of intervening structures, piping and pipe supports. Intervening structures offer limited protection for ANO-2 upper ADV and its safety-related block valve. Any missile that could potentially impact the ADV and its safety-related block valve would have to follow a very precise path (i.e., elevation) while avoiding the numerous columns, low-density structural steel (i.e., braces and beams), and building siding. The likelihood that both of these assumptions would be realized simultaneously is extremely low. Therefore, the ANO-2 upper ADV, and associated safety-related block, is considered to be reasonably protected from tornado-generated missiles.

Operation of ANO-1 and ANO-2 ADVs and their safety-related block valves are available via platforms with more than one ladder providing means of access. The ladders for each platform are adequately separated such that a single missile cannot damage multiple access points. A missile strike directly to the platform is unlikely based on the surrounding intervening structures, but in the event of such an impact, the missile would likely pass through the grating causing limited damage that would not impede access to the ADVs and the safety-related block valves.

Therefore, reasonable assurance is provided to ensure the ANO-1 and ANO-2 ADVs, associated safety-related block valves, and means of access is available and functional following a BDBEE event.

Audit Item Reference CI 3.2.1.C

SE tracker Notes

Confirm that the evaluation of the emergency feedwater (EFW) turbine exhaust piping for robustness is completed with acceptable results

Licensee Input Needed to Close the Item

Provide reasonable protection justification for the ability of the turbine-driven EFW (TDEFW) steam supply piping to survive a tornado event, including potential tornado missiles.

Response

ANO-1 and ANO-2 EFW Steam Supply piping

Both ANO-1 and ANO-2 have safety-related main steam piping up to and including the MSIVs located above El. 404' in their auxiliary buildings. The EFW steam supply piping (at both units) is seismic Category 1; however, there are portions of the piping that are not enclosed within a tornado/missile resistant structure. For each unit, this main steam piping includes the main steam piping that is routed to the ADVs, the ADVs' safety-related block valves, and the main steam piping that supplies steam to the TDEFW pump. Neither unit's licensing bases requires these areas to be within tornado/missile resistant enclosures. However, for the associated piping, ANO-2 Safety Analysis Report (SAR), Table 3.5-8, states that a postulated missile cannot destroy the integrity of the main steam lines. The ANO-2 Safety Evaluation Report (SER), Section 10.3, states, in part, the following:

> Portions of the seismic Category 1 main steam piping (upstream of the main steam isolation valve) are located outdoors without protection from tornado missiles. In response to our concerns regarding potential damage of the safety-related main steam piping due to tornado missiles, the applicant has submitted the results of an analysis which conclude that the design of the main steam piping can withstand a postulated tornado missile impact without failure of the piping. We have performed an independent evaluation and agree with the applicant's analysis of the tornado missile effects on the outdoor seismic Category 1 main steam piping and conclude that the piping can withstand the tornado missile impact.

Walkdowns of the EFW steam supply piping were performed on both ANO-1 and ANO-2 to determine the extent of existing missile protection provided by intervening structures. The walkdown findings along with additional as-built information were evaluated in Engineering Report CALC-ANOC-CS-15-00004, which concludes that the EFW steam supply piping for both units is reasonably protected from tornado generated missiles in all directions by adjacent structures and equipment.

ANO-1 EFW Turbine Exhaust Piping

The TDEFW pump is required for Phase 1 core cooling. The EFW system pumps, valves, and connecting piping are designed, constructed and maintained in accordance with seismic Category 1 requirements (reference Upper Level Document (ULD) ULD-1-SYS-12, ANO-1 Emergency Feedwater System, Section 4.7).

The north and the west side of the EFW turbine exhaust piping is surrounded by two foot thick seismic walls, which provide missile protection. A missile approaching from the north or west is not a concern.

On the east side, there is a firewall made of 12 inch thick concrete masonry. This is not a seismic wall and does not provide missile protection. However, the vent is about 160 feet away from the east wall of the turbine building providing a good distance past the interference provided by the firewall. A missile approaching from the east is therefore not a concern.

The south wall of the turbine building is not a seismic wall, but there are two buildings (new administration building and the administration building) to the south of the turbine building which would act as a missile barrier. The vent is also located at least 60 feet from the south wall of the turbine building, so a missile approaching from the south is not a concern.

In addition, a rupture disc has been installed in the EFW pump turbine driver exhaust line just below the Elev. 368' floor slab. This provides an alternate vent path in the unlikely event that the exhaust line is pinched closed. This rupture disc is located in a non-Class I area which contains sufficient volume and vent area to accept the steam exhaust.

Therefore, there is reasonable protection for the ANO-1 EFW turbine exhaust vent from tornado missile.

ANO-2 - EFW Turbine Exhaust Piping

The TDEFW pump is required for Phase 1 core cooling. The EFW turbine exhaust piping performs no active function, and is classified as non-safety related (reference ULD-2-SYS-12, ANO-2 Emergency Feedwater System, Section 4.7). The EFW pump turbine exhaust piping is ANSI B31.1.0 class and has been analyzed to withstand design basis earthquake (DBE) seismic loads (ANO-2 SAR Section 10.4.9.1).

Since some failure modes (e.g., crimping) of this non-safety related exhaust piping could impair functioning of the safety-related portions of the EFW system, this piping has been designed for protection against safe shutdown earthquakes (SSEs), tornadoes, and high-energy line breaks (HELBs). The EFW turbine exhaust provides dual paths for protection against crimping caused by HELB from the main feedwater or main steam lines which pass in close proximity to the exhaust piping. One path has been analyzed and designed to survive a DBE (SSE) event. The other path has been analyzed and designed to survive both tornado wind loads and tornado missile strikes.

Audit Item Reference CI 3.2.4.7.A

SE Tracker Notes

Confirm that a final strategy for use of the mobile boration unit is developed.

Licensee Input Needed to Close Item

Mobile boration strategy needs to be provided.

Response

The long-term borated makeup replenishment strategy is addressed as follows:

Suction is taken from the intake canal by the NSRC low-pressure medium flow (LPMF) pump via four parallel suction hoses. The NSRC would supply two LPMF pumps to ANO, one for each unit. The LPMF pump discharges 500 gpm and is routed to the NSRC water treatment system (WTS). The WTS contains two parallel reverse osmosis skids capable of providing 125 gpm each (250 gpm total) of clean water. The 250 gpm of clean water is routed to two NSRC mobile boration units (MBUs) staged near the WTS while the remaining 250 gpm of waste water is routed to the discharge canal. The MBUs discharge to the NSRC high-pressure injection pump (HPIP) which can produce 60 gpm at 2000 psi. The NSRC would supply two HPIPs to ANO, one for each unit. With this strategy, borated water could be supplied to the RWT, BWST, or BAMTs depending on the needs of the station.

Audit Item Reference Audit Question (AQ) 67

SE Tracker Notes

NEI 12-06, Section 3.2.2, Paragraph (5) requires evaluation of water supplies used for FLEX makeup strategies. The capacities of the qualified condensate storage tank (QCST) and the BWST along with other selected tanks mentioned in the integrated plan were not specified so it cannot be determined if these tanks capacities are adequate for the intended purposes of plant cooldown and RCS inventory makeup or additionally, when the required switchover from primary to alternate supplies would be accomplished. Provide the capacity of all the tanks and water supplies that would be used for FLEX makeup strategies, the timing for switchover to alternate supplies and discuss the consequences of using potentially impure raw water source to supply the SGs.

Licensee Input Needed to Close Item

Finite Element Analysis needs to be provided.

Response

The Finite Element Analysis (Report No. 2013-0771-DC-002), and the responses to the NRC questions (Report 2013-0771-PC-001) have been uploaded to the ePortal. Responses to additional follow-up NRC questions have been formally documented in CALC-ANOC-CS-00005 which has also been uploaded to the ePortal.

Audit Item Reference AQ 84

SE Tracker Notes

Clarify the motive force(s) that would be used to operate the ADVs for both ANO-1 and ANO-2 and provide an analysis that supports their continued operation for the duration of the event. How many ADV cycles are expected and how many are supported by the existing on-site capabilities?

Licensee Input Needed to Close Item

Provide justification that the operators can access the ADVs and operate them after a tornado event.

Response

The ADVs for ANO-1 and ANO-2 would be locally operated per the following procedures which provide instructions on local manual operation of the ADVs which would be used in an ELAP/station blackout (SBO) condition.

- ANO-1 procedure 1203.002, "Alternate Shutdown," Exhibit A, "Local Operation of ADVs at Mode 3, > 525 °F,"
- ANO-1 procedure OP-1202.008, "Blackout"
- ANO-2 procedure OP-2202.008, "Station Blackout"

- ANO-2 procedure OP-2203.014, "Alternate Shutdown"
- ANO-2 procedure OP-2105.008, Steam Dump and Bypass Control System Operation, Exhibit 2, "Manual Operation of Upstream Atmospheric Dump Valves"

Operations personnel are qualified for local manual operation of the ADVs. The ADVs are subject to a preventive maintenance program to ensure their availability to function as required. Local manual operation of the ADVs (upstream ADVs for ANO-2) is performed using handjack/handwheel and is already credited at ANO for being able to maintain hot shutdown conditions for SBO, Loss of AC Power or the Appendix R Safe Shutdown. Environmental conditions for accessibility to the ADV room/area is addressed in Audit Item Reference AQ.86 (below). As discussed in the response to Audit Item Reference CI 3.2.1.A above, access to the ADVs are reasonably protected from tornado generated missiles as documented in Engineering Report CALC-ANOC-CS-15-00004. The conclusions of CALC-ANOC-CS-15-00004 are based on engineering judgment regarding the observed surrounding structures' and systems' ability to impede a missile.

Because this is a manual operation requiring no external power source other than an operator and the valves can be throttled, no analysis is needed for continued operation. Additionally, there are no limits to the number of cycles other than manpower.

<u>**Audit Item Reference AQ 86**</u>

<u>SE Tracker Notes</u>

Describe how manual ADV control will be accomplished (e.g., communication between the control room and a local operator stationed at the ADV), and, as applicable, whether environmental factors such as the potential for ambient noise and elevated temperatures due to exiting steam have been considered.

<u>Licensee Input Needed to Close Item</u>

Provide an analysis of the temperature and required stay times in the ADV rooms. Also provide an assessment of the ability of the ADVs to operate for their complete mission time under ELAP conditions.

<u>Response:</u>

The following procedures provide instructions on local manual operation of the ADVs which would be used in an ELAP/SBO condition.

- ANO-1 procedure 1203.002, "Alternate Shutdown," Exhibit A, "Local Operation of ADVs at Mode 3, > 525 °F"
- ANO-1 procedure OP-1202.008, "Blackout"
- ANO-2 procedure OP-2202.008, "Station Blackout"
- ANO-2 procedure OP-2203.014, "Alternate Shutdown"
- ANO-2 procedure OP-2105.008, Steam Dump and Bypass Control System Operation, Exhibit 2, "Manual Operation of Upstream Atmospheric Dump Valves"

Operations personnel are qualified for local manual operation of the ADVs. The ADVs are subject to a preventive maintenance program to ensure their availability to function as required. Gloves, flashlight and hearing protection are staged in the ADV operation tote bag in the alternate shutdown locker. A handheld radio is used for communications with the control room operators. Local manual operation of the ADVs (upstream ADVs for ANO-2) is already credited at ANO for being able to maintain hot shutdown conditions for SBO, Loss of AC Power, or the Appendix R Safe Shutdown.

Continuous standby at the ADV is not required for operation. Initial cooldown may require frequent valve adjustments and pressure monitoring; however, after the initial transient, ADV position would be effectively constant once SG pressure had been "dialed in" within the desired operating band. Only small, infrequent adjustments would be needed to compensate for changes in decay heat.

Calculations have been performed to model the worst case ADV area temperature responses following a BDBEE. Operator accessibility in the ANO-1 and ANO-2 ADV rooms is conservatively governed by Entergy Fleet heat stress guidance EN-IS-108. Habitability limits for local actions were previously evaluated up to 150 °F for a previous NFPA-805 analysis. It should be noted that following plant cooldown and depressurization, continual occupancy of these areas would not be required.

The results of the calculations show that for ANO-1 the temperatures in the ADV area remain below 128 °F with no compensatory actions up to 120 hours post-event. There are no additional required actions to cope with ADV area temperatures at ANO-1 as the temperatures do not challenge the personnel habitability limits.

For ANO-2, Door 405 is opened no later than three hours to mitigate the temperature increase in the ADV room. In addition to opening the door at three hours, two cases evaluated temperature in the ADV room: one evaluates no additional mitigating actions and the other case evaluates a roof vent being cut in the structure to lower temperatures.

Case 1 was performed for the ADV room where a 49 ft^2 ventilation path to the roof is opened at 24 hours (manual action to destructively open a vent path). Case 2 reflects the current plant configuration as a roof vent is not available in the ADV room.

Description	**Temp at 120 hours**	**Peak Temperature / Time**
Case 1 - 49 ft^2 Roof Penetration opened at 24 hours.	123 °F	141 °F / 24 hours
Case 2 - No Roof Penetration open	147 °F	149 °F / 73 hours

Using the guidance of 150 °F as the habitability limit, both of the ANO-2 ADV cases are acceptable. The ANO-2 cooldown would be complete at approximately five hours following an ELAP. After the cooldown is complete, it is expected that only intermittent manual operation of the ANO-2 ADVs would be required. Without any additional compensatory measures beyond opening doors, the acceptance criterion for the room is not exceeded. The temperature reached at 120 hours with no mitigation actions is deemed acceptable for infrequent occupancy to allow local operation of the ADVs as required. However, the established roof penetration provides the basis for a course of action that could be established to provide a more suitable environment for continual manual operation of the ADVs, if required.

There is no local electrically powered instrumentation used or needed to operate the ADVs manually, only mechanical indicators; therefore, environmental factors are not a concern for equipment in the ADV room/area.

Audit Item Reference AQ 106

SE Tracker Notes

In the six month update, licensee indicates that they may be changing methodology to providing borated water to the RCS. Provide discussion on the proposed change.

Licensee Input Needed to Close Item

Provide a completed draindown analysis for the RWT and BWST that incorporates the potential tornado missile strike. NRC review of the tank finite element analysis is covered by item SE-33

Response

Calculation CALC-13-E-0005-51, Rev. 0, evaluates the duration of time inventory that can be provided, given specific perforation cases, from the BWST and RWT for RCS makeup. This calculation was uploaded to the ePortal.

Audit Item Reference AQ 113

SE Tracker Notes

Licensee states that FLEX equipment will be prestaged once a flood event is initiated. Describe what equipment and where it will be prepositioned to assure protection (include N+1 equipment).

Licensee Input Needed to Close Item

Provide more detailed formal description of capabilities for capabilities to transport heavy FLEX equipment (diesels, pumps) from backup storage or NSRC to deployable positions during flood persistence time.

Response

Upon notification of predicted flood conditions at the ANO site, pre-staging of equipment is conducted under the guidance of a model work order. The work order is activated once the natural emergency procedures OP-1203.025 and OP-2203.008 direct the activities to commence. In addition, the Entergy corporate severe weather procedure EN-FAP-EP-010 has generic checklists for preparation of the site for severe weather conditions that may be beneficial as the site commences pre-staging of FLEX equipment. These procedures require notification to the Entergy Corporation headquarters to identify and request additional support equipment. Equipment from the corporation would be dispatched to the ANO site to assist. This equipment includes water vessels capable of moving heavy equipment, supplies, consumables, etc., to areas susceptible to flood waters, at any flood depth or level. This additional equipment would be available to assist in maintenance and refueling of equipment during all conditions as necessary.

In the extreme licensing basis flood, there are five days of time following initial notification to perform actions to prepare for the flood including the credited pre-staging actions of the FLEX equipment. Station natural emergencies procedures have been revised to reference the model work order for flood preparations that reflect the capabilities of the FLEX equipment and provide for the flood preparation actions to ensure the plant can respond to an ELAP event should one occur in a flood condition. Included in these improvements are the actions that direct the notification to the Entergy Corporation. Activation of the Corporate Emergency Response Center would drive pre-staging the equipment at or near the ANO site that is necessary (airboats, vessels, etc.) to maintain and refuel the FLEX equipment. This equipment is available throughout the Entergy service territory and can be readily delivered to the ANO site in an expeditious manner.

Depending on the actual conditions expected to be experienced during the flooding event the preparation activities would be different (e.g., storm conditions may make pre-staging the backup equipment unadvisable). Nevertheless, the model work order discusses the need to consider the following actions as part of the determination of the correct preparation activities:

1. The use of a portable 20' SeaLand container functioning as a temporary platform. The container can be located in close proximity to the staging location of the portable PASS FLEX platform and is of the same approximate height. Cribbing can be used to ensure a level surface. The interior of the container can be loaded with material (sand, concrete blocks, etc.) to ensure container stability during rising water levels. ISO 1496 is applicable to these containers and these movable devices are constructed and qualified to withstand a minimum 300 psf loading. The FLEX SG makeup pump can be staged on the roof of a SeaLand container (the FLEX PDG would be staged on the PASS FLEX platform). Access to the roof of the SeaLand container can be via a portable ladder. The pump can be secured to the roof using typical rigging solutions and readily available fasteners (chains, straps, etc.). SeaLand containers are readily available on site and the capability to relocate the containers is accomplished with common commercially available equipment.

2. Since both units would shutdown and cooldown in response to rising flood levels, two FLEX SG makeup pumps can accommodate the required flows for this scenario and additional generator capacity can be staged on the PASS FLEX platform. Currently, the strategy stages three pumps and one portable diesel generator on the platform. It is acceptable to remove one pump and replace with an additional diesel generator as the platform can take this load combination and can accommodate the placement of the additional diesel generator.

Therefore, adequate plans are in place to ensure N equipment readiness as well as contingency planning options to replace N equipment with N+1 (or NSRC) equipment using resources supplied by the Entergy Corporation, use of SeaLands as temporary platforms, or reconfiguring the pre-staging of the number of pumps and diesels on the post-accident sampling system (PASS) FLEX platform.

Audit Item Reference AQ 129

SE Tracker Notes

Discuss the long-term reliability of the steam driven EFW pump during an ELAP event. In particular:

a. **Excessive moisture in the steam supply can disrupt turbine operation. Discuss whether the ELAP event will impact steam supply line moisture removal such that turbine operation is potentially impacted. If the condensate discharges to a local sump, please address long term area temperature and humidity along with the removal of the condensate before local room flooding can occur.**

b. **The steam driven EFW pump has mini flow recirculation line that provides relief from dead heading the pump. This recirculation may not be protected from external events associated with an ELAP event. Staff requests the licensee assess operation of the mini flow recirculation line and any action required if the line become crimped, or severed resulting in loss of inventory.**

Licensee Input Needed to Close Item

Provide an evaluation of the impact of the non-seismic minimum flow lines on the overall strategy.

Response

The standpipes in the QCST that the ANO-1/ANO-2 TDEFW pump minimum flow lines discharge to are seismic Category 1 per piping & instrument diagram (PI&D) M-204, Sh. 5; therefore, failure of the minimum flow lines would not drain the QCST.

Calculation 80-D-1083-36 and its outstanding changes qualify the TDEFW minimum flow line as seismic Category 1 up to anchor 3-EFW-112-H1, which is downstream of valve FW-11A. Therefore, FW-11A, shown on PI&D M-204, Sh. 3, is seismically qualified and can be used to isolate the minimum flow line for ANO-1 TDEFW pump. Procedure OP-1106.006 states that the normal range for minimum flow is between 100 and 140 gpm and between 75 and 150 gpm is acceptable for operability. Additionally, ER-ANO-2003-0500-001 concludes that an EFW pump flow rate of 75 gpm for short periods (3 hours or less) is acceptable. Per DAR-SEE-II-12-13, the required EFW flow rate to the ANO-1 SGs remains above 75 gpm until approximately 50 hours into the event. Therefore, in the event that the minimum flow recirculation line is isolated to prevent inventory loss, the ANO-1 TDEFW pump minimum flow requirements would be satisfied well beyond the point at which the portable SG makeup pump would be staged to supply the ANO-1 SGs (24 hours after the event).

Drawing M-2204, Sh. 4, shows that isolation valve 2EFW-10A of the minimum flow line of the ANO-2 TDEFW pump is seismic. Therefore, 2EFW-10A, shown on PI&D M-2204, Sh. 4, can be used to isolate the minimum flow line for the ANO-2 TDEFW pump. Procedure OP-2106.006 states that the normal range for minimum flow is between 51 and 80 gpm and must be greater than 22 gpm for operability. Per DAR-SEE-II-12-13, the required EFW flow rate to the ANO-2 SGs remains above 50 gpm beyond 72 hours into the event. Thus, the ANO-2 TDEFW pump minimum flow requirements are never challenged, even if the minimum flow recirculation line were to be isolated in order to prevent inventory loss from a break in the non-seismic portion of the minimum flow lines.

Audit Item Reference Safety Evaluation (SE) 21

SE Tracker Notes

The generic analysis in WCAP-17601-P strictly addressed ELAP coping time without consideration of the actions directed by a site's mitigating strategies. WCAP-17792-P extends these analytical results through explicit consideration of mitigating strategies involving RCS makeup and boration. In support of the RCS makeup and boration strategies proposed therein, a generic recommendation is made that PWRs vent the RCS while makeup is being provided.

a. If the mitigating strategy will include venting of the RCS, please provide the following information:

i. The vent path to be used and the means for its opening and closure.

ii. The criteria for opening the vent path.

iii. The criteria for closing the vent path.

iv. Clarification as to whether the vent path could experience two-phase or single-phase liquid flow during an ELAP. If two-phase or liquid flow is a possibility, please clarify whether the vent path is designed to ensure isolation capability after relieving two-phase or liquid flow.

v. If relief of two-phase or liquid flow is to be avoided, please discuss the availability of instrumentation or other means that would ensure that the vent path is isolated prior to departing from single-phase steam flow.

vi. If a pressurizer PORV is to be used for RCS venting, please clarify whether the associated block valve would be available (or the timeline by which it could be repowered) in the case that the PORV were to stick open. If applicable, please further explain why opening the pressurizer PORV is justified under ELAP conditions if the associated block valve would not be available.

vii. If a pressurizer PORV is to be used for RCS venting, please clarify whether FLEX RCS makeup pumps and FLEX steam generator makeup pumps will both be available prior to opening the PORV. If they will not both be available, please provide justification.

b. If RCS venting will not be used, please provide the following information:

i. The expected RCS temperature and pressure after the necessary quantity of borated makeup has been added to an unvented RCS.

ii. Adequate justification that the potential impacts of unvented makeup will not adversely affect the proposed mitigating strategy (e.g., FLEX pump discharge pressures will not be challenged, plant will not reach water solid condition, adequate boric acid can be injected, increased RCS leakage will not adversely affect the integrated plan timeline, etc.).

Licensee Input Needed to Close Item

Provide information for both ANO-1 and ANO-2 describing the need to vent. The evaluation should include the following: Does the analysis show the need to vent the RCS to inject the required amount of boron? Discuss the steps in procedures that allow for venting (opening and closing criteria). Confirm that a water-solid RCS will not be permitted. Also, discuss whether ANO has plans to use the pressurizer power operated relief valves to vent.

Response

RCS Venting

The RCS cooldown calculations are CN-SEE-II-13-4 and CN-SEE-II-13-2 for ANO-1 and ANO-2, respectively. These calculations address RCS boration with either no RCS leakage (ANO-1) or minimal RCS leakage and no uncontrolled letdown (ANO-2). Note that leakage provides a beneficial letdown path for RCS boration, and neglecting or minimizing leakage is conservative with respect to boron concentration. The cooldown calculations for both units state that RCS venting may be required for letdown.

RCS Venting Procedural Guidance

RCS venting is directed through each units' FLEX Developed Strategy (FDS) guidelines, FDS-001 for ANO-1 and FDS-002 for ANO-2, which governs each unit's ELAP response. Both FDS-001 and FDS-002 direct RCS venting as part of the Alternate Boration FLEX Support Guidelines (FSGs) if the nuclear instrument startup rate is positive. 1FSG-008 and 2FSG-008 are the ANO-1 and ANO-2 Alternate Boration FSGs, respectively. 1FSG-008 provides direction to vent through any of the SG high point, pressurizer high point, and reactor vessel high point vents. 2FSG-008 provides direction to vent through the reactor high point and pressurizer high point vents. The vents are opened to allow a calculated inventory of borated water to maintain subcritical conditions in the RCS, which is calculated within 1FSG-008 and 2FSG-008, and the vents are closed once this required volume of water has been injected.

Preventing Water Solid RCS

Both units have guidance within their FDS documents, FDS-001 and FDS-002, to prevent a water solid RCS by providing an upper limit for pressurizer level.

Pressurizer Power-Operated Relief Valves (PORVs)

ANO-1 has guidance in FDS-001 to open the pressurizer PORV in the event that RCS pressure exceeds 2450 psig. The basis for this setpoint is to protect the pressurizer PORV from lifting, not for boration purposes. ANO-2 has guidance as part of the FDSs/FSGs to open the Emergency Core Cooling System vent valves.

<u>Audit Item Reference SE 27</u>

<u>SE Tracker Notes</u>

Safety Injection Tank (SIT)/Core Flood Tank (CFT) Injection. Review analysis to confirm that nitrogen injection is precluded from SITs/CFTs. As applicable, confirm that isolation/venting will be effected prior to nitrogen injection.

<u>Licensee Input Needed to Close Item</u>

For ANO-1, provide the calculation for ensuring that nitrogen does not inject from the CFT into the RCS during the event.

<u>Response</u>

For ANO-1, RCS inventory control is delayed until Phase 2. ANO-1 does not credit any inventory from their CFTs and requires RCS makeup from an external source.

Due to the design of the ANO-1 once-through SGs, plant cooldown is delayed until approximately eight hours after an ELAP. Prior to six hours from the beginning of the BDBEE, a charging pump and BAMT from ANO-2 are connected to the ANO-1 RCS to maintain RCS inventory and natural circulation. After assuring that the RCS inventory is maintained at normal operational levels in the pressurizer, cooldown at a rate of 20 °F/hour to a final temperature of 350 °F is planned.

As the RCS cools down and decreases pressure, the CFTs are designed to passively inject their contents into the RCS. This starts to occur when the RCS pressure is equal to the pressure of the nitrogen cover gas in the CFTs. In order to assure that no nitrogen injection from the CFTs occurs, the RCS pressure should be maintained above 240 psia until the CFTs are isolated. Since the CFTs are not credited and a charging pump is available and running for inventory control, the CFTs can be isolated at any time once the cooldown has begun.

Guidance is provided in the FSGs to ensure CFTs are isolated during the cooldown and before approaching 240 psia.

For ANO-2, RCS inventory control during Phase 1 relies upon passive injection from the SITs. ANO-2 has a large accessible volume in the SITs and is implementing a cooldown and depressurization strategy consistent with the Pressurized Water Reactor Owners Group (PWROG) Core Cooling recommendations for the ELAP scenario. SIT volumes are adequate to maintain required RCS inventory during Phase 1.

RCS cooldown would be initiated at two hours into the event at a rate of 75 °F/hr. Cooldown would stop at an RCS temperature of 350 °F to preclude nitrogen injection into the RCS from the SITs and ensure functionality of the TDEFW pumps.

Guidance is provided in the FSGs to ensure SITs are isolated before cooling down below an RCS temperature of 350 °F.

Audit Item Reference SE 29

SE Tracker Notes

The licensee is requested to provide a summary evaluation to confirm that the temperature and pressures within containment will not exceed the environmental qualification (EQ) of electrical equipment that is being relied upon as part of their FLEX strategies. The licensee needs to ensure that the EQ profile of the required electrical equipment remains bounding for the entire duration of the event.

Licensee Input Needed to Close Item

Provide summary evaluation for ANO-1 and ANO-2 regarding the qualification under ELAP conditions of containment electrical equipment to support indefinite cooling.

Response

ANO-1

For ANO-1, the EQ conditions specified for procurement of EQ equipment are 286 °F, 59 psig, 100% humidity, and total radiation exposure of 2×10^4 roentgens (for 24 hours of operation by essential equipment). Plant equipment and components which are required to remain functional during and following an accident have been demonstrated, purchased, and maintained to be qualified to withstand the environment of these combined EQ conditions. From Calculation CALC-13-E-0005-02, ANO-1 MAAP Containment Analysis for BDBEE, the worst case containment temperature and pressure based on current FLEX strategy occur in a Mode 5 mid-loop scenario for ANO-1 and assume the RCS is vented via the pressurizer manway. Decay heat from the reactor is therefore transferred into containment via a boiling RCS. Venting is required to maintain containment integrity. With this measure, the containment pressure design limit is not exceeded, and the collapsed water level in the vessel never falls below the top of active fuel. However, the containment design temperature is exceeded at approximately 72 hours and is approximately 2 °F over the design value at the end of a 120-hour sequence. This is acceptable because the EQ design temperature is not exceeded until after 72 hours, by which time NSRC equipment would be available and used to reestablish containment cooling to reduce temperature and pressure.

FLEX strategies are designed to prevent fuel failure; therefore, the EQ condition of total radiation exposure of 2×10^4 roentgens is not present. In addition, the equipment is qualified to operate for its qualified life plus 30 days of the harsh loss-of-coolant accident (LOCA) environment. In the EQ program, the equipment is maintained such that it is replaced/reworked and requalified before reaching its end-of-life (EOL). Without radiation exposure accelerating the degradation of the equipment, and being maintained with margin to EOL, the equipment continuing to function for the relatively short extension of time at temperatures above the EQ value until cooling is reestablished is reasonable. For a Mode 1 – 4 scenario, the containment pressure and temperature limits described above, are never exceeded for the 120-hour duration of the evaluation. NSRC equipment arrives onsite 24 hours after notification that the site is in an ELAP. Containment cooling can be reestablished anytime thereafter, provided sufficient resources are available to align the NSRC equipment, to reduce containment temperature and pressure.

ANO-2

For ANO-2, the EQ conditions specified for procurement of EQ equipment are 300 °F (10 min), 250 °F (1 hour), 200 °F (20 hours), 59 psig (3 hours), 100% humidity, and total radiation exposure of 3.3 x 10^7 RADS. Plant equipment and components which are required to remain functional during and following an accident have been demonstrated, purchased, and maintained to be qualified to withstand the environment of these combined EQ conditions. From Calculation CALC-14-E-0002-01, ANO-2 FLEX MAAP4 Containment Analysis, the worst case containment temperature and pressure based on current FLEX strategy occur in a Mode 5 mid-loop scenario for ANO-2 and assumes the RCS is vented via the pressurizer manway. Decay heat from the reactor is therefore transferred into containment via a boiling RCS. Venting is required to maintain containment integrity. With this measure, the containment pressure and temperature design limits are not exceeded, and the collapsed water level in the vessel never falls below the top of active fuel. Additionally, NSRC equipment would begin to arrive onsite 24 hours after notification that the site is in an ELAP. Containment cooling can be reestablished anytime thereafter, provided sufficient resources are available to align the NSRC equipment, to reduce containment temperature and pressure.

FLEX strategies are designed to prevent fuel failure; therefore, the EQ condition of total radiation exposure of 3.3 x 10^7 RADS is not present. In addition, the equipment is qualified to operate for its qualified life plus 30 days of the harsh LOCA environment. In the EQ program, the equipment is maintained such that it is replaced/reworked and requalified before reaching its EOL. Without radiation exposure accelerating the degradation of the equipment, and being maintained with margin to EOL, the equipment continuing to function for the relatively short extension of time at temperatures above the EQ value until cooling is reestablished is reasonable.

For a Mode 1 - 4 scenario, the containment pressure and temperature limits described above, are never exceeded for the 120-hour duration of the evaluation. NSRC equipment arrives onsite 24 hours after notification that the site is in an ELAP. Containment cooling can be reestablished anytime thereafter, provided sufficient resources are available to align the NSRC equipment, to reduce containment temperature and pressure.

Audit Item Reference SE 30

SE Tracker Notes

Need justification for the electrical panel on the roof of the post-accident sampling system (PASS) building for protection from wind/rain.

Licensee Input Needed to Close Item

Provide an assessment of the ability of the connection panel on the PASS building roof to survive the initiating external event.

Response

The connection panel on the roof of the PASS building (2TB1011) is designed for exterior usage per ANSI/IEEE Standard C57.12.28 "Pad-mounted Equipment Enclosure Integrity", as specified in Section 3.1.10 of EC 44044. Standard C57.12.28 covers conformance tests and requirements for the integrity of above grade pad-mounted enclosures such that the electrical equipment maintained in the box would not be adversely impacted by normal weather conditions. 2TB1011 is a secondary connection panel only required for use during a flood scenario such that it is not required to function in a seismic event, high winds, or missile-induced structural loads.

Section 3.1.22 of EC 44044 specifies that 2TB1011 includes a hood that covers the entire enclosure in order to reduce the effect of rain dripping into the enclosure. Additionally, the receptacles and plugs are rated to IP69K, which is for equipment designed to withstand high-pressure and high-temperature washdown.

Additionally, Section 8.1.1.1 of EC 46389 requires that the casing base of 2TB1011 be anchored to the roof surface using silicone adhesive to waterproof the fiberglass enclosure. This same silicone adhesive was used to waterproof the penetrations into the box for the conduits encasing the permanently installed cables that direct diesel generator power into the plant.

Audit Item Reference SE 31

SE Tracker Notes

Cable routing, under flooding conditions, from FLEX diesel-driven electrical generator (DG) on platform to patch panel on PASS building roof.

Licensee Input Needed to Close Item

Provide an evaluation that addresses NRC concerns regarding potential submergence of the cable (for both the cable and splices/connectors), and/or stresses on the connection points due to hanging the cable (during normal conditions and stormy/windy weather - cadence may amplify forces on connection points).

Response

The cable deployment strategy during a flood scenario includes the acquisition and storage of longer 250-foot temporary cables that can be routed from the portable diesel generator (PDG) staged on the flooding platform, down to the ground level and covered in sandbags as it is routed towards the PASS building, and secured to existing permanent fixtures as it ascends the PASS building to connect to the connection panel on the roof (2TB1011). These longer cables eliminate the submergence of the locking connectors that are used during the non-flood scenario and are IP69K rated, which is only rated for high temperature and high pressure spray, but not submergence.

The route for the submerged cables includes a delay fence and a security fence, both of which extend above the flood elevation and act as debris filters, as well as a tight path between the BWST and the PASS building, further reducing the chance for debris large enough to drag the cables. Existing permanent structures are used to tie off the cables and provide strain relief such that the force on the cables would not remove the mounting of 2TB1011 from the PASS roof.

Mounting details for the connection panel on the roof of the PASS building (2TB1011) are included in CALC-13-E-0005-18. Section 6.2 of that calculation evaluates the pre-qualified frame connected to the existing concrete roof, including the three-dimensional forces and a check on the four anchor bolts with a minimum embedment of 1 5/8".

Audit Item Reference SE 33

SE Tracker Notes

Finite Element Analysis (FEA) report for tornado qualification of RWT, BWST, and QCST.

Licensee Input Needed to Close Item

Provide the FEA analysis for review and answer any associated NRC staff methodology questions.

Response

The FEA analysis (Report No. 2013-0771-DC-002), and the responses to the NRC questions (Report 2013-0771-PC-001) have been uploaded to the ePortal. Responses to additional follow-up NRC questions have been formally documented in CALC-ANOC-CS-00005 which has also been uploaded to the ePortal.

Audit Item Reference SE 34

SE Tracker Notes

Tornado separation distance.

Licensee Input Needed to Close Item

Provide an evaluation of the separation distance of the buildings using an area sufficiently similar to the area enclosed by a 1-degree latitude-longitude box using the 95-percentile tornado.

Response

ENTGANO83-RPT-001, Rev.1, reports a separation distance of 1,542 feet based on tornado data from 1951 to 2012. This data set includes all tornadoes that touched down in any counties within a 70-mile radius of ANO. The number of tornadoes from 1951 to 2012 within these counties was 459 (ENTGANO83-RPT-001, Rev.1). The number of tornadoes from 1973 to 2012 within these counties was 346 (ENTGANO83-RPT-001, Rev.1). Both sets of data (1951 to 2012 and 1973 to 2012) are presented due to the Fujita scale being developed in 1973 and due to the under-reporting of low intensity tornadoes during the 1950 to 1970 time period.

NUREG/CR-4461, Rev. 2, presents tornado characteristics based on 90% confidence intervals with land areas representative of boxes with sides of 1°, 2°, and 4° of latitude and longitude. The characteristics for the 2° and 4° boxes are considered most reliable, and those for 1° boxes should only be used if the number of events is large enough to ensure that the statistics are likely to be reliable. Along the southern border of the U.S., a 1° box covers an area of approximately 4,000 mi^2 (NUREG/CR-4461 Rev. 2). In the middle of the U.S., a 1° box covers an area of approximately 3,600 mi^2 (NUREG/CR-4461 Rev. 2). A 70 mile radius represents a land area of approximately 15,400 mi^2, which is approximately the area of a 2° latitude by longitude box located in the middle to southern portion of the U.S.

In terms of sample size, for a 90% and 95% confidence level, the number of tornadoes required for statistical significance is shown below where 'n' is the required sample size and $z_{\alpha/2}$ is the z score for different confidence levels.

$$n = \frac{\left(z_{\alpha/2}\right)^2 \times p \times (1-p)}{E^2}$$

Where:

n = Sample size

$z_{\alpha/2}$ = z score for confidence level, 1.645 (90%) and 1.96 (95%)

p = Estimated proportion of population, 0.5 is conservative

E = Margin of error, 0.05

$$n\,(90\%) = \frac{1.645^2 \times 0.5 \times (1-0.5)}{0.05^2} = 271$$

$$n\,(95\%) = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.05^2} = 384$$

For a 70 mile radius (2° box), the number of tornadoes from 1951 to 2012 was 459, and the number of tornadoes from 1973 to 2012 was 346 (ENTGANO83-RPT-001, Rev. 1). Therefore, using a 70 mile radius (2° box) provides a sample size that is most appropriate for evaluating the tornado separation distance.

Historically, the 95th percentile has been used in design basis analysis such as determining the design basis accident (DBA) atmospheric dispersion (Regulatory Guide 1.145). However, the use of a more realistic 90th percentile is more consistent with non-DBA events and FLEX strategies which use non-safety related equipment and manual actions to deal with the event. As stated in Reference 4, "The separation distance between storage locations is not intended to bound the width of all possible tornadoes but is intended to provide reasonable assurance that N sets of FLEX equipment would remain deployable for most tornadoes (NEI 12-06 Rev. 0, Section 2.3)." Using the 90th percentile follows the guidance of NEI 12-06 and provides a reasonable separation distance for the site. Therefore, the 90th percentile tornado width of 1,542 feet is appropriate for the FLEX storage building separation distance at ANO.

The FLEX storage building locations were selected to be as far apart as possible without challenging the logistics (debris removal, road crossings, etc.) of accessing the FLEX equipment within the buildings. The northwest FLEX Storage Building #1 is located near transmission lines to the west and State Road 333 to the north and east. The southeast FLEX Storage Building #2 is located north of the May Road bridge in order to avoid potential issues with using the bridge as a deployment path for FLEX equipment after a BDBEE.

The separation distances of the FLEX storage buildings are approximately 2,700 feet when considering tornadoes from the southwest, and approximately 2,300 feet when considering tornadoes from the west. These distances were calculated using drawing No. C-667, Sheet 1, Grading and Drainage Plan for FLEX Storage Buildings. The limiting separation distance of 2,300 feet corresponds to the 94th percentile, based on the 70 mile radius tornado data given in ENTGANO83-RPT-001 Rev. 1.

<u>**Item Reference SE 35**</u>

<u>SE Tracker Notes</u>

Regarding the seismic design of the two FLEX storage buildings, if the buildings are not designed to a level commensurate with the plant SSE, provide justification that the equipment necessary to mitigate a beyond-design basis seismic event under the conditions of Order EA-12-049 can be deployed successfully. This could be demonstrated by one of the following means:

1. **Evaluate the storage buildings to the SSE level and demonstrate its performance is adequate to support fulfillment of the strategies (e.g., does it collapse, fail major/minor structural members, skew doorframes, etc.)**
2. **Show that there is another load case (such as wind loading) which governs the building design such that the building would be functional following an SSE.**
3. **Show that the equipment stored in the building is not essential for the strategies to succeed following a seismic event. (This may be applicable to sites who rely heavily on pre-staged FLEX equipment already in other protected buildings.)**
4. **Show that the reevaluated GMRS seismic hazard is equivalent to or enveloped by the ASCE 7-10 spectra which was used to design the building.**

The NRC staff considers a configuration where the FLEX storage buildings are not designed to survive SSE-level loads an alternative to NEI 12-06, sections 5.3.1.2, 5.3.1.3 and 5.3.2.2. Licensees may propose a justification for the alternative that differs from the suggestions above as long as the ability to deploy at least "N" sets of equipment during a seismic event is demonstrated. This information is necessary to evaluate the requirement of Order EA-12-049 to provide reasonable protection for the associated equipment from external events.

Response

The Entergy approach of using two FLEX storage buildings was implemented at ANO utilizing the seismic provisions of ASCE 7-10 as permitted by NEI 12-06, Section 5.3.1.1.b. An evaluation was performed to validate the ability of each building to withstand an SSE-level seismic load and function as required in order to ensure that the equipment stored within can be successfully deployed.

The evaluation determined that the ANO FLEX buildings have SSE accelerations that are larger than the accelerations calculated per ASCE 7-10. However, the design wind forces are larger than the resultant forces of the respective SSE accelerations. Therefore, the ANO FLEX buildings are qualified for the site SSE accelerations.

In the audit report there were a few items listed under NRC review that did not require further licensee input; however, additional information is now available that supports the following item.

Audit Item Reference CI 3.2.1.2.B

For ANO-1, confirm adequate justification for (including seal leakage testing data) the use of two gpm/seal in the ELAP analysis.

Action

NRC review and endorsement of Flowserve white paper.

Response

The NRC has reviewed and endorsed the Flowserve white paper (letter dated November 12, 2015, ADAMS Accession No. ML15310A094). The NRC endorsement letter contains limitations and conditions to Flowserve white paper. The response to each one of these limitations and conditions is provided below:

1. Each licensee should confirm that its plant design and planned mitigation strategy are consistent with the information assumed in the calculation performed by Flowserve, which is summarized in Table 1 of the white paper.

    Confirmed - the ANO-1 plant design and planned mitigation strategy are consistent with the information provided in Table 1 of the Flowserve N9000 seal white paper.

2. Each licensee should confirm that the peak cold-leg temperature prior to the cooldown of the reactor coolant system assumed in Flowserve's analysis is equivalent to the saturation temperature corresponding to the lowest setpoint for main steam line safety valve lift pressure.

    Confirmed - the peak cold-leg temperature documented in Table 1 of the Flowserve N9000 seal white paper is based on the lowest ANO-1 setpoint for the main steam line safety valve lift pressure.

3. The NRC staff did not specifically review and is not endorsing the final column in Table 3, which estimates the maximum leakage rate in the case of seal failure modes more severe than expected during an ELAP event. This information is considered beyond the scope of determining licensees' compliance with Order EA-12-049. In particular, because actuation of the Abeyance seal is not expected during the ELAP event for any plant considered in the white paper, the NRC staff did not specifically review and is not endorsing the functionality of this component.

   No response required.

4. In its white paper, Flowserve has generally specified leakage rates in volumetric terms. For converting the specified volumetric flow rates to mass flow rates, licensees should use a density of 62 lbm/ft^3 (approximately 993 kg/m^3) throughout the ELAP event. This condition reflects observations made during testing conducted by Flowserve that simulated a loss of seal cooling, wherein the seal leakage mass flow rate remained roughly constant as the test apparatus underwent a significant cooldown and depressurization.

   The Flowserve white paper indicated that volumetric flow rate was observed to be held constant throughout the test. This is documented by the following statements from the white paper, "After more than eight hours since the initial heatup, an elastomer failure in the third stage increase the leakage to 1.67 gpm... the 1.67 gpm leakage value held constant during most of the subsequent ~two-hour cooldown and depressurization." For ANO-1, consistent with WCAP-17601-P, a high volumetric leak rate of two gpm per reactor coolant pump (RCP) is assumed at the initiation of the planned mitigation strategy. Conservatively, the low leak rate, which occurs after the ANO-1 RCS cooldown and depressurization, is also two gpm per RCP. This is acceptable and conservative, as the assumed ANO-1 constant leak rate is held constant throughout the ELAP event and bounds the N9000 test leak rate observed following elastomer failure and discussed in the Flowserve white paper.

5. The NRC staff conducted a sample audit of the plant-specific calculations performed by Flowserve for determining leakage rates as a function of time during an ELAP event. The NRC staff's audit calculations generally showed good agreement with the values calculated by Flowserve. Furthermore, licensees' mitigation strategies generally contain significant margin relative to the seal leakage rates calculated in the N-Seal white paper. However, if deemed necessary during plant-specific mitigation strategy audits, the NRC staff may perform additional audit calculations to confirm the appropriateness of the specific leakage rate assumptions and calculations for individual plants.

   No response required.

Attachment 4 to

0CAN011601

Interim Staff Evaluation Open Item and Confirmatory Item Responses

Interim Staff Evaluation Open Item and Confirmatory Item Responses

On February 25, 2014, the NRC issued the Interim Staff Evaluation (ISE) for Arkansas Nuclear One, Unit 1 (ANO-1) and Unit 2 (ANO-2). In that document, two open items and twenty-six confirmatory items were identified. A NRC onsite audit was conducted at ANO during the week of April 20, 2015, during which all of the confirmatory and open items were closed, with the exception of the items discussed in Attachment 3, as documented in the audit report. Listed below are the Entergy responses to the ISE open and confirmatory items in addition to those provided in Attachment 3. These responses were provided to the NRC before and during the onsite audit.

ISE Open Item 3.2.1.8.B

For ANO-1 and ANO-2, verify resolution of the generic concern associated with the *modeling of the timing and uniformity of the mixing of a liquid boric acid solution* injected into the RCS under natural circulation conditions potentially involving two-phase flow.

Response

ANO-1:

WCAP-17601-P, Section 5.3.3.1.1.3, provides the generic Babcock & Wilcox (B&W) plant response to a loss of AC power. For the lowered-loop units like ANO-1, the pressurizer empties at about 30,000 seconds (8.33 hours). Shortly thereafter, the lowered-loop design loses natural circulation. Based on the generic WCAP-17601-P results, the volumetric loss of RCS liquid must remain less than the available post-trip pressurizer liquid volume in order to maintain long-term heat removal by natural circulation. As such, the margin to loss of natural circulation may be estimated by comparing the aggregate decrease in RCS liquid inventory with the post-trip pressurizer liquid inventory of 600 ft^3 at 45 lbm/ft^3 (averaging 1800 psi and 573 °F) or 27,000 lbm. The post-trip pressurizer liquid inventory for ELAP is about 600 ft^3.

The RCS inventory losses up until 8.33 hours:

1. 75 gpm loss for 10 minutes (unsecured letdown),
2. Eight gpm total seal leakage plus one gpm unidentified leakage for 500 minutes, 5250 gallons = 702 cubic ft.

The ANO-1 analysis (CN-SEE-II-13-4, Rev. 1) conservatively treats loss of a post-trip inventory of 600 ft^3 as the threshold for loss of natural circulation; this is less than the 702 ft^3 value based on inventory losses in Section 5.3.3.1.1.3 of WCAP-17601-P. Therefore, in order to preserve natural circulation, RCS makeup must begin at a time when the RCS inventory losses are still below 600 ft^3 (i.e., before 8.33 hours).

The ANO-1 strategy is to provide RCS makeup in excess of RCS losses (at a rate of 35 gpm and ≥ 2270 ppmB) within six hours after the event, approximately two hours before the pressurizer empties. This strategy ensures single phase natural circulation is preserved and raises RCS boron concentration to ensure the reactor remains shutdown.

Based on the information provided above, the generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the RCS under natural circulation conditions potentially involving two-phase flow is not applicable to ANO-1. Therefore, the boron mixing criteria endorsed by the NRC are met (NRC Letter from Jack Davis to Jack Stringfellow dated January 8, 2014 (ML13276A183)).

ANO-2:

The site-specific ELAP analysis, (CN-SEE-II-13-2, Rev. 1), determined that ANO-2 has 3.43% Δρ shutdown margin at 72 hours into the event and, therefore, no actions are needed to provide additional negative reactivity during an ELAP event for RCS temperatures in excess of 350 °F. The analysis indicates sufficient shutdown margin from the Safety Injection Tank (SIT) injection alone through 72 hours into the event.

The analysis also determined that the transition to two phase conditions occurs at approximately 18.5 hours into the ELAP event. ANO-2 strategy begins RCS injection at hour 17.5, which ensures that single phase natural circulation would be maintained.

Based on the information provided above, the generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the RCS under natural circulation conditions potentially involving two-phase flow is not applicable to ANO-2.

ISE Confirmatory Item 3.1.1.2.A

Confirm whether there is a need for a power source to move or deploy the FLEX equipment (e.g., to open the door from a storage location).

Response

Two pre-engineered metal storage buildings have been built in order to house the portable FLEX equipment used to support Phase 2. These buildings are designed with manually operated rollup doors (lockable). Therefore there is no need for a power source to move or deploy the FLEX equipment.

ISE Confirmatory Item 3.1.1.4.A

Confirm that the local staging area for RRC equipment has been identified and a description of the methods to be used to deliver the equipment to the site has been provided.

Response

The National SAFER Response Center (NSRC) FLEX equipment local staging area has been selected. The area is shown in drawings C-667, Sheet 9, and C-667, Sheet 10, available on the ePortal.

Equipment would be delivered from offsite sources via truck or air lift. These vehicles would follow pre-selected routes directly to the plant site pre-staging area located by the ANO cooling tower parking lot, or to selected intermediate staging areas (Morrilton and Clarksville Municipal

Airports). The delivery of equipment from the intermediate staging areas would use the same methodology. Helicopter landing considerations have been accounted for in selection of the areas. These areas are designed to accommodate the equipment being delivered from the NSRC.

The NSRC personnel would commence delivery of pre-selected equipment set from the NSRC upon notification of the Strategic Alliance for FLEX Emergency Response (SAFER) Control Center by the plant site. Typically equipment would be transported by truck with preselected routes and any necessary escort capabilities to ensure timely arrival at one of the staging areas. Depending on time constraints, equipment can be flown commercially to a major airport near the plant site and trucked to the staging areas. The use of helicopter delivery is typically considered when routes to the plant are impassable and time considerations for delivery would not be met with ground transportation. Multiple pre-selected routes are one method to circumvent the effects of seismic events, floods, etc. and these routes would take into account potentially impassible areas such as bridges, rivers, heavily wooded areas and towns. The drivers would have the routes marked and would be in communication with the SAFER Control Center to ensure that the equipment arrives on time.

ISE Confirmatory Item 3.1.3.1.A

Confirm that the axis of separation and distance between the portable equipment storage buildings provides assurance that a single tornado will not impact both buildings.

Response

To provide reasonable assurance that at least one of the storage buildings would not be damaged by tornado missiles, the two buildings are separated based on a site specific evaluation and installed on an axis that is approximately perpendicular to the axis of the predominant path for tornadoes in the area of the site. The current building separation is based on an analysis of historical tornado data for the region surrounding the ANO site (ENTGANO83-RPT-001, Rev. 1). Using the tornado widths and paths from National Oceanic and Atmospheric Administration's (NOAA) Storm Prevention Center for 1951 – 2012, tornado data was collected. There were no tornadoes recorded as direct hits at ANO. The analysis considered tornadoes within approximately 70 miles of the site. The predominant paths for tornadoes at ANO are from the SW to the NE, with a few tornadoes going from west to east path. The evaluation of tornado data for the region surrounding the ANO site determined that a separation of approximately 1542 feet provides assurance that a single tornado does not impact both buildings. The ANO storage buildings are located at a distance of over 2,000 ft. from each other to account for other considerations such as available space and accessibility.

ISE Confirmatory Item 3.2.1.B

Confirm that the ANO-2 cooldown analysis supports the delay in the cooldown to eight hours following the ELAP.

Response

The ANO-2 cooldown strategy is in accordance with WCAP-17601. The ANO-2 strategy implements a cooldown and depressurization within two hours into the ELAP event. The eight-hour cooldown delay stated in Enclosure 2 of the ANO First Six Month Report, dated August 28, 2013, was eliminated and no longer considered a coping time under ELAP conditions.

ISE Confirmatory Item 3.2.1.1.A

Confirm that reliance on the RELAP5/MOD2-B&W code in the ELAP analysis for ANO-1, is limited to the flow conditions prior to boiler-condenser cooling initiation.

Response

The ANO-1 strategy relies on the RELAP5/MOD2-B&W code only for determining the time at which the pressurizer empties, as discussed in WCAP-17601-P, Section 5.3.3.1.1.3. For a lowered-loop B&W unit, the code indicates the pressurizer empties at 30,000 seconds (8.33 hours). While level remains in the pressurizer, the RCS is maintained in natural circulation.

A mass balance model was developed specific to ANO-1 in order to develop a strategy that maintains level in the pressurizer (CN-SEE-II-13-4, Rev. 1). The ANO-1 strategy commences RCS makeup (at a rate greater than the RCS losses) by six hours after the start of the event. As the six-hour makeup commences prior to the 8.33-hour emptying of the pressurizer, natural circulation would be maintained.

No reliance on RELAP5/MOD2-B&W code is utilized by the strategy in the boiler-condenser cooling configuration.

ISE Confirmatory Item 3.2.1.1.B

Confirm that the use of CENTS in the ELAP analysis is limited to the flow conditions prior to reflux boiling initiation.

Response

The ANO-2 site specific analysis, CN-SEE-II-13-2, Rev. 1, utilized site specific CENTS cases based upon reference Cases 6 and 8 from WCAP-17601. The principle change from the WCAP-17601 cases for the site specific cases was to use a modified cooldown termination temperature (350 °F). The site specific analysis additionally evaluated the inputs and assumptions from WCAP-17601 for applicability to the FLEX requirements established in NEI 12-06. The results of the ANO-2 specific CENTS analysis determined that two-phase natural circulation conditions occur at approximately 18.5 hours into the ELAP event. RCS makeup would be initiated prior to this time at a rate to ensure single-phase natural circulation is maintained. A sensitivity case was performed with a 20 gpm RCS makeup beginning at 17.5 hours to demonstrate single phase conditions would be maintained (Run #4, logged by Table 6-2 of CN-SEE-II-13-2, Rev 1). ANO-2 strategy would begin RCS makeup via a charging pump prior to 17.5 hours to maintain single phase natural circulation. This strategy would prevent the RCS from departing from single-phase natural circulation. As such, a reflux boiling condition would not be permitted to occur.

ISE Confirmatory Item 3.2.1.2.A

For ANO-1 confirm that the strategy is effective in keeping the RCS temperatures within the limits of the seal design temperatures, and supports the leakage rate (two gallons per minute(gpm)/seal)) used in the ELAP analysis.

Response

The Flowserve white paper (White Paper on the Response of the N-Seal Reactor Coolant Pump (RCP) Seal Package to Extended Loss of All Power) indicated that volumetric flow rate was observed to be held constant throughout the test. This is documented by the following statements from the white paper, "After more than eight hours since the initial heatup, an elastomer failure in the third stage increase the leakage to 1.67 gpm… the 1.67 gpm leakage value held constant during most of the subsequent ~2 hour cooldown and depressurization." For ANO-1, consistent with WCAP-17601-P, a high volumetric leak rate of two gpm per RCP is assumed at the initiation of the planned mitigation strategy. Conservatively, the low leak rate, which occurs after the ANO-1 RCS cooldown and depressurization, is also two gpm per RCP. This is acceptable and conservative, as the assumed ANO-1 constant leak rate is held constant throughout the ELAP event and bounds the N9000 test leak rate observed following elastomer failure and discussed in the Flowserve white paper.

ISE Confirmatory Item 3.2.1.4.A

For ANO-1, confirm the revision to WCAP-17601 used and also confirm whether there are any deviations taken from the assumptions presented in NEI 12-06, Section 3.2.

Response

For ANO-1, the revision of the WCAP-17601 used in the analysis is Revision 1. The assumptions are consistent with those detailed in NEI 12-06, Section 3.2.

ISE Confirmatory Item 3.2.1.8.A

Confirm the acceptability of the ANO-2 shutdown margin results after accounting for the delay in the cooldown to eight hours following an ELAP.

Response

The ANO-2 strategy no longer delays cooldown to eight hours following an ELAP. The ANO-2 strategy implements a cooldown and depressurization within two hours into the ELAP event. Consistent with this strategy, the site specific ELAP analysis (CN-SEE-II-13-2, Rev. 1) indicates shutdown margin would be maintained greater than the 1.0% $\Delta\rho$ acceptance criteria of WCAP-17601. From CENTS results, shutdown margin would be 3.43% $\Delta\rho$ following SIT injection.

ISE Confirmatory Item 3.2.1.9.A

Confirm the adequacy of the RCS injection strategy considering the analysis in licensee Calculation CN-SEE-11-13-2 as it relates to the delay in the ANO-2 cooldown to eight hours following an ELAP.

Response

The ANO-2 strategy no longer delays cooldown to eight hours following an ELAP. The ANO-2 strategy implements a cooldown and depressurization within two hours into the ELAP event. Consistent with this strategy, the site specific ELAP analysis (CN-SEE-II-13-2, Rev. 1) determined that a 20 gpm RCS makeup initiated before 17.5 hours is adequate in order to satisfy RCS inventory control for ELAP events initiated from operating Modes 1 - 4.

ISE Confirmatory Item 3.2.1.9.B

Confirm the final specific times for connection and use of the portable RRC pumps.

Response

NSRC equipment delivery is projected for 24 hours, except in a flood event when the deployment path to site may be flooded for flood persistence time. ANO has no specific time assumed for NSRC equipment as Phase 2 strategy can continue almost "indefinitely". Containment analyses end at 120 hours and show containment pressure slowly increasing, thus providing margin for NSRC equipment repowering of containment coolers beyond flood persistence timeframe. NSRC pumps are a backup to Phase 2 pumps, thus timing is not critical to strategy success.

ISE Confirmatory Item 3.2.3.A

Confirm acceptable results of the ANO-2, containment ELAP analysis after it is completed

Response

The results of Calculation CALC-14-E-0002-01, ANO-2 MAAP Containment Analysis for BDBEE, determined that the peak containment pressure for Modes 1 - 4 is seven psig, while the peak containment temperature for Modes 1 - 4 is 258 °F. The ANO-2 design maximum containment pressure is 59 psig, and the maximum design containment temperature is 300 °F.

The containment response is not analyzed past 120 hours (five days). Containment pressure and temperature may be reduced by repowering the existing containment coolers. For ANO-2, the top flange on any of the large Service Water 2F-6 strainers may be removed and replaced with a pre-fabricated replacement flange with hose connections to provide cooling water flow to the containment coolers in Phase 3.

The containment temperature and pressure do not exceed the design limits and consequently the critical parameter instrumentation meet the qualification requirements necessary for the conditions expected during FLEX.

ISE Confirmatory Item 3.2.4.2.A

Confirm acceptable results of the ANO-2, Main Control Room heat-up calculation after it is performed.

Response

CALC-14-E-0002-03, Rev. 0, concluded that temperatures in the ANO-2 Main Control Room (MCR) do not go above the acceptance criteria of 110 °F (Section 2.7.2.3 of NUMARC 87-00). Maintaining MCR habitability is accomplished by opening Doors 342 and 343 to the MCR by four hours into the transient to allow air flow. Thereafter, a 12,000 cfm portable fan is placed in the doorway of Door 342 to exhaust air from the MCR at 10 hours.

Long-term (i.e., after 120 hours) ventilation and cooling capability would be accomplished by repowering existing safety-related heating, ventilation, and air conditioning (HVAC) equipment, which is protected from BDBEEs. There is margin remaining on the load capacity of the NSRC FLEX diesel generators and low pressure high flow pumps that would be utilized to accommodate re-powering the necessary fans/chiller units and supplying necessary cooling water. As the Technical Support Center (TSC) would be fully staffed prior to 120 hours, the exact equipment combination and loading sequence would be determined by the TSC based on information and resources available at that time.

ISE Confirmatory Item 3.2.4.2.B

Confirm the adequacy of ANO-2 battery room ventilation for extreme temperature protection when the design development is completed.

Response

Since battery cell performance is better at high temperatures and degrades at lower temperatures (< 60 °F), the interest for extreme high temperatures is in the DC charging and distribution equipment, and for extreme low temperatures, the interest is in the battery cells.

For ANO-2, the electrical equipment room Doors 257, 265, 266, 268, 269, 270, and 340 are opened at three hours following the event initiation and a 12,000 cfm fan is placed at Door 340 by 10 hours in order to meet acceptance criteria of 122 °F for extended operation as determined in CALC-14-E-0002-03. However, temperatures in several rooms briefly exceed the 122 °F acceptance criteria before the doors are blocked open at three hours. Per NUMARC 87-00, the equipment in the rooms can be exposed to thermal environments of 150 °F to 300 °F for up to eight hours. The temperature in the DC equipment rooms does not reach 150 °F at any point following the event. Therefore, the short exposure to temperatures above 122 °F is acceptable and the equipment in these rooms is expected to remain operable.

The battery room ventilation fan is repowered from the FLEX PDGs. This fan draws air into the battery rooms and exhausts to the atmosphere to maintain room temperature and to maintain hydrogen concentration acceptably low. Re-powering the fan occurs at the start of Phase 2, which is six hours following an ELAP. The ELAP exhaust path is through the existing exhaust path (i.e., current design). The only dampers in the exhaust flowpath are fire dampers and backdraft dampers. There are no dampers in the flow path that require air supply or electric power to open or close.

During cold weather, the battery rooms (2102 and 2103) would be at normal operating temperature at the onset of the event and the temperature of the electrolyte in the cells would build up due to the heat generated by the batteries discharging and during re-charging. The battery rooms are located internal to the plant, leading to a long time frame required for outside temperatures to cause the electrolyte in the cells to drop to a limiting temperature. Therefore, it is reasonable to assume that the room would remain near the pre-event temperature during the relatively short period of time until the FLEX generators are deployed.

Long-term (i.e., after 120 hours) ventilation and cooling capability would be accomplished by repowering existing safety-related HVAC equipment, which is protected from BDBEEs. There is margin remaining on the load capacity of the NSRC FLEX diesel generators and low-pressure high flow pumps that would be utilized to accommodate re-powering the necessary fans/chiller units and supplying necessary cooling water to them. As the TSC would be fully staffed prior to 120 hours, the exact equipment combination and loading sequence would be determined by the TSC based on information and resources available at that time.

ISE Confirmatory Item 3.2.4.2.C

Confirm the adequacy of calculations for extreme temperature protection regarding ANO-2 TDEFW pump room and electrical equipment rooms, when the design development is completed

Response

Calculations were performed to determine turbine driven emergency feedwater (TDEFW) pump room heat-up out to 120 hours after a BDBEE resulting in an ELAP. The only time the operators need to access the room on a frequent basis is when the RCS is undergoing cooldown, which would occur from hour two to approximately hour five, as documented in CN-SEE-II-13-2, Rev. 1. During that time, the temperature is calculated to be approximately 125 °F. This temperature is deemed acceptable for infrequent occupancy to allow local operation of TDEFW pump controls as required. When access to the TDEFW pump room is required, a course of action would be established based on existing area conditions and in accordance with station procedures to provide protection to personnel from high temperatures.

Following plant cooldown and depressurization, steam generator (SG) makeup would be transitioned to the FLEX SG makeup pump and placed in service no later than 72 hours for ANO-2 if no TDEFW pump room cooling is provided utilizing offsite NSRC resources (i.e., re-powering TDEFW room cooler). Following the transfer of feedwater source, the ANO-2 TDEFW pump would be secured and personnel entry into the TDEFW room is no longer required.

Calculation CALC-91-E-0139-01 determined that the operation of TDEFW pump 2P7A is not challenged by the elevated room temperatures in ANO-2 TDEFW pump room (Room 2024) up to 150 °F. Calculations show that this temperature would not be reached until approximately 108 hours after a BDBEE. The TDEFW pump in Room 2024 would be secured by 72 hours to transition to a portable pump; therefore, no additional actions are required in this room.

ISE Confirmatory Item 3.2.4.4.A

Confirm that upgrades to the site's communications systems have been completed as planned.

Response

Upgrades to the site's communications systems have been completed in accordance with Entergy's Communications Assessment and as evaluated by the NRC staff documented in ADAMS Accession No. ML13127A198.

ISE Confirmatory Item 3.2.4.10.A

For ANO-2, confirm that an acceptable load shedding strategy is developed.

Response

The direct current (DC) loads shed for ANO-2 FLEX strategy are identified in Attachment 7.2 of CALC-14-E-0002-07, ANO-2 FLEX Battery Load Shed Calculation. There are no adverse consequences as a result of shedding these loads. This was confirmed during the development and validation of the FLEX Support Guidelines (FSGs) and supporting procedures.

ISE Confirmatory Item 3.2.4.10.B

For ANO-2, confirm that an acceptable direct current (DC) load profile is developed.

Response

The DC load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling are described in calculation CALC-14-E-0002-07, ANO-2 FLEX Battery Load Shed Calculation.

<u>ISE Confirmatory Item 3.2.4.10.C</u>

For ANO-2, confirm that an acceptable basis for the minimum de bus voltage is determined.

<u>Response</u>

A minimum battery voltage of 105 V for batteries 2D11 and 2D12 is identified in CALC-14-E-0002-07, ANO-2 FLEX Battery Load Shed Calculation. This value was taken from the SBO emergency duty cycle calculation, which identified 1.81 V as the minimum cell voltage (58 cells total).

<u>ISE Confirmatory Item 3.3.2.A</u>

Confirm that acceptable strategies and their bases are developed and maintained in an overall program document, as described in NEI 12-06, Section 11.8, items 1 and 3.

<u>Response</u>

ANO has implemented overall program documents (EN-OP-201 Diverse and Flexible Coping Strategies (FLEX) Fleet Program Document and EN-OP-201-01 ANO FLEX Program Document) for implementation and maintenance of the FLEX strategies in accordance with NEI 12-06 guidance. Existing plant configuration control procedures have been modified to ensure that changes to the plant design, physical plant layout, road, buildings, and miscellaneous structures do not adversely impact the approved FLEX strategies in accordance with NEI 12-06, Section 11.8.

<u>ISE Confirmatory Item 3.4.A</u>

Confirm that the licensee has fully addressed considerations (2) through (10) of NEI 12-06, Section 12.2, Minimum Capability of Off-Site Resources, which requires each site to establish a means to ensure the necessary resources will be available from off-site.

<u>Response</u>

The SAFER Response Plan for ANO (AREVA Document 38-9233737-000) contains information on the specifics of generic and site specific equipment obtained from the NSRC. The document also contains the logistics for transportation of the equipment, staging area set up, and other needs for ensuring the equipment and commodities sustain the site's coping strategies. Off-site equipment would be procured through the SAFER organization. SAFER is aligned with the EPRI templates for maintenance, testing and calibration of the equipment.

Attachment 5 to

0CAN011601

Final Integrated Plan

FINAL INTEGRATED PLAN DOCUMENT

Arkansas Nuclear One Units 1 & 2

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 & 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 United States (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 3.1.1) 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 3.1.2) on March 12, 2012, to implement mitigation strategies for Beyond-Design-Basis External Events (BDBEEs). The order provided the following requirements for strategies to mitigate BDBEEs:

1. Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities following a BDBEE.
2. These strategies must be capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink and have adequate capacity to address challenges to core cooling, containment and SFP cooling capabilities at all units on a site subject to the order.
3. Licensees must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to the order.
4. Licensees must be capable of implementing the strategies in all modes.

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 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 3.1.2) 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 3.1.3), 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 3.1.4), 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 3.1.5) 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 3.1.1).

NEI 12-02 (Reference 3.1.6) 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 3.1.7), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

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

2.1 General Elements

2.1.1 Assumptions

The assumptions used for the evaluations of Arkansas Nuclear One (ANO) Unit 1 (ANO-1) and Unit 2 (ANO-2) ELAP/Loss of Ultimate Heat Sink (LUHS) event and the development of diverse and flexible coping strategies (FLEX) are stated below.

Assumptions are consistent with those detailed in NEI 12-06, Section 3.2.1 (Reference 3.1.3). The recommendations contained within the Executive Summary of the Pressurized Water Reactor Owners Group (PWROG) Core Cooling Position Paper (OG-12-482) and the assumptions from that document are incorporated into the plant-specific analytical analyses.

ANO site-specific assumptions:

- Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 (Reference 3.1.8) have not been completed and therefore have not been assumed in this submittal.
- Exceptions for the site security plan or other (license/site-specific) requirements are addressed in the FLEX Support Guidelines (FSGs).
- Deployment resources are assumed to begin arriving at hour 6 after the event and the site is assumed to be fully staffed by 24 hours.

- A flood of the magnitude of the probable maximum flood (PMF) would be forecasted about five days prior to the flood's arrival at the plant site. It is assumed that at least 24 hours are available for the deployment of FLEX equipment for the preparation for a flooding scenario, and that power is available during this time.

- FLEX connections are assumed to be protected and diverse with respect to the applicable hazards.

- ANO would declare an ELAP within sufficient time to take actions to stage equipment and initiate coping strategies.

- No events or single failures of systems, structures, and components in addition to those presented in NEI 12-06 (Reference 3.1.3) are assumed to occur immediately prior to or during the event, including security events.

- This plan defines strategies capable of mitigating a simultaneous loss of all AC power and loss of normal access to the ultimate heat sink (UHS) resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at all units onsite. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety have been incorporated into the unit's guidance. Each unit's technical specifications (TS) 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 BDBEE may place the site in a condition where it cannot comply with certain TSs and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p) (Reference 3.1.9).

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 containment function, and 3) maintain cooling and prevent damage to fuel in the SFP using installed equipment, onsite portable equipment, and pre-staged onsite resources. This indefinite coping capability would address an extended loss of all AC power – loss of onsite power, emergency diesel generators (EDGs) and any AC source, but not the loss of AC power to buses fed by station batteries through inverters - with a simultaneous loss of access to the UHS. This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a BDBEE.

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 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 developed strategies (FDSs) and 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. During the initial coping period, only installed plant equipment and the normal station operating staff are used to maintain the essential functions of core cooling, containment integrity, and SFP cooling. The duration of Phase 1 at ANO is expected to be less than 6 hours. Six hours accounts for the longest expected time for debris removal and deployment of the first piece of Phase 2 FLEX equipment.

- Phase 2 – Transition from installed plant equipment to onsite FLEX equipment. During the transition phase, onsite FLEX equipment is deployed by the station staff augmented with emergency personnel responding from offsite to maintain essential functions. Phase 2 durations begin once the Phase 2 equipment is deployed and operating to meet plant needs. Note that, while the plant is in Phase 2 because of this deployment, use of installed equipment can be continued. Phase 2 equipment and strategies would continue to be used until no longer required. This could be in as little time as 24 hours (earliest availability of Phase 3 equipment from offsite per NEI 12-06 (Reference 3.1.3) or the Phase 2 equipment could be used indefinitely.

- Phase 3 – Obtain additional capability and redundancy from offsite equipment and resources until power, water, and coolant injection systems are restored. For the long term (indefinite) phase, offsite FLEX equipment from the National Strategic Alliance for FLEX Emergency Response (SAFER) Response Center (NSRC) is deployed to maintain essential functions. Phase 3 durations begin once offsite equipment is deployed and operating to meet plant needs. Phase 3 equipment is assumed to be available as early as 24 hours after the BDBEE or as late as 72 hours after the BDBEE.

The specific duration of each phase is established based on prudent and realistic response times for the station staff to mobilize and implement applicable strategies in a manner that does not inhibit the emergency response. These times ensure that margin exists in maintaining or restoring core cooling, containment, and SFP cooling to accommodate the many unknowns associated with BDBEE.

The strategies described below are capable of mitigating an ELAP/LUHS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at ANO-1 and ANO-2. These pre-planned strategies developed to protect the public health and safety are incorporated into the ANO-1 and ANO-2 EOPs in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

2.3 Reactor Core Cooling and Heat Removal Strategy

The FLEX strategy for reactor core cooling and decay heat removal is to release steam from the steam generators (SGs) using the atmospheric dump valves (ADVs) and the addition of a corresponding amount of feedwater to the SGs via the turbine driven emergency feedwater (TDEFW) pumps. The Emergency Feedwater (EFW) system includes the safety-related qualified condensate storage tank (QCST) as the initial water supply to the TDEFW pumps.

Reactor coolant system (RCS) cooldown and depressurization would be initiated at approximately 8 hours and 2 hours for ANO-1 and ANO-2, respectively.

DC bus load shedding would ensure battery life is extended to at least 9 hours. Prior to battery depletion, a portable generator would repower battery chargers to ensure instrumentation remains available throughout the event.

RCS makeup and boron addition would be initiated by 6 hours and 17.5 hours for ANO-1 and ANO-2, respectively, to ensure natural circulation, reactivity control, and boron mixing are maintained.

2.3.1 Phase 1 Strategy

During a station blackout (SBO) operator actions are currently governed by the applicable SBO procedures. Heat is removed from the core through the SG using the ADVs/main steam safety valves (MSSVs), with the SG being fed by the TDEFW pumps at both units. Following loss of remote control of the ADVs and the TDEFW pumps, local manual action is possible and would be used to continue plant control consistent with procedures. The QCST would supply the initial feedwater inventory for both units. While not a credited strategy, additional feedwater supply may be gravity drained from non-safety-related Condensate Storage Tanks (CSTs) if they are still available after a BDBEE.

ANO-1 currently delays RCS cooldown and depressurization for up to 8 hours (after the initiation of the event) until the RCS inventory control is assured, (ANO-1 does not credit inventory from the core flood tanks (CFTs)). ANO-2 is capable of higher cooldown rates than ANO-1 (ANO-1 is limited due to loss of natural circulation at higher cooldown rates) and can complete the RCS cooldown and depressurization before the need to establish portable SG makeup and installed RCS makeup capability. Therefore, ANO-2 cooldown and depressurization is initiated at 2 hours after the ELAP/LUHS event.

The TDEFW pumps would be utilized by both units to provide feedwater flow from the QCST. The TDEFW pumps are located in the auxiliary building. The auxiliary building is designed to withstand the effects of earthquakes, tornadoes, floods, external missiles, and other appropriate natural phenomena.

The Phase 1 water source for all events is the QCST. The QCST is capable of providing at least 4 hours of EFW supply in the event that it is compromised due to a wind/missile event. Following depletion of condensate sources, the diesel-driven fire pump, P-6B, would be used to provide suction to the TDEFW pumps from the emergency cooling pond (ECP) or Lake Dardanelle.

Power supplied to the TDEFW pump, valve operators, and other necessary support systems is independent of AC power sources. The diesel-driven fire pump starts automatically on loss of AC power and would require valve operation to align the pump's discharge to both units' service water headers, which supply each unit's EFW headers.

The ADVs would be opened in order to remove the steam generated from the SGs and support the natural circulation cooling of the core. For ANO-1, each main steam line, between the reactor building penetration and the corresponding main steam isolation valve (MSIV), is provided with spring-loaded MSSVs and air-operated ADVs which discharge to the atmosphere.

This arrangement permits controlled release of steam for RCS cooldown when the MSIVs are closed. This is accomplished by manual operation either from the control room or by using local operation.

For ANO-2, each main steam line, between the reactor building penetration and the corresponding MSIV, is provided with spring-loaded MSSVs and two sets of ADVs and respective isolation valves. This arrangement permits the controlled release of steam for RCS cooling when the MSIVs are closed. This can be accomplished from the control room or by local operation.

For ANO-1, RCS cooldown and depressurization is delayed until Phase 2.

For ANO-2, beginning at 2 hours into the event, RCS cooldown would be initiated at a rate of 75 °F/hr. Cooldown would stop at an RCS temperature of 350 °F to preclude nitrogen injection into the RCS from the safety injection tanks (SITs) and ensure functionality of the TDEFW pumps. The rapid RCS cooldown minimizes adverse effects of high temperature coolant on reactor coolant pump (RCP) shaft seal performance and reduces SG pressure to allow for eventual feedwater injection from a portable pump in the event that the TDEFW pump becomes unavailable.

Following event initiation, for ANO-2, the decay heat removal and SG/RCS depressurization relies on the EFW system to draw water from the QCST to supply feedwater to the SGs using the TDEFW pump and to depressurize the SGs using the ADVs. For non-missile events, an evaluation (Reference 3.1.43) concluded that the QCST would be exhausted 7 hours following the event. If the QCST is compromised by a missile event, the diesel driven fire pump, P-6B, would be used to provide suction to the TDEFW pumps from the ECP or Lake Dardanelle.

RCS – For Phase 1, ANO-1 contains the RCS inventory and relies upon the initial inventory. ANO-1 requires RCS makeup from an external source. ANO-1 RCS inventory makeup is delayed until Phase 2. For ANO-2, RCS inventory control during Phase 1 relies upon passive injection from the SITs. The SITs volume is adequate to maintain required RCS inventory during Phase 1. For both units, RCS leakage is assumed to be through the RCP seals and the unidentified RCS leakage within the TS limits (See Section 2.3.8).

Electrical/Instrumentation – Load stripping of non-essential DC loads would be completed within 3 hours into the event. This extended load shedding would extend the battery powered monitoring function to at least 9 hours following the event initiation for ANO-1 and ANO-2 station batteries (see Section 0).

2.3.2 <u>Phase 2 Strategy</u>

The transition into Phase 2 for core heat removal would occur as portable resources are utilized to support the Phase 1 strategies. The TDEFW pump is assumed to remain available as long as steam is available for powering the pump and a source of supply water is maintained. In preparation of TDEFW pump unavailability, two diesel-driven FLEX SG makeup pumps (one per unit) would be staged to deliver feedwater to both SGs if the TDEFW pump becomes unavailable.

Prior to depletion of the QCST, a portable diesel-driven pump would be staged to transfer inventory to the QCST from the ECP, or directly to each unit's FLEX SG makeup pump. The qualified backup in the event the QCST is depleted is provided from the ECP via a portable FLEX inventory transfer pump.

Based on the potential timing of staging the FLEX inventory transfer pump in events where the QCST and the borated water storage tank (BWST) maintain their integrity following the BDBEE (non-wind/missile events), the strategy is to backfill the QCST from the BWST utilizing hoses and the FLEX tie-ins identified in Section 2.3.5.3. Backfilling from the BWST provides additional time to stage the FLEX inventory transfer pump and the hose required to transfer water from the ECP to the QCST or to the suction of the FLEX SFP makeup pump, when SFP spray is required. Connection of the BWST to the QCST for a gravity drain backfill increases the coping duration up to 25 hours for the QCST following a BDBEE prior to needing replenishment from the FLEX inventory transfer pump (Reference 3.1.55).

The Phase 2 strategy for core heat removal following a wind/missile event is the same as the one described in Phase 1, using the diesel-driven fire pump, P-6B, taking suction from the ECP or Lake Dardanelle. A means of refilling the QCST would be available following all BDBEEs through existing makeup piping located below the QCST missile barrier. In addition, the FLEX inventory transfer pump may be aligned directly to the suction of the FLEX SG makeup pump or the SFP makeup pump, if necessary.

When sufficient steam pressure is no longer available to drive the TDEFW turbine, two portable, diesel driven pumps (one FLEX SG makeup pump per unit) capable of providing the required feed rate to the SGs would be used. Hoses would be provided to connect the suction of the FLEX SG makeup pump to the QCST tie-in connections and the discharge manifold of the pump to either the primary or alternate tie-in connections in the EFW system.

For ANO-1, the RCS inventory control strategy relies on re-powering one of the three ANO-2 charging pumps from the portable diesel generator and cross-connection of the charging pump to the ANO-1 High Pressure Injection (HPI) System (Section 2.3.5.6).

This strategy is considered an alternate method of compliance because it does not utilize a portable pump per the guidelines of Section 3.2.2(13) of NEI 12-06, Rev. 0. The justification for this alternative method is provided below.

The NRC Order EA-12-049 (Reference 3.1.2) states, "The initial phase requires the use of installed equipment and resources to maintain or restore core cooling. The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources from off site." NEI 12-06 allows for crediting plant installed equipment to meet the guidance as long as there is sufficient diversity. The use of an ANO-2 charging pump for ANO-1 and/or ANO-2 RCS inventory control relies upon portable onsite FLEX equipment. A portable FLEX generator and temporary power cables are required to repower one of three charging pumps through diverse connections. The charging pumps are robust for all BDBEEs. High pressure hoses are used to make the final connections from the new piping connections to the cross-tie header. Though this is considered an alternate approach to the guidance of NEI 12-06, this strategy meets the diversity requirements and therefore, the ANO-1 strategy for RCS inventory control meets the requirements of EA-12-049.

The ANO-1 analysis determined that an RCS makeup of at least 35 gpm at 2100 psia needs to be aligned to the RCS within 6 hours following the initiation of the ELAP. The strategy to connect the ANO-2 charging pump to the ANO-1 HPI system improves the ability to meet the required response time for ANO-1 RCS makeup. The ANO-2 charging pump is provided suction from the ANO-2 boric acid makeup tanks (BAMTs) and then the ANO-2 refueling water tank (RWT), which contain sufficient inventory of borated water to supply both units well into Phase 3. ANO-1 would not commence cooldown until level in RCS is adequate (calculated to require 2 hours of injection). Thus, ANO-1 would initiate RCS cooldown and depressurization at a rate of 20 °F/hour. Cooldown and depressurization would be completed when ANO-1 RCS temperature reaches 350 °F. Two banks of ANO-1 pressurizer heaters are capable of being re-powered from the FLEX portable diesel generator (PDG) to control ANO-1 RCS pressure during Phase 2.

To maintain ANO-2 RCS natural circulation, a makeup flow rate of 20 gpm is provided no later than 17.5 hours following the ELAP. The ANO-2 RCS inventory analysis (Reference 3.1.14) determined that single-phase is maintained until approximately 18.5 hours into the event. This analysis assumed maximum RCP leakage (15 gpm/RCP). Therefore, ANO-2 RCS makeup is provided an hour prior to the loss of single-phase natural circulation so that it is ensured throughout the event. The ANO-2 charging pump would be aligned to provide flow to either ANO-1 through the cross-tie piping or to ANO-2 through the existing charging flow path. Since the strategy for ANO-2 RCS makeup utilizes the normal alignment from the ANO-2 charging pumps to the RCS, there is no discharge tie-in connection required to fulfill the strategy.

The electrical portion of the Phase 2 coping strategy has the main goal of repowering one train of battery chargers for each unit, battery room ventilation fans, ANO-1 pressurizer heaters, one ANO-2 charging pump, and other critical loads.

For ANO-1, the primary connection is to the 480 VAC electrical safety Load Center B5 which can be used to repower one train of battery chargers for each unit, and the alternate connection would be to Motor Control Centers (MCCs) B55, B61, and B65 which can accomplish the same task. For ANO-2, the primary connection would be to the 480 VAC electrical safety Load Center 2B6 which can be used to repower the battery chargers, and the alternate connection would be on the 480 VAC electrical safety Load Center 2B5 which can accomplish the same task. Engineered Safety Features (ESF) Load Centers 2B5 and 2B6 can be cross-tied. By repowering either one of these buses, any one of the three charging pumps can be repowered through MCC 2B52, 2B62, or 2B64.

For both units, this strategy provides train diversity in that provisions have been made to repower the required equipment through different electrical paths should one or the other be out of service. This strategy would require one FLEX PDG to power both units.

The 480 VAC FLEX PDG and the required power cables would be transported from one of the ANO FLEX storage buildings to its deployed position by the post-accident sampling system (PASS) building (Figures 1 and 2).

Deployment and connection of the 480 VAC FLEX PDG from one of the ANO FLEX storage buildings would be completed by 6 hours after an ELAP event. Therefore, by hour six into the event, the 480 VAC FLEX PDG would be supplying power to one ANO-2 charging pump, to ANO-1 pressurizer heaters, and any other FLEX Phase 2 required electrical loads (e.g. battery chargers).

2.3.3 Phase 3 Strategy

The Phase 3 strategy for core cooling and decay heat removal requires an offsite pump capable of removing heat from the reactor core in addition to other loads. The NSRC can provide a low pressure/high flow dewatering pump for this purpose. A booster pump would also be provided by the NSRC to provide additional suction lift as needed. Additionally, a water filtration system, water treatment system (WTS), would be supplied from the NSRC to provide a method to remove impurities from alternate fresh water supplies to the TDEFW pump or the FLEX SG makeup pump.

Using the SGs for core cooling and decay heat removal is dependent on reactor core decay heat generation and the available supply of clean water from onsite sources or from water processing units provided from the NSRC. Restoring the Decay Heat Removal (DHR) system for ANO-1 and Shutdown Cooling (SDC) system for ANO--2 provides an alternate method for removing decay heat and/or cooling down the RCS to cold shutdown. Restoration of the DHR (ANO-1) and SDC (ANO-2) systems requires repowering the DHR pump (ANO-1) and the Low Pressure Safety Injection (LPSI) pump (ANO-2) via an NSRC generator to establish recirculation in the RCS.

The long term borated makeup replenishment strategy is accomplished by taking suction from the intake canal by the NSRC low pressure medium flow (LPMF) pump via four parallel suction hoses. The NSRC would supply two LPMF pumps to ANO, one for each unit. The LPMF pump discharges 500 gpm and is routed to the NSRC WTS. The WTS contains two parallel reverse osmosis skids capable of providing 125 gpm each (250 gpm total) of clean water. The 250 gpm of clean water is routed to two NSRC mobile boration units (MBUs) staged near the WTS while the remaining 250 gpm of waste water is routed to the discharge canal. The MBUs discharge to the NSRC high pressure injection pump (HPIP) which can produce 60 gpm at 2000 psi. The NSRC would supply two HPIPs to ANO, one for each unit. With this strategy, borated water can be supplied to the RWT, the BWST, or the BAMTs depending on the needs of the station.

The Phase 3 NSRC 4160 VAC generators would be located adjacent to the ANO-1 reactor building equipment hatch for ANO-1 and just west of the bowling alley rollup door on ANO-2 turbine building, both on elevation 354'.

2.3.4 Systems, Structures, Components

2.3.4.1 Turbine Driven Emergency Feedwater Pump

An actuation of both trains of Emergency Feedwater Initiation and Control (EFIC) / Emergency Safety Features Actuation System (ESFAS), ANO-1 and ANO-2 respectively, would start each unit's TDEFW pump. Each TDEFW pump is sized to provide the design basis EFW flow requirements. For each unit, the TDEFW pump is located in its auxiliary building and it is protected against the applicable design basis external events. The TDEFW pumps have minimum flow recirculation lines that provide relief from dead heading the pumps. Some portions of these lines are not seismically qualified. Nevertheless, the TDEFW pump minimum flow requirements are never challenged, even if the minimum flow recirculation lines were to be isolated in order to prevent inventory loss from a break in the non-seismic portion of the minimum flow recirculation lines.

2.3.4.2 Steam Generator Atmospheric Dump Valves (ADVs)

During an ELAP/LUHS event with the loss of all AC power and instrument air, reactor core cooling and decay heat removal would be accomplished via the SGs for an indefinite period by removing heat from the SGs via the ADVs. The instrument air (IA) system supplies air to the ADVs. During an ELAP event IA is unavailable to support remote operation of these valves, so operators would switch to manual control of the valves to cooldown the RCS.

2.3.4.3 Batteries

The safety-related batteries and associated DC distribution systems are located within robust structures designed to meet applicable design basis (see Section 2.6.3) external hazards and would 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 9 hours of operation.

2.3.4.4 Safety-Related Condensate Storage Tank (QCST)

The QCST, T-41B, is shared by ANO-1 and ANO-2 and meets the requirements in NEI 12-06 (Reference 3.1.3) for protection from seismic, extreme heat, extreme cold, and flooding events. The QCST is the primary source of condensate supply for the EFW system. For all BDBEE, with the exception of a high wind/missile event, an analysis determined the impact of the cooldown scenario for both units on the QCST. This analysis concluded that the QCST inventory would be exhausted 7 hours following the BDBEE. In case of a high wind/missile event, the bottom 5' of the QCST is protected by a tornado missile concrete shield wall. While this portion of the tank is protected, additional volume is required of the QCST for FLEX following a beyond-design-basis tornado strike. Following a beyond-design-basis tornado missile strike, the QCST must provide sufficient inventory to allow time to manually align the diesel-driven firewater pump, P-6B, FLEX crosstie to EFW suction via service water piping (Reference 3.1.46). The time requirement to align the firewater pump to the EFW suction for both units is approximately 4 hours. An evaluation was performed (Reference 3.1.44) to credit the availability of the inventory in the QCST by applying the tornado wind and tornado missile criteria of NRC Regulatory Guide (RG) 1.76, Rev. 1 (Reference 3.1.24) as an alternate approach to NEI 12-06 (Reference 3.1.3) to meet NRC Order EA-12-049 (Reference 3.1.2). The conclusions of Reference 3.1.44, the results of a drain down analysis (Reference 3.1.58), and the inherent protection of the QCST appendages by the existing 5' missile barrier wall, provide the necessary QCST required inventory to provide the time it takes to align the diesel-driven fire pump, P-6B, to the suction of the TDEFW pumps.

2.3.4.5 ANO-1 Borated Water Storage Tank

The BWST, T-3, meets the requirements in NEI 12-06 (Reference 3.1.3) for protection from seismic, extreme heat, extreme cold, and flooding events. For all BDBEE, with the exception of a high wind/missile event, the inventory of the BWST is backfilled into the QCST to extend the coping duration before requiring the use of the FLEX inventory transfer pump to transfer inventory from the ECP to the QCST. By backfilling the BWST inventory into the QCST, the inventory of the QCST becomes depleted 25 hours following the beginning of its use for SG injection and SFP makeup. Any remaining inventory in the BWST may be used for RCS makeup.

An evaluation was performed (Reference 3.1.44) to show the BWST is robust for FLEX per RG 1.76, Rev. 1. The results of this evaluation concluded that modifications to protect certain appendages were required to ensure that the BWST is sufficiently robust and capable of providing a minimum of 100,962 gallons of borated water for a period of 72 hours following high wind BDBEEs. Given the installed modifications, the BWST can provide sufficient inventory following a BDBEE tornado missile strike.

2.3.4.6 Diesel Driven Fire Pump (P-6B)

The fire protection system, which includes the fire water system, is designed to minimize the effects of fires on plant systems, structures, and components (SSCs). This system has no safety-related functions; however, it has the safety significant function to minimize the effects of fires on plant SSCs. Therefore, the fire protection system is an augmented quality system. The system has three fire water pumps, a motor-driven fire pump (P-6A), a diesel-driven fire pump (P-6B), and a motor-driven jockey pump (P-11). If the QCST is compromised due to a missile strike, the diesel-driven fire pump, P-6B, would be used to provide suction to the TDEFW pumps from the ECP or Lake Dardanelle. The diesel driven fire pump is housed in the seismic Category I intake structure, and is protected from tornado winds and missiles. The diesel-driven fire pump starts automatically on loss of AC power. The diesel driven fire pump has a day tank containing sufficient diesel oil for at least 8 hours of operation and may be refueled.

2.3.4.7 Emergency Cooling Pond

The ECP is located entirely within the site boundary, and comprises an area of approximately 14 acres (Reference 3.1.10). The ECP inventory is protected for all BDBEEs as it is part of the site's UHS and is, therefore, is acceptable for use. Inventory from this source would be used to refill the QCST and the SFP following a BDBEE through the use of a portable diesel-driven pump.

2.3.4.8 ANO-2 Boric Acid Makeup Tanks

Two BAMTs, located on the auxiliary building at elevation 386', provide a source of boric acid solution for injection into the RCS. The BAMTs meet the requirements in NEI 12-06 (Reference 3.1.3) for protection from wind/missile, extreme heat, extreme cold, and flooding events. The tanks are seismic Category I.

2.3.4.9 ANO-2 Refueling Water Tank

The RWT meets the requirements in NEI 12-06 (Reference 3.1.3) for protection from seismic, extreme heat, extreme cold, and flooding events. The RWT is susceptible to tornado missile strikes.

An evaluation was performed (Reference 3.1.44) to show the RWT is robust for FLEX per RG 1.76, Rev. 1. The results of this evaluation concluded that modifications to protect certain appendages were required to ensure that the RWT is sufficiently robust and capable of providing a minimum of 100,962 gallons of borated water for a period of 72 hours following all high wind BDBEEs. Given the installed modifications, the RWT can provide sufficient inventory following a BDBEE tornado missile strike.

2.3.4.10 ANO-2 Charging Pumps

The ANO-2 charging pumps (2P-36A, 2P-36B, or 2P-36C) are positive-displacement pumps and are rated for a constant flow rate of 44 gpm. Each of the charging pumps is tested quarterly to verify their output is between approximately 42 and 48 gpm. The pumps are seismically and electrically robust and protected from flood and wind events. The pumps would be powered by the FLEX PDG.

The FLEX strategy for ANO-1 and ANO-2 credits the use of the ANO-2 charging pumps as the means for RCS inventory control.

2.3.4.11 ANO-1 Pressurizer Heaters

Two banks of ANO-1 pressurizer heaters are capable of being repowered by the FLEX PDG. Repowering two banks of ANO-1 pressurizer heaters would be sufficient to control ANO-1 RCS pressure throughout Phase 2 and Phase 3.

2.3.5 FLEX Modifications

2.3.5.1 Preferred FLEX SG Makeup Pump Discharge Tie-in Connections

For ANO-1, the preferred tie-in connection is located in the EFW pump room (Room 38) on the discharge line of the TDEFW pump P-7A between valves FW-10A and CV-2645 (Figure 3).

For ANO-2, the primary tie-in connection is located in Room 2055 (lower south piping penetration room) of the auxiliary building, on the discharge line of the motor-driven EFW pump 2P-7B, between valves 2CV-1025 and 2CV-1075 (Figure 4).

A hose would be routed from each unit's FLEX SG makeup pump discharge to the primary tie-in connection located inside the auxiliary building. This is a structure with a robust design with respect to seismic events, floods, high winds, and associated missiles satisfying NEI 12-06. Each tie-in connection is capable of providing flow to each SG to support symmetric cooldown and sized for a maximum flow rate of 300 gpm.

2.3.5.2 Alternate FLEX SG Makeup Pump Discharge Tie-in Connections

In the event that the primary FLEX SG makeup pump discharge connection is not available, an alternate tie-in connection location is provided.

For ANO-1, the alternate tie-in connection is located just outside the EFW pump room, on the discharge line of the motor-driven EFW pump P-7B, between valves FW-10B and CV-2646 (Figure 3).

For ANO-2, the alternate tie-in connection is located in Room 2048 (lower north piping penetration room) of the auxiliary building, on the discharge line of the TDEFW pump 2P-7A, between valves 2CV-1026 and 2CV-1076 (Figure 4).

In case the primary tie-in connection is unavailable, a hose would be routed from each unit's FLEX SG makeup pump discharge to the alternate tie-in connection located inside the auxiliary building. This is a structure with a robust design with respect to seismic events, floods, high winds, and associated missiles satisfying NEI 12-06. Each tie-in connection is capable of providing flow to each SG to support symmetric cooldown and sized for a maximum flow rate of 300 gpm.

2.3.5.3 QCST Tie-in Connections

The QCST tie-in consists of a total of four connections. Two connections are for the QCST suction and two for QCST fill. One suction tie-in is located in the north valve pit and the other in the south valve pit on spare lines 2HCC-288-4" and HCC-29-4", respectively. These lines are spare QCST lines that are not used for current plant operation.

Each suction tie-in consists of a Storz connection to allow a hose to be connected to the QCST. Existing valves CS-287 and 2CS-818 provide isolation for the tie-ins. The valve pits are accessible from plant grade elevation adjacent to the QCST. Having a connection in each valve pit provides diversity to ensure that at least one connection for access to the QCST would be available following all BDBEEs.

The QCST fill tie-ins are located in the annulus between the tank and its missile shield wall on spare lines HCC-25-4" and HCC-27-4". The fill connections tie in downstream of existing valves and consist of a check valve and a threaded hose connection. Existing valves CS-283 and CS-284 provide isolation for the new FLEX fill connections. The annulus is accessible via ladder at grade elevation on either the north or south side of the QCST.

2.3.5.4 Installation of Fire Water to Service Water (SW) Cross-tie for Transfer of Inventory to EFW Suction in Phase 1

This cross-tie is needed in the event that the QCST (T-41B) is compromised due to a missile in a high wind BDBEE. Following this event, diesel-driven fire water pump P-6B would be used to deliver adequate suction to the TDEFW pumps for both units (P-7A and 2P-7A) via the service water (SW) system. This cross-tie is part of the Phase 1 FLEX strategy high wind BDBEE that compromises the QCST from a missile strike as it relies only on installed plant equipment. During normal operations, the cross-tie is isolated from the fire water and the SW systems by gate valves. It is only intended that this new piping be used in Phase 1 to provide adequate time to transition to portable pumps. The fire water to SW cross-tie piping is located in the ANO-1 intake structure at plant grade elevation 354'. The cross-tie consists of a SW isolation gate valve (SW-6047) and a fire water isolation gate valve (FS-5700). Five 6" flanged connections are located on the cross-tie in between the isolation valves to provide a Phase 3 connection point into SW for long term plant cooling (Figure 3). Once the FLEX strategy transitions into Phase 3, connection points for a portable pump provided from the NSRC are provided on this cross-tie as a means of re-establishing flow in the SW system, which allows the operation of decay heat removal in Phase 3. This header is designed to provide a maximum flow rate of 3,000 gpm when utilized for Phase 3.

2.3.5.5 Borated Water Storage Tank Tie-in Connection

The BWST tie-in is located above the treated waste tanks (T-16A/B) in the valve gallery accessible from plant elevation 354'. This tie-in has been installed downstream of the BWST (T-3) to provide access to the BWST's borated water inventory. Utilizing hoses, this tie-in may be used to provide flow to the suction of the ANO-2 charging pumps, a portable FLEX pump, and provides the ability to gravity drain the contents of the BWST into the QCST. Gravity draining the BWST into the QCST allows delaying actions of staging a portable pump to refill the QCST. When gravity draining the BWST into the QCST, the tie-in can provide flow up to 267.5 gpm, which bounds the limiting strategy required to refill the QCST (247.5 gpm). This connection is located downstream of the BWST (Figure3).

2.3.5.6 ANO-1 Makeup and Purification (MUP) System Tie-ins for Phase 2 RCS Makeup

The ANO-1 strategy uses the ANO-2 charging pumps and a series of hoses to establish RCS injection. The primary suction sources for the ANO-2 charging pumps are the BAMTs and then the RWT, both of which rely on installed piping. Alternatively, the BWST can be connected to the common suction header of the ANO-2 charging pumps via FLEX tie-ins and hoses. There are two available FLEX connections on the discharge of the charging pumps, both of which can be fed by any charging pump and are sufficient for the RCS makeup requirements.

The MUP tie-ins consist of two tie-in connections that provide RCS injection during FLEX scenarios. These two MUP system tie-ins are installed downstream of the primary makeup pumps. The MUP system tie-ins support RCS makeup and inventory control in all operating modes by providing the ability to inject borated water into the ANO-1 RCS.

The primary connection for RCS injection is located at elevation 335' (Room 57) downstream of the primary makeup pumps and connects to the loop "B" HPI line.

The alternate connection for RCS makeup is located at elevation 360' in the upper north piping penetration room (Room 79) upstream of CV-1220 and connects to the loop "A" HPI line. This creates diversity since the other connection at elevation 335' is located on the primary makeup pump's discharge header and can deliver makeup flow to the RCS through either train.

Both tie-ins provide RCS makeup capability utilizing a portable pump in all plant modes. Each tie-in is designed for the Mode 5 and 6 flow requirements of a maximum flow of 120 gpm, which bounds all RCS makeup requirements. Both tie-ins use the HPI path within the MUP system to inject into the RCS. In Modes 1-4 the tie-ins receive borated water from the ANO-2 charging pumps. Both tie-ins utilize a new FLEX cross-tie pipe.

2.3.5.7 FLEX Charging Pump Cross-Tie Piping

The FLEX charging pump cross-tie piping is located at elevation 335'. The cross-tie begins in ANO-2 Access Area 2040, passes from ANO-2 to ANO-1 through Stairwells 2001 and 1, respectively, and terminates in ANO-1 Access Area 20 (elevation 335'). The cross-tie piping is not connected to any existing plant piping. There are two routes to connect each end of the cross-tie to the respective system (ANO-1 MUP, ANO-2 chemical volume and control system (CVCS)). High pressure hose would be used to connect the cross-tie piping to the tie-ins in both auxiliary buildings. Twenty-five-feet of hose can connect the FLEX charging pump discharge tie-in to the ANO-2 side of the cross-tie or, alternatively, 85' of hose can connect any of the three charging pump drain lines to the cross-tie. Forty feet of hose can connect the primary ANO-1 MUP tie-in at elevation 335' to the ANO-1 side of the cross-tie or, 200' of hose can connect to the alternate ANO-1 MUP tie-in at elevation 360' (Figure 3).

2.3.5.8 ANO-2 Chemical and Volume Control System Charging Pump Suction Line Tie-in

The ANO-2 CVCS charging pump suction tie-in is installed upstream of ANO-2 charging pumps 2P-36A, 2P-36B, and 2P-36C on the suction header located in pump room 2053 at elevation 335'. This tie-in allows access to the borated water inventory from the RWT and BAMTs. This tie-in could potentially be used if the borated water inventory from the RWT or BAMTs is required as the suction source for a portable FLEX pump (Figure 3). Additionally, this tie-in allows suction to be provided to the ANO-2 charging pumps from the BWST or any other available borated water source following a BDBEE via hoses (Figure 3). The suction tie-in is capable of providing the required flow of 44 gpm to one of the charging pumps.

This tie-in consists of an isolated tie-in with either a Storz connection or a standard hose connection which are compatible with the hoses that would be provided from the NSRC.

2.3.5.9 ANO-2 Chemical and Volume Control System Charging Pump Discharge Line Tie-in

The CVCS charging pump discharge tie-in is installed downstream of ANO-2 charging pumps 2P-36A, 2P-36B, and 2P-36C on the discharge header located in pump room 2051 at elevation 335'. This tie-in connects to a cross-tie header and ANO-1 MUP system tie-in (Figure 3).

2.3.5.10 ANO-2 High Pressure Safety Injection System Tie-ins

Primary and alternate tie-in connections are installed in the High Pressure Safety Injection (HPSI) system to provide FLEX strategy capability of RCS inventory control and cooling. To ensure diversity, the primary tie-in connection is installed in the "A" HPSI pump (2P-89A) discharge line and the alternate tie-in connection is installed in the "B" HPSI pump (2P-89B) discharge line. During normal operations, each of these FLEX HPSI tie-ins would be isolated. Each tie-in is capable of providing makeup to the RCS and sized for a maximum flow of 120 gpm. This is based on the flow requirement if a BDBEE were to occur in Mode 5 with SGs unavailable for heat removal, which bounds all FLEX RCS makeup requirements of 120 gpm.

The two HPSI FLEX tie-in connections are located in room 2084 (upper south piping penetration room) of the auxiliary building at elevation 362'. The primary function of these tie-ins is to provide a flow path in lower modes (i.e., Modes 5 or 6). However, these tie-ins are compatible with NSRC equipment and may be used to provide RCS injection in Modes 1 through 4 after NSRC equipment is delivered to the site following an ELAP. The suction sources are identical to those discussed in the ANO-1 injection strategy.

2.3.5.11 Flood Staging Platforms

A new portable platform has been fabricated and is stored in the old SG storage facility area inside the security owner controlled area (SOCA). This portable platform can be erected at a location west of the PASS building and west of the QCST pipe chase within five days warning of a possible external flood BDBEE (Figure 5). The new flood staging platform is designed with a working surface at elevation 363' mean sea level (MSL), to situate the staged equipment above the probable maximum flood (PMF) elevation (elevation 361'), with overall approximate dimensions of 21' x 50'.

A smaller, staging platform is permanently installed near the ECP for staging the FLEX inventory transfer pump for QCST makeup (Figure 6). The new ECP platform is designed with a working surface at elevation 363' MSL, to situate the staged pump above the PMF elevation (elevation 361'), with overall approximate dimensions of 16' x 20'.

2.3.5.12 Post-Accident Sampling System Building Penetrations

New piping penetrations with hose connections on the inside and outside of the PASS building have been installed to provide leak-tight hookups for a flood BDBEE. In addition, for all BDBEEs, pipe sleeve penetrations have been installed to provide access from the PASS building to inside of the ANO-1 auxiliary building.

A total of six capped pipe sections are provided, three of which provide the ability to connect hoses in ANO-2 through the existing personnel access door between the PASS and auxiliary buildings, and three of which provide hose connections to three additional grouted piping penetrations between the PASS and auxiliary buildings on the ANO-1 side in order to pull hoses to ANO-1. These penetrations are normally capped during all current plant operating conditions and have hose adapters that are deployed following a BDBEE (Figure 7).

To feed cables and hoses into the PASS building for a non-flood event, the primary option is to open the main exterior door on the west side of the PASS building and pull the hoses and cable directly inside. As an alternate to opening the PASS building exterior door for the wind/missile or seismic event (in case the door is blocked or jammed), the various grouted piping penetration hose hookups described above are provided in diverse locations on the exterior of the PASS building. As an alternate means of access for cables and hose, two new 12" diameter core bores with missile-plate penetration assemblies have been installed on the south exterior of the PASS building, with centerlines just below elevation 363'-0", to provide normally-sealed openings in the wall that can be opened post-event to pull the necessary cables and hoses into the building.

The strategy provides train diversity in that provisions have been made to repower the required equipment through different electrical paths should one or the other be out of service.

2.3.5.13 Primary and Alternate Electrical Tie-in Connections

Conduit, cable, termination panels, load center, and MCC breakers are installed to implement the electrical infrastructure required to support Phase 2 of the FLEX strategy. Phase 2 has a primary staging location and an alternate staging location for a flood event. The primary Phase 2 equipment staging location is west of the PASS building. The alternate staging location for a flood event is near the same location, but a portable platform is erected at this location (Section 2.3.5.11) to elevate the equipment above the PMF level (361'). A primary 480 VAC PDG connection panel (2TB1010) is installed inside the PASS building for non-flood events. A flood-level connection panel (2TB1011) is installed on the roof of the PASS building to coincide with use of the alternate staging location.

For ANO-1, a new safety-related air circuit breaker has been installed in 480 VAC Load Center B5. The circuit breaker allows a connection point for the FLEX PDG, allowing AC power to be distributed to ANO-1 safeguard loads during Phase 2. Load Center B5 would be utilized as the ANO-1 primary connection point. This connection repowers whichever 125 VDC battery bank (D06 or D07) was utilized during Phase 1, along with other critical loads (a battery room exhaust fan and pressurizer heaters). This allows a battery charger on the B5 bus, either D03A or D03B, to be repowered to charge Class 1E battery bank D07. An existing cross-tie between B5 and B6 allows the repowering of a battery charger on the B6 bus, either D04A or D04B, for Class 1E battery bank D06, if desired. In addition, this breaker would allow additional buses and non-essential loads on those buses to be repowered. The alternative strategy to repower the critical loads is to align the FLEX PDG with three new, dedicated breakers in 480 VAC MCCs B55, B61, and B65 (B-5525, B-6112, and B-6534). ANO-1 and ANO-2 termination panels (TB1113/TB1114 and 2TB1008) are installed in the corridor outside the switchgear rooms on elevation 372' to split the incoming cables from the FLEX PDG and branch them to 1) the load center and three MCCs for ANO-1, and 2) 480 VAC load centers 2B5 and 2B6 for ANO-2.

The ANO-2 approach is similar, utilizing the same connection points mounted on and within the PASS building and providing connections to Load Center 2B5 and 2B6 via spare cubicles (Figure 22). To provide for the repowering of a charging pump for the ANO-1 strategy and the battery charger and other critical loads for the ANO-2 strategy, new breakers are installed in existing spare cubicles located in Load Centers 2B5 and 2B6. New breakers are required to meet ANO-2 Phase 2 FLEX response load requirements. The breaker installed in 2B6 would support the primary strategy, and the breaker installed in 2B5 would support the alternate strategy. The 2B6 load center provides power to the 2P-36B and 2P-36C (swing) charging pumps. The 2B6 load center can also power the 2B5 load center through existing cross-tie breakers. The 2B5 load center provides power to the 2P-36A and 2P-36C charging pumps. As a result, any of the three ANO-2 charging pumps are capable of being powered to support the ANO-1 and ANO-2 FLEX strategies.

2.3.6 Key Reactor Parameters

Instrumentation providing the following key parameters is credited for all phases of the reactor core cooling and decay heat removal strategy when station batteries are available:

- RCS temperatures are adequately monitored by core exit thermocouples (CETs) and SG pressure indication.
- SG levels are adequately monitored using wide range level (ANO-2) and once through steam generator (OTSG) level (ANO-1) indication.
- QCST level indication remains available.

- Adequate RCS level and pressure indications are available. This includes pressurizer level (both units), pressurizer pressure (ANO-2), wide range pressure (ANO-1) and the Reactor Vessel Level Monitoring System (RVLMS) on both units.
- Containment pressure indication remains available.
- Adequate low level neutron flux monitoring is available based on source range instruments. Note that one of the redundant trains in ANO-2 relies on log power rather than source range due to RG 1.97 qualifications.
- Battery capacity by monitoring DC bus voltage remains available based on being directly connected to each DC power panel.
- SFP level indication is provided by a modification to support NEI 12-02 requirements. The design of the level instruments includes its own battery pack that exceeds the time requirement of the extended load shed. An external DC power supply may also be connected to the unit. Cables to connect this external DC power supply to the SFP instrumentation (SFPI) channels are maintained by ANO. Any DC source from 9 to 36 VDC (24 Volts nominal) may be utilized to provide this emergency DC power source (e.g., car battery).

The above instrumentation is available prior to and after load stripping of the DC and AC buses during Phase 1. Availability during Phases 2 and 3 is assured by the strategy to repower the vital 480 VAC buses including the Class 1E battery chargers.

If DC batteries are assumed inoperable, a voltmeter/ammeter is credited for reading the following key parameters for both units (unless noted):

- Wide range SG level and pressure
- Wide range pressurizer level
- Wide range RCS pressure (ANO-1) and pressurizer pressure (ANO-2)
- CET temperature
- CFT level (ANO-1) and SIT level (ANO-2)
- Containment pressure
- QCST level

2.3.7 Thermal Hydraulic Analyses

2.3.7.1 Secondary Analysis

Thermal hydraulic calculations were performed to determine the inventory required to maintain SG levels and times associated with the volumes. The conclusions from this analysis indicated that the existing QCST minimum required inventory of 267,000 gallons would be sufficient to remove the sensible heat and decay heat for approximately 7 hours. If QCST and BWST integrity is maintained following the BDBEE, the QCST is backfilled from the BWST utilizing hoses and the FLEX tie-in connection identified in Section 2.3.5.5. Connection of the BWST to the QCST for a gravity drain backfill results in an increased coping duration for the QCST following a BDBEE. The QCST inventory becomes depleted 25 hours following the beginning of its use for SG injection and SFP makeup.

Backfilling from the BWST to the QCST provides sufficient time to stage the FLEX inventory transfer pump and the hose required to transfer water from the ECP to the QCST or to the suction of the portable SFP makeup pump.

If the QCST is compromised due to a missile event, the diesel-driven fire pump, P-6B, is used to provide suction to the TDEFW pumps from the ECP or Lake Dardanelle.

2.3.7.2 RCS Analysis

ANO-1 is a Babcock and Wilcox (B&W) Pressurized Water Reactor (PWR) with lowered RCS loops and relatively small CFTs. Section 5.3.3.1.1.3 of Reference 3.1.13 provides the generic B&W plant response to a loss of AC power without OTSG cooldown. For the lowered loop (LL) units like ANO-1, the pressurizer empties at about 30,000 seconds (8.33 hours). Shortly thereafter the LL design loses natural circulation. Based on these results, in order to maintain natural circulation, the site specific analysis for ANO-1 (Reference 3.1.12) determined that RCS makeup is required no later than 6 hours following the onset of the ELAP event. This analysis determined that a pump rated for at least 35 gpm at 2100 psia needs to be aligned to the RCS no later than 6 hours following the onset of the ELAP event to support an RCS cooldown. The capacity of any of the three ANO-2 charging pumps exceed the analysis requirements. Each of the ANO-2 positive displacement charging pumps has a capacity of 44 gpm at a maximum discharge pressure of 2735 psig. The pumps are seismically and electrically robust as described in NEI 12-06 and protected from flood and wind events. The FLEX strategy establishes RCS makeup and pressurizer heaters no later than 6 hours following the event. A cooldown at a rate of 20 °F/hr is initiated as early as 2 hours following initiation of RCS makeup (or 8 hours after the commencement of the event).

ANO-2 is a Combustion Engineering (CE) PWR. ANO-2 has a large accessible volume in the SITs and is implementing a cooldown and depressurization strategy consistent with the PWROG core cooling recommendations for the ELAP scenario (Reference 3.1.13). Based on the results of the specific analysis (Reference 3.1.14), natural circulation is maintained until approximately 18.5 hours into the ELAP event. The analysis determined that an RCS makeup of 20 gpm at 200 psia should be initiated no later than 17.5 hours of the event initiation to maintain natural circulation following the event.

For both units, the RCS makeup strategy is initiated at least one hour before the loss of natural circulation, thus reflux boiling is avoided.

The strategy provides flexibility in the methods for ensuring the necessary inventory is provided to each unit. The primary method for verifying the necessary inventory is being supplied via monitoring of the pressurizer level instrumentation in the control rooms. Should the pressurizer level indication be lost, self-powered instruments would be utilized to obtain a reading from the pressurizer level transmitter that can be converted into a level reading.

The following method for controlling the inventory makeup is provided in the FSGs.

A single ANO-2 charging pump would be aligned to either ANO-1 or ANO-2 RCS. Flow would be controlled by valve adjustments monitored by changes in pressurizer levels or strap-on portable flow measurements (timed injection could also be used). Only one unit would be aligned to receive flow at a time. This is an acceptable method as the flow requirements are initially only to ANO-1 until well into the event. At the point ANO-2 requires injection to the RCS, the required flow is low for both units (9 gpm to ANO-1 and 20 gpm to ANO-2). This would allow operation of a single charging pump at any given time because the 44 gpm capacity results in a need to operate the pump for ANO-1 only about 20% of the time and a need to operate the pump for ANO-2 only about 45% of the time, leaving approximately 35% of the time available for adjustment of valve positions. Additionally, both units would have been depressurized. Given the excess volume available in the RCS, alternating flow between the units would not create a safety concern.

2.3.8 Reactor Coolant Pump Seals

For ANO-1, an initial RCS letdown loss of 75 gpm for 10 minutes is assumed in the analysis. RCP controlled bleed-off (CBO) is isolated early following a BDBEE (10 minutes after the event), as directed in the current station blackout procedure (Reference 3.1.41), which effectively terminates the major portion of seal leakage. After CBO isolation, the leak rate assumed in the analysis is 2 gpm/RCP (8 gpm total seal leakage) and 1 gpm representing the Technical Specifications unidentified RCS leakage limit, resulting in 9 gpm total leakage.

For ANO-2, the leak rate assumed in the analysis is a maximum of 15 gpm/RCP (60 gpm total seal leakage) prior to the commencement of the ANO-2 RCS cooldown. The ANO-2 leak rate is dynamically modeled and decreases during the ANO-2 RCS cooldown.

2.3.9 Shutdown Margin Analysis

For ANO-1, Section 5.3.3.1.1.1 of Reference 3.1.13, determined that the shutdown margin (SDM) is preserved, and that the reactor remains more than 1% shutdown; therefore, no return to criticality occurs.

The site-specific ELAP analysis (Reference 3.1.14) determined that ANO-2 has 3.43 $\%\Delta\rho$ SDM at 72 hours into the event and, therefore, no actions are needed to provide additional negative reactivity during an ELAP event for RCS temperatures in excess of 350°F. The analysis indicates that SIT injection alone is sufficient to maintain adequate SDM 72 hours into the event.

A uniform boron mixing model is assumed for both ANO-1 and ANO-2. This model is further discussed in Reference 3.1.15, the PWROG Boron Mixing white paper. To meet the white paper conditions, natural circulation would be maintained for the duration of both ANO-1 and ANO-2 ELAP events. Additionally, at least 60 minutes of margin exists from the time RCS makeup is initiated to the time makeup is no longer required, allowing ample time for complete mixing. RCS makeup would be initiated from the cold legs, and limiting RCP seal leakage is considered.

2.3.10 Flex Pumps and Water Supplies

2.3.10.1 FLEX Inventory Transfer Pump

The FLEX inventory transfer pump performance criteria is 850 gpm (277' total dynamic head (TDH)) and can refill the QCST from the ECP for the duration of Phase 2 (Reference 3.1.49). This pump's discharge line can also be connected to the suction of the portable SFP makeup pump. When SFP spray is required, flow from the FLEX inventory transfer pump is split with 500 gpm provided directly to the SFP makeup pump (250 gpm per unit) and 350 gpm used to refill the QCST (for SG feed). Hydraulic analysis of the flow path from the ECP to the QCST has confirmed that applicable performance requirements are met. The FLEX inventory transfer pumps are a trailer-mounted, diesel-driven pumps that are stored in the FLEX storage buildings. The pump is deployed by towing the trailer to the designated staging location near the ECP.

Based on NEI 12-06, Section 3.2.2, it is acceptable to maintain a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this case, the N+1 could simply involve a second pump of equivalent capability. Two FLEX inventory transfer pumps are available for the site. This meets the N+1 requirement because a single FLEX inventory pump is capable of providing the flow rate required for SFP makeup (including SFP spray) and EFW makeup for both units.

2.3.10.2 FLEX Steam Generator Makeup Pump

Consistent with NEI 12-06, Appendix D, SG water injection capability is provided using a portable FLEX pump through a primary and alternate connection. The FLEX SG makeup pump ratings are 300 gpm (688' TDH for ANO-1 and 716' TDH for ANO-2) (References 3.1.47 and 3.1.48). The FLEX SG makeup pumps are trailer-mounted, diesel engine driven pumps that are stored in the FLEX storage buildings. The portable, diesel-driven FLEX SG makeup pumps (Table 3) would provide a back-up SG injection method in the event that the TDEFW pump can no longer perform its function due to low turbine inlet steam flow from the SGs. Hydraulic analyses have confirmed that the FLEX SG makeup pump is sized to provide the minimum required SG injection flowrate to support reactor core cooling and decay heat removal. Four FLEX SG makeup pumps (two per FLEX storage building) are available to satisfy the N+1 requirement.

2.3.10.3 EFW Water Supplies

Safety Grade Condensate Storage Tank

The QCST (T-41B) provides an EFW water source at the initial onset of the event. The QCST meets the requirements in NEI 12-06 for protection from seismic, high winds, extreme heat, extreme cold, and flooding events. The QCST is susceptible to tornado missile strikes in accordance with the plant's current licensing basis. While the bottom 5' of inventory in the QCST is protected from the design basis tornado missiles due to the presence of a 5-ft tall, concrete shield wall (Reference 3.1.45), additional volume is required of the QCST for FLEX following a tornado missile strike event. Following a BDBEE tornado missile strike, the QCST must provide sufficient inventory to allow time to manually align the diesel-driven firewater pump, P-6B, FLEX crosstie to EFW suction via SW piping (Reference 3.1.46). Section 2.3.4.4 above contains the information about the alternate approach to qualify the QCST as robust during a beyond design basis missile strike event for FLEX purposes only. The QCST volume is maintained greater than or equal to 267,000 gallons per Surveillance Requirement 3.7.6.1 of the Technical Specifications and aligned to provide emergency makeup to the SGs.

Emergency Cooling Pond and Lake Dardanelle

The ECP has approximately 22.8 million gallons of storage capacity and is a source of water for the ultimate heat sink. At a conservative consumption rate of 850 gpm (the transfer pump sizing criteria based on 250 gpm spray to each unit's SFP as well as 350 gpm to account for decay heat at both units), over 18 days of inventory is present within the ECP. The FLEX inventory transfer pump can use this source of water to transfer water from the ECP to the QCST or to the suction of the portable SFP makeup pump. If the QCST is compromised due to a missile strike, diesel-driven fire pump, P-6B, is used to provide suction to the TDEFW pumps from the ECP (or Lake Dardanelle). Lake Dardanelle is the normal source of water for the UHS.

For the TDEFW pumps and QCST, the use of inventory from Lake Dardanelle or the ECP is part of the current licensing basis (References 3.1.10 and 0) and is, therefore, acceptable for use.

For FLEX, non-standard inventory refers to the use of water that has not been demineralized for the purposes of feeding the ANO-1 OTSGs and the ANO-2 SGs. Lake Dardanelle and the ECP are the only non-standard water sources credited for all BDBEEs. Following a BDBEE, these sources of water would be used for SG makeup, which would require interfacing with the QCST, TDEFW pumps, ANO-1 OTSGs, ANO-2 SGs, and Phase 2 FLEX equipment.

For ANO-1, Reference 3.1.37 determined the effects on the heat transfer capabilities using Lake Dardanelle or the ECP water as a long-term source of coolant for the OTSGs. The analysis conservatively assumes that makeup to the SGs is initiated 30 minutes following the BDBEE and continues for 120 hours. The analysis indicated that after approximately 120 hours, the heat transfer capabilities of each SG was reduced by 0.4% and 0.5% using ECP and Lake Dardanelle water, respectively. The OTSGs are designed to remove heat from the RCS at full power conditions. This decrease in heat transfer capability of less than one percent is deemed acceptable as the heat transfer requirements decrease exponentially after shutdown.

For ANO-2, Reference 3.1.38 determined the effects on the heat transfer capabilities using Lake Dardanelle or the ECP water as a long-term source of coolant for the ANO-2 U-tube SGs. The analysis indicated that after approximately 120 hours, the heat transfer capabilities of each SG was reduced by 0.45% and 0.6% when using ECP and Lake Dardanelle water, respectively. Heat transfer reduction of less than one percent is acceptable because the SGs are capable of removing more heat than the minimum required with a one percent heat transfer loss.

2.3.10.4 Borated Water Supplies

The following borated water sources have been evaluated for use during a BDBEE. Each borated water source is discussed below.

ANO-2 Safety Injection Tanks

ANO-2 has large accessible volume in the SITs and is implementing a cooldown and depressurization strategy consistent with the PWROG core cooling recommendations for the ELAP scenario (Reference 3.1.13). Based on this recommendation, ANO-2 would initiate a cooldown 2 hours after the event. ANO-2 does not require RCS makeup early in the event as the inventory from the four SITs is sufficient for RCS makeup during a cooldown. The volume of the ANO-2 SITs is passively injected into the ANO-2 RCS to make up for volume contraction during cooldown and is adequate to maintain required inventory for 17.5 hours.

ANO-1 Borated Water Storage Tank

The BWST is located outside the reactor building and the auxiliary building. The BWST is a seismic Category I tank, but it is subject to wind/missile events. The tank contains a minimum of 2,270 ppm boron in solution. Section 2.3.4.5 above contains the information associated with the alternate approach to qualify the BWST as robust during a beyond design basis missile strike event for FLEX purposes only. The BWST nominal Technical Specification value of 40.2' corresponds approximately to a minimum volume of 370,100 gallons.

ANO-2 Boric Acid Makeup Tanks

Two BAMTs, located in the auxiliary building at elevation 386','provide a source of boric acid solution for injection into the RCS. The BAMTs meet the requirements in NEI 12-06 (Reference 3.1.3) for protection from seismic, wind/missile, extreme heat, extreme cold, and flooding events. The minimum total volume available is 20,358 gallons at a boron concentration of 6,125 parts per million (ppm). The BAMTs are the preferred borated water source for the RCS injection strategies.

ANO-2 Refueling Water Tank

The RWT, located west of the containment auxiliary building, is a 505,000 gallon capacity stainless steel tank. The tank was built to meet seismic Category I requirements, but is subject to wind and missile strikes. Section 2.3.4.9 above contains the information associated with the alternate approach to qualify the RWT as robust during a beyond design basis missile strike event for FLEX purposes only. During Modes 1 through 4, the RWT borated volume is maintained between 384,000 and 503,300 gallons as required by Technical Specifications, at a boron concentration between 2,500 and 3,000 ppm.

ANO-1 Core Flood Tanks

The CFTs are part of the Core Flooding System (CFS) which provides core protection for intermediate and large RCS pipe failures. The CFS is self-contained, self-actuating, and passive in nature. The CFS automatically floods the core when the RCS pressure drops below approximately 600 psig. No credit is taken for injection of fluid from the CFTs. The strategy assumes that these tanks are isolated prior to reduction in RCS pressure due to the CFT cover gas pressure.

2.3.11 Electrical Analysis

The Class 1E battery duty cycle of at least 9 hours for ANO was calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the licensee's FLEX strategy as outlined in the NEI white paper on extended battery duty cycles (References 3.1.53 and 3.1.54). The time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the DC loads is approximately 3 hours for ANO.

The strategy to repower the station's vital AC/DC buses requires the use of one FLEX PDG to power both units. This is in accordance with the N+1 criterion outlined by Section 3.2.2 of NEI 12-06 which states that, "It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site." Based on this criterion, there are two FLEX PDGs stored in the FLEX storage buildings.

The FLEX PDG has a prime duty rating of 800 kW standby.

2.4 Spent Fuel Pool Cooling/Inventory

ANO has two independent SFPs. The pools for both units are similar in design and are not interconnected in any way. The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide makeup water to the SFP sufficient to maintain the normal SFP level.

2.4.1 Phase 1 Strategy

SFP cooling is not challenged early in the event for either unit. The initial coping strategy for SFP cooling is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051. During Phase 1, SFP cooling would be by boil-off of inventory in the pool. SFP makeup is addressed in Phase 2, but during Phase 1 makeup hoses and oscillating monitor nozzles would be staged prior to commencement of boiling to ensure that makeup capability is available for Phase 2.

For ANO-1, for the normal operating decay heat load, the time to boil is 9.15 hours, and for the maximum credible heat load, the time to boil is 3.87 hours. The boil-off rates of 28.10 gpm and 66.50 gpm were determined for normal and maximum decay heat in the SFP, respectively (Reference 3.1.18). These values correspond to a required volumetric flow rate of 27.32 gpm and 64.66 gpm, respectively, to replace any boil-off losses in the SFP using water with coolant properties at 130 °F.

For ANO-2, for the normal operating decay heat load, the time to boil is 4.17 hours, and for the maximum credible heat load, the time to boil is 2.19 hours. ANO-2 SFP has a smaller volume and a higher decay heat load than the ANO-1 SFP. The boil-off rates of 42.92 gpm and 81.73 gpm were determined for normal and maximum decay heat in the SFP, respectively. These values correspond to a required volumetric flow rate of 41.73 gpm and 79.46 gpm, respectively, to replace any boil-off losses in the SFP using water with coolant properties at 130 °F.

2.4.2 Phase 2 Strategy

The Phase 2 baseline capabilities required for SFP cooling are makeup via hoses on the fuel floor (direct makeup), makeup via connection to SFP cooling piping (hardened makeup), and spray capability via monitor nozzles from the refueling floor using a portable pump. The Phase 2 strategy initiates makeup to the SFP without accessing the refueling floor by using the existing SFP cooling piping which discharges into the pool. Hoses from the FLEX storage building are connected from the FLEX SFP makeup pump to the hose connection to provide the required makeup without accessing the refueling floor. Suction to the FLEX SFP makeup pump would be from the available sources of water. The FLEX SFP makeup pump is trailer mounted and would be towed to the staging area by towing vehicles also located within the protected FLEX storage buildings.

2.4.3 Phase 3 Strategy

The long-term phase of the FLEX cooling strategy is reliant on maintaining makeup/boil off as done in Phase 2. NSRC equipment would be used to provide higher quality water as needed to makeup to the SFP until repairs to plant systems or procurement of alternate means of removing SFP decay heat are sufficient to allow the transition from the FLEX equipment to another means of SFP cooling.

2.4.4 Structures, Systems, and Components

2.4.4.1 Hardened Connection

Per NEI 12-06 (Reference 3.1.3), each unit is required to provide the capability to makeup to the SFP via hose makeup, spray makeup using spray monitors on the curb of the pool, and hardened makeup utilizing existing piping without the need to access the SFP deck.

ANO-1 is utilizing the SFP coolers outlet drain SF-1037 to provide a hose connection for hardened SFP makeup following a BDBEE (Figure 3). NEI 12-06 states that makeup needs to exceed SFP boil-off when using hardened SFP makeup strategy.

For ANO-2, the SW system tie-in for FLEX SFP hardened markup is located in Room 2073 (access area) of the auxiliary building. New line 2HBC-194-2" and isolation valve 2SW-158 tie into the existing SW line. Valve 2SW-158 is locked closed and this tie-in is used following a BDBEE in support of the FLEX strategy (Figure 4). Installation of this SW system tie-in satisfies the SFP hardened makeup requirement of the guidance for diverse and flexible coping strategies in NEI 12-06 for SFP cooling.

2.4.4.2 Spray/Hose Connection

One pipe riser has been installed to provide hose makeup and spray for both units. The SFP riser is located in Stairwell 2001 and runs from elevation 354' to elevation 404'. At elevation 354', a hose would be routed from the FLEX SFP makeup pump staging location. At elevation 404' a hose would be routed inside of the SFP area and split into separate hose runs for both SFPs. The SFP Riser begins inside Fire Door 235 with the hose connection 3' above floor elevation. The riser ends inside of Fire Door 308 above the stairs, 7' above floor elevation.

The FLEX SFP riser consists of a 4" pipe to provide SFP spray and hose makeup. A FLEX SFP makeup pump is rated at a minimum of 500 gpm (based on the NEI 12-06, 250 gpm per unit spray requirement) with a total developed head to overcome the 50' of elevation head loss, which satisfies the required input pressure of the spray nozzle, and other line losses. As the capacity of this pump is capable of delivering makeup to both units, only one spare pump would be required.

2.4.4.3 Ventilation

Establishing a vent pathway for steam and condensate from the SFP area is required as a baseline capability of NEI 12-06 (Reference 3.1.3). A vent pathway is required as steam from a boiling SFP can cause access and equipment problems in other parts of the plant. The vent pathway for ANO consists of a low point and a high point opening to the atmosphere to create a stack effect to facilitate the flow of steam out of the SFP area and out of the high point vent. Based on site walk-downs, the FSGs direct that the following doors should be opened for ventilation of the area: 87, 89, 94, 95, 96, 188, 316, 321, the ANO-1 turbine building roof access hatch, and the ANO-2 turbine building roof access hatch. The ANO-1 and ANO-2 turbine building roof access hatches are accessed and opened from within the auxiliary building. Venting of steam to these areas does not adversely impact any equipment relied upon for the ANO FLEX strategies.

2.4.5 SFP Parameters

The key parameter for the SFP makeup 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 (Reference 3.1.5).

2.4.6 Thermal-Hydraulic Analyses

An analysis (Reference 3.1.18) was performed that determined with the normal operating heat load, the SFP would reach a bulk boiling temperature of 212 °F in approximately 9.13 hours and 4.17 hours for ANO-1 and ANO-2, respectively. Assuming 15' of water is needed above the fuel racks for shielding, makeup to the SFP is not required until 47.65 hours for ANO-1, and 24.74 hours for ANO-2, after the event. The FLEX SFP makeup pump is shared between units and is adequately sized to provide necessary makeup flow for both units (500 gpm). Deployment of the FLEX SFP makeup pump from one of FLEX storage buildings within 24 hours would provide makeup to restore the SFP level and maintain an acceptable level of water for shielding purposes.

2.4.7 Flex Pump and Water Supplies

2.4.7.1 FLEX SFP Makeup Pump

The FLEX SFP makeup pump is a 500 gpm pump (320' TDH) (Reference 3.1.50). The FLEX SFP makeup pump is a trailer-mounted, diesel-driven pump that is stored in the FLEX storage building. The pump is deployed by towing the trailer to the designated staging location. The FLEX SFP makeup pump is rated at a minimum of 500 gpm (based on the NEI 12-06, 250 gpm per unit spray requirement) with a total developed head to overcome the 50' of elevation head loss, the required input pressure of the spray nozzle, and other line losses.

Based on NEI 12-06, Section 3.2.2, it is acceptable to maintain a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this case, the N+1 could simply involve a second pump of equivalent capability. Therefore, since the capacity of this pump is capable of delivering sufficient makeup to the SFPs on both units simultaneously, only one spare pump is required. Note that there are two FLEX SFP makeup pumps available for the site (one per FLEX storage building).

2.4.7.2 Safety-Related Condensate Storage Tank (QCST)

The QCST is the primary makeup source of water for the SFP FLEX makeup pump. Boron addition would not be necessary because boil-off of SFP inventory would leave behind/concentrate the boron from that water.

2.4.7.3 Emergency Cooling Pond

The ECP is the secondary makeup source of water for the SFP FLEX makeup pump. Suction from the FLEX SFP makeup pump would be from the QCST with inventory being maintained via the ECP using the FLEX inventory transfer pump, or directly from the latter.

2.4.8 Electrical Analysis

The SFP would be monitored by instrumentation installed by Order EA-12-051. Each instrumentation channel (primary and backup) is independent and powered by two different electrical buses and sources of power. Each instrument has the capability to connect to a source of power independent of the normal AC/DC power system. The instruments have built-in batteries that would enable function for up to seven days following a loss of power. In the event of a complete loss of all AC power, the site would repower the battery charger and other 480 VAC loads within 6 hours of the incident using a FLEX PDG. The extra batteries supplied with each instrument channel provides adequate power to monitor the SFP level during such an event until the 480 VAC buses are repowered, restoring power to the SFPI. An external DC power supply may also be connected to the unit. The battery panels each have a separate DC input that allows connection to a third source of power in the form of a backup DC power source. Cables to connect this external DC power supply to the SFPI channels are maintained by ANO. Any DC source from 9 to 36 VDC (24 Volts nominal) may be utilized to provide this emergency DC power source (e.g., car battery).

2.5 Containment Integrity

With an ELAP initiated while either ANO unit is in Modes 1-4, containment cooling for that unit is lost for an extended period of time. Containment temperature and pressure would slowly increase. Structural integrity of the reactor containment building due to increasing containment pressure would not be challenged during the first 120 hours of an ELAP event.

2.5.1 Phase 1

A containment evaluation was performed based on the boundary conditions described in Section 2 of NEI 12-06. Based on the results of this evaluation, no actions are required to ensure maintenance of containment integrity through Phase 1 for an event which occurs when the SGs are available. Containment venting through an identified penetration or access hatch is required for events which occur when SGs are not available depending on decay heat, RCS temperature, and RCS level at the time of the event.

2.5.2 Phase 2

Phase 2 coping strategy is to continue monitoring containment temperature and pressure using installed instrumentation.

For each unit, a containment evaluation was performed (References 3.1.20 and 3.1.21) based on the boundary conditions described in Section 2 of NEI 12-06. Based on the results of this evaluation, no actions are required to ensure maintenance of containment integrity through Phase 2 for an event which occurs when the SGs are available (RCS in Modes 1-4). The evaluation also indicated that a FLEX event which occurs when the RCS is in Modes 5 or 6, with SGs unavailable, may challenge containment pressure unless a vent path is established. Containment venting through an identified penetration or access hatch is required within 6 hours to relieve containment pressure and ensure that containment pressure or temperature design limits under the assumed worst case boil-off conditions would not be exceeded (see Section 2.5.6 below).

2.5.3 Phase 3

The containment cooler units can be utilized during Phase 3 to maintain containment design parameters indefinitely. Both the ANO-1 and ANO-2 containment coolers are provided cooling water by the SW system. In addition, containment coolers are powered from each safety-related 480 VAC train. By utilizing pre-engineered, temporary modifications following a simultaneous extended loss of AC power and loss of normal access to the ultimate heat sink, flow could be re-established to the containment coolers utilizing the SW system piping. For ANO-2, the top flange on any of the large SW 2F-6 pump strainers may be removed and replaced with a pre-fabricated replacement flange with hose connections. The pre-fabricated replacement flanges are stored onsite. For ANO-1, a new fire water to SW cross-tie is recommended for EFW supply because of missile damage to the QCST, as described in Section 2.3.5.4 of this report. Five blind flanged connections are provided on this cross-tie and used as the connection points for NSRC pump injection for containment cooling. Similar to the case of ANO-2, these flanges may be replaced with pre-fabricated flanges with hose connections.

The valves on the inlet and outlet piping of the containment coolers would need to be manipulated. Needs for containment cooling would be established following the event and the temporary modifications would allow the containment coolers to function using a temporary SW supply.

2.5.4 Structures, Systems, Components

A low pressure / high flow dewatering pump and booster pump from the NSRC would be connected to the connections in the SW headers using pre-fabricated hose adapters.

2.5.5 Key Containment Parameters

Instrumentation providing the following key parameters is credited for all phases of the containment integrity strategy:

- Containment Pressure: Containment pressure indication is available in the main control room (MCR) throughout the event.

2.5.6 Thermal-Hydraulic Analyses

A containment evaluation for ANO-1 and ANO-2 was performed based on the boundary conditions described in Section 2 of NEI 12-06 (References 3.1.20 and 3.1.21). Based on the results of these evaluations, no actions are required to ensure maintenance of containment integrity through Phases 1 and 2 for an event which occurs when the SGs are available (RCS in Modes 1-4). The evaluations indicated that a FLEX event which occurs when the RCS is in Modes 5 or 6, with SGs unavailable, challenges containment pressure and temperature unless a vent path is established. Containment venting through an identified penetration or access hatch is required within 6 hours of the event to relieve containment pressure and ensure that containment pressure or temperature design limits under the assumed worst case boil-off conditions would not be exceeded.

For ANO-1, Reference 3.1.20 concluded that during Modes 5 or 6, containment pressure and temperature limits would not be exceeded if the equivalent area of a 3" diameter vent path is established within 6 hours. Based on the results of this analysis, the containment venting strategy consists of using the existing plant heating piping to establish a vent path between the reactor building and the south piping penetration room. Note that this strategy vents radioactive effluent from boil-off of the RCS to the south piping penetration room.

For ANO-2, Reference 3.1.21 concluded that during Modes 5 or 6 containment pressure and temperature limits would not be exceeded if the equivalent area of a 4" diameter vent path is established within 6 hours. Based on the results of this analysis, the containment venting strategy consists of installing two 3" valves in a portion of a temporary containment seal (Hawke seal) that is used during outages. The valves would only be opened if a BDBEE occurs and containment venting is necessary. The two 3" schedule 40 pipe spools have a combined internal area of 14.786 in^2. The vent path required, based on the analysis (Reference 3.1.21), must have an equivalent area of 12.566 in^2; therefore, the two 3" valves provide adequate venting.

2.5.7 Flex Pump and Water Supplies

The NSRC is providing a low pressure / high flow dewatering pump and booster pump which would be used if required to provide cooling loads. Water supply would be provided by the ECP or Lake Dardanelle.

2.5.8 Electrical Analysis

The Phase 3 coping strategy described above requires power to restore the containment coolers. The 4160 VAC diesel generator being supplied from the NSRC would provide adequate power to meet the starting load conditions for both Phase 2 loads and the specific Phase 3 loads.

2.6 Characterization of External Hazards

2.6.1 Seismic

Per NEI 12-06, all sites are required to consider the seismic hazard. The ANO seismic hazard is considered to be the earthquake magnitude associated with the design basis seismic event.

Per the unit Safety Analysis Reports (SARs) (References 0 and 3.1.10), the seismic criteria for ANO includes two design basis earthquake spectra: operating basis earthquake (OBE) and design basis earthquake (DBE). The site-specific design response spectra define the vibratory ground motion of the OBE and DBE. The maximum horizontal acceleration for the DBE is 0.20g and the OBE has a maximum horizontal acceleration of 0.10g.

Implementation of the FLEX coping strategy is structured to be achievable following a seismic event, including storage and deployment of FLEX equipment, and utilization of installed SSCs that are seismically robust as defined in NEI 12-06. The FLEX storage buildings, and interaction with equipment within, are evaluated for the seismic event per NEI 12-06, Section 5.3.1.1.b. The forces on the building from the plant's design basis earthquake (SSE) are bounded by the forces from the wind loading. Therefore, there is reasonable assurance that the building can withstand a SSE such that equipment within would remain deployable. The conditions of the equipment deployment paths following a BDBEE were assessed (Reference 3.1.60). A subsurface exploration was performed to evaluate the engineering properties of the subsurface soils within the two proposed FLEX storage building sites, NSRC Staging Area (the Phase 3 equipment staging area), and along the travel paths. The potential for soil liquefaction along the equipment deployment paths was determined to be low; therefore, no mitigation or ground improvements were deemed necessary in these areas.

2.6.2 External Flooding

The types of events evaluated to determine the worst potential flood included (1) probable maximum flood (PMF) due to flood flow at Dardanelle Dam yielding a water level at 358' MSL, (2) catastrophic failure of the closest dam upstream of Dardanelle Dam yielding a water level of 361' MSL, and (3) the effect of wind induced waves. The maximum plant site flood level from any cause is elevation 361' MSL. A flood of the magnitude of the maximum probable flood would be forecasted about five days prior to its arrival at the plant site. The plant may be shut down by the time the flood level reaches 354', which is the elevation where flooding of the turbine building would commence. The units would be shut down in accordance with natural emergencies procedures 1203.025 and 2203.008 (References 3.1.63 and 3.1.64) and, during the flood, the operators would maintain the plant in a safe shutdown condition.

The flooding hazard analysis applies to ANO-1 and ANO-2. As a result, the credited FLEX equipment has been evaluated to ensure that the equipment remains accessible and available after a flooding event.

The majority of actions associated with the FLEX strategy are within the ANO-1 and ANO-2 auxiliary buildings. However, several actions require personnel to exit the auxiliary buildings for deploying and staging portable equipment and aligning other components necessary to support the FLEX strategy.

The current licensing basis (CLB) for the combined effects flood mechanism provides five days' notice prior to flooding of the ANO site. For the flood reevaluation, it is assumed that the combined affects also provides five days' notice. The CLB for combined effects is 360.5' MSL with splash effects up to 368' MSL (splash effects are only considered against the face of the auxiliary building and do not apply to the platform faces with very small surface areas when compared to the wall of the auxiliary building). For the ANO FLEX strategy, portable equipment would be pre-staged during the five day period on flood staging platforms. This includes the staging of any required hoses and cables, which would be secured using sandbags. It also includes setup of diesel refueling equipment. As part of the pre-staging for the flood BDBEE, a panel for connecting the temporary cables is located on the roof of the PASS building (elevation 369') and piping penetrations are located on the outer walls of the PASS building for connecting hoses to prevent the need to open the flood door on the PASS building's north wall (see Section 2.3.5.12).

Therefore, in a flood BDBEE, pre-staging of equipment is completed to provide assurance that the FLEX strategy would be successful if implemented. Pre-staging equipment for flooding is considered an alternate method to meet the guidance.

Upon notification of predicted flood conditions at the ANO site, pre-staging of equipment is conducted under the guidance of a model work order. The work order is activated once the natural emergency procedures OP-1203.025 and OP-2203.008 direct the activities to commence. In addition, the Entergy corporate severe weather procedure EN-FAP-EP-010 has generic checklists for preparation of the site for severe weather conditions that may be beneficial as the site commences pre-staging of FLEX equipment. These procedures require notification to the Entergy Corporation headquarters to identify and request additional support equipment. Equipment from the corporation would be dispatched to the ANO site to assist. This equipment includes water vessels capable of moving heavy equipment, supplies, consumables, etc., to areas susceptible to flood waters, at any flood depth or level. This additional equipment would be available to assist in maintenance and refueling of equipment during all conditions as necessary.

In the extreme licensing basis flood there is 5 days of time following initial notification to perform actions to prepare for the flood including the credited pre-staging actions of the FLEX equipment. Station natural emergencies procedures have been revised to reference the model work order for flood preparations that reflect the capabilities of the FLEX equipment and provide for the flood preparation actions to ensure the plant can respond to an ELAP event should one occur in a flood condition. Included in these improvements are the actions that direct the notification to the Entergy Corporation. Activation of the Corporate Emergency Response Center would drive pre-staging the equipment at or near the ANO site that is necessary (airboats, vessels, etc.) to maintain and refuel the FLEX equipment. This equipment is available throughout the Entergy service territory and can be readily delivered to the ANO site in an expeditious manner.

Depending on the actual conditions expected to be experienced during the flooding event the preparation activities would be different (e.g., storm conditions may make pre-staging the backup equipment unadvisable). Nevertheless, the model work order discusses the need to consider the following actions as part of the determination of the correct preparation activities:

1. The use of a portable 20' SeaLand container functioning as a temporary platform. The container can be located in close proximity to the staging location of the portable PASS FLEX platform and is of the same approximate height. Cribbing can be used to ensure a level surface. The interior of the container can be loaded with material (sand, concrete blocks, etc.) to ensure container stability during rising water levels. ISO 1496 is applicable to these containers and these movable devices are constructed and qualified to withstand a minimum 300 psf loading. The FLEX SG makeup pump can be staged on the roof of a SeaLand container (the FLEX PDG would be staged on the PASS FLEX platform). Access to the roof of the SeaLand container can be via a portable ladder. The pump can be secured to the roof using typical rigging solutions and readily available fasteners (chains, straps, etc.). SeaLand containers are readily available on site and the capability to relocate the containers is accomplished with common commercially available equipment.

2. Since both units would shutdown and cooldown in response to rising flood levels, two FLEX SG makeup pumps can accommodate the required flows for this scenario and additional generator capacity can be staged on the PASS FLEX platform. Currently, the strategy stages three pumps and one portable diesel generator on the platform. It is acceptable to remove one pump and replace with an additional diesel generator as the platform can take this load combination and can accommodate the placement of the additional diesel generator.

Therefore, adequate plans are in place to ensure N equipment readiness as well as contingency planning options to replace N equipment with N+1 (or NSRC) equipment using resources supplied by the Entergy Corporation, use of SeaLands as temporary platforms, or reconfiguring the pre-staging of the number of pumps and diesels on the PASS FLEX platform.

The flood staging platforms were designed with a staging elevation of 363' MSL. The CLB splash effects up to 368' MSL are only applicable to a structure with a large surface area to impact, such as the auxiliary or reactor buildings. The flood staging platforms have structural steel members for a wave to impact and do not have to consider the same splash effects as the CLB value.

2.6.3 Severe Storms with High Wind

Figures 7-1 and 7-2 from NEI 12-06 (Reference 3.1.3) were used for this assessment. The ANO site is located at 35° - 18' N (References 3.1.10 and 0, Sections 2.1.1 and 2.2.1, respectively); therefore, ANO is not susceptible to hurricanes based on its location in Arkansas. The plant site is north of the final contour line shown in Figure 7-1 of NEI 12-06 (Reference 3.1.3).

It was determined that the ANO site has the potential to experience damaging winds caused by a tornado exceeding 130 mph. Figure 7-2 of NEI 12-06 (Reference 3.1.3) indicates a maximum wind speed of 200 mph for Region 1 plants, including ANO, which is located at 35°-18' N, 93°-13' W (References 3.1.10 and 0, Sections 2.1.1 and 2.2.1, respectively). Therefore, high wind hazards are applicable to the ANO site.

In summary, (1) based on Figure 7-1 of NEI 12-06, ANO is not susceptible to hurricanes so the hazard is screened out, and (2) based on local data and Figure 7-2 of NEI 12-06, ANO has the potential to experience damaging winds so the hazard is screened in.

NEI 12-06 requires an evaluation of external hazards that are considered credible for a specific site. This includes evaluating storms (e.g., hurricanes, high winds, and tornadoes) for the protection and deployment of FLEX equipment and offsite resources. NEI 12-06, Section 3.2.1.3 also provides the following guidance:

- Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods and high winds, and associated missiles, are available.

- Installed electrical distribution system, including inverters and battery chargers, remain available provided they are protected consistent with current station design.

The definition of "robust" provided in NEI 12-06 is, "The design of an SSC either meets the current plant design basis for the applicable external hazards or has been shown by analysis or test to meet or exceed the current design basis." Therefore, equipment and components that meet the current design basis could be assumed to be available post BDBEE and credited in the FLEX coping strategies.

The ANO-1 and ANO-2 strategy for FLEX requires use of the ANO-1 BWST and/or the ANO-2 RWT. The RWT is not required for safe shutdown after a tornado and was designed for a wind load of 80 mph at 44'-9" above ground (Reference 3.1.10, Section 3.3.1). The BWST is a seismic Class 1 structure required for a safe reactor shutdown (Reference 0, Section 5.1.2). The BWST is only designed for wind loads of 80 mph, (Reference 3.1.59, Section 5.3.3) which is less than the design basis tornado wind speed of 300 mph (Reference 0, Section 5.1.5). Therefore, an evaluation was performed to determine if the tanks are "robust" (per the definition in Appendix A of NEI 12-06) for tornado and tornado missiles for use in the ANO FLEX strategy. NEI 12-06 defines robust as: "Robust (designs): The design of an SSC either meets the current plant design basis for the applicable external hazards or has been shown by analysis or test to meet or exceed the current design basis." When evaluated against current tornado wind and missile design basis for the site, the ANO-1 BWST and ANO-2 RWT do not meet the NEI definition of "robust".

For the CLB, the ANO-1 BWST and ANO-2 RWT are the normal sources for large inventory additions to the respective RCS or SFP. The tanks are located between the two units and are partially protected by the reactor and turbine buildings. Each tank has sufficient capacity to support the FLEX strategy for both units.

The tornado-resistant design of the ANO units was completed prior to the issuance of RG 1.76, Design Basis Tornado and Tornado Missiles for Nuclear Power Plants, (Reference 0, Section 5.1.5, and Reference 3.1.10, Section 3.3.2.1). The current design assumptions used for both units are conservative relative to the criteria of RG 1.76 Revision 1 (Reference 3.1.24). When applying the conservative criteria of the current design basis of the site to the ANO-1 BWST and ANO-2 RWT, the tanks do not meet the NEI definition of "robust".

As an alternative to the NEI 12-06 definition of robust, i.e., the use of current plant design basis, Entergy requested approval of the use of RG 1.76, Revision 1, as the criteria for robust with respect to tornado winds and missiles for the use of the ANO-1 BWST and the ANO-2 RWT for support of ANO FLEX strategies.

To credit the tanks for compliance with EA-12-049, Entergy completed a detailed evaluation (Reference 3.1.44) to confirm and document the "robust" status of the ANO-1 BWST and ANO-2 RWT relative to tornado and tornado missiles consistent with RG 1.76, Revision 1. This evaluation determined that modifications were required to protect certain appendages in the tanks to ensure that the BWST and the RWT are sufficiently robust to provide the required inventory after a wind-missile strike event. The modifications have been implemented; therefore, the tanks are credited to provide sufficient borated water during a wind-missile strike BDBEE.

This evaluation was used only for meeting NRC Order EA-12-049 and does not alter the current design bases of the ANO-1 BWST and ANO-2 RWT. The use of RG 1.76, Revision 1, for this evaluation does not indicate any intent by ANO to alter the site's current design or licensing basis.

The ANO-1 and ANO-2 strategy for FLEX requires use of the QCST. As discussed in Section 2.3.4.4 above, the bottom 5' of the QCST is protected by a tornado missile concrete shield wall. While this portion of the tank is protected, additional volume is required of the QCST for FLEX following a beyond-design-basis wind/tornado strike. Using the same approach as the one described above for the ANO-1 BWST and ANO-2 RWT, Entergy applied RG 1.76, Revision 1, to the QCST to qualify additional water supply through a finite element analysis. In a similar way as described above, this represents an alternative to NEI 12-06 definition of robust. The conclusions of Reference 3.1.44, the results of a drain down analysis (Reference 3.1.58), and the inherent protection of the QCST appendages by the existing 5' missile barrier wall, provide the necessary QCST inventory to provide the time required to align the diesel-driven fire pump, P-6B, to the suction of the EFW pumps.

Portable FLEX equipment stored onsite is protected from tornado winds and missiles per NEI 12-06 guidance.

NEI 12-06, Section 7.3.1.1.c, allows for FLEX storage locations with sufficient separation distance to be designed for local building codes and ASCE 7-10. This section requires that the separation minimizes the probability that a single event would damage all FLEX mitigation equipment such that at least N sets of FLEX equipment would remain deployable following the high wind event, where "N" is the number of units onsite. Designing for tornado winds and tornado missiles is not required with this separation.

Per the evaluation contained in Reference 3.1.24, a reasonable separation distance that bounds a large majority of tornados in the region based on the 90th percentile tornado width and the 1973 – 2012 data is 1,380'. Separation of the storage building locations by this distance provides reasonable assurance that N sets of FLEX equipment would remain deployable for most tornadoes. As an upper bound, the tornado data from 1951 – 2012 provides a recommended separation distance of approximately 1,542'. The actual storage buildings are located at a distance of over 2,000' from each other, perpendicular to the prominent tornado paths, thus exceeding the upper bound separation distance determined in Reference 3.1.24.

2.6.4 Ice, Snow, and Extreme Cold

Per the FLEX guidance, all sites should consider the temperature ranges and weather conditions for the site with respect to storing and deploying FLEX equipment. That is, the equipment procured should be suitable for use in the anticipated range of conditions for the site, consistent with normal design practices.

NEI 12-06 (Reference 3.1.3) states that plants above the 35th parallel should provide the capability to address the impedances caused by extreme snowfall and cold. The ANO site is located at approximately latitude 35°-18' N (References 3.1.10 and 0); therefore, the FLEX strategies consider the impedances caused by extreme snowfall with snow removal equipment, as well as the challenges that the extreme cold temperature may present.

As defined by Figure 8-2 of NEI 12-06 (Reference 3.1.3), the ANO site is not in a Level 1 or 2 region. Therefore, the FLEX strategies consider the hindrances caused by ice storms.

In summary, based on the available local data and Figures 8-1 and 8-2 of NEI 12-06, the hazards of snow, ice, and extreme cold temperatures are screened in for the ANO site.

The extreme low temperature documented in the ANO SAR, -15°F, is used as the initial low temperature in the analysis of tanks (QCST, BWST, and RWT) and the gravity drain hose temperatures. A review of historical meteorological data dating back to 1945 indicated that the lowest 72-hour average temperature ever recorded at nearby Fort Smith, AR, was 6°F. In addition, the historical meteorological data only recorded 9 hours below 0°F. An analysis (Reference3.1.26) was performed using outside temperatures of -15°F and 6°F when the FLEX inventory transfer pump is in service providing makeup from the ECP to the QCST. This analysis determined the minimum flow required through the hoses to prevent freezing.

Operations monitors and records average ECP temperatures once per shift. The minimum allowable average ECP temperature is 34 °F. Based on monitoring the ECP temperature once per shift, and the ability to take mitigating actions on low temperature prior to the ELAP, 34 °F is deemed to be a reasonable and conservative ECP temperature during the extreme cold weather event. Due to the potential for ice formation on the ECP surface, an axe or some other tool would be made available during periods of extreme cold weather in order to puncture the surface ice to allow deployment of the FLEX inventory transfer pump suction line.

The SG makeup provided by the initial volume of fluid in the QCST directly following a BDBEE is assumed to stay above 32 °F. This is a reasonable assumption due to the fact that the fluid in the QCST is maintained at a minimum of 77 °F during normal operations. This fluid would be depleted in 7 hours and the heat transferred from this fluid to the ambient air is not significant enough to induce freezing.

An analysis (Reference 3.1.26) was performed to determine if the water in the BWST and the RWT remains available and unfrozen for the duration of 72 hours at which time equipment from the NSRC would be made available. The analysis assumed that all tanks start at the lowest allowed temperatures during normal operations. This analysis also determined if the flowing water through the hoses remains unfrozen and how rapidly any stagnant water in the hoses would freeze.

The results of this analysis determined that, post BDBEE with an ambient temperature of -15 °F, no freezing occurs in the BWST for a period of 27 hours (the time in which the BWST is no longer required to makeup to the QCST); similarly, no freezing occurs in the RWT for a period of 72 hours.

For the hoses, which have a significantly shorter time to freeze, the analysis was performed for the different hose sizes, lengths, and materials, and were analyzed for both the 6 °F ambient and the -15 °F lowest recorded temperatures. All hoses, with exception of the QCST to SFP makeup pump hose, were found to be adequate given the flow rates provided for the pumps.

In the case of the QCST to SFP makeup pump hose, the limiting scenario for the extreme cold weather event is normal heat loads in the SFP for both units. With an initial ECP temperature of 34 °F, the temperature of ECP water entering the QCST was determined to be above 32 °F with an ambient outside temperature of 6 °F. With this initial QCST temperature, the minimum flow rate required to prevent freezing in the SFP suction hoses is determined to be 87 gpm. Level in the SFP would be monitored by the newly installed SFP level instrumentation. Once the SFP makeup pump has been secured when the level in the pool is close to full, actions would be taken to prevent freezing in the stagnant hoses (i.e., draining the hoses or connecting new hoses). As the level in the SFP decreases due to boil off, additional hoses can be reconnected to the SFP makeup pump to allow makeup from the QCST.

Phase 2 FLEX equipment is stored in the FLEX storage buildings, such that initial exposure to the extreme temperature prior to ELAP would be mitigated. Equipment which cannot tolerate storage in the low temperature conditions has been provided with block heaters.

2.6.5 High Temperatures

Per NEI 12-06 (Reference 3.1.3), all sites are required to address extreme high temperatures. Therefore, for FLEX equipment, the ANO site considered the site maximum expected temperatures with respect to the specification, storage, and deployment requirements, including ensuring adequate ventilation or supplementary cooling, if required. At ANO, the maximum temperature recorded was 115°F.

All Phase 2 FLEX equipment is stored in two FLEX storage buildings such that initial exposure to the extreme temperature prior to ELAP would be mitigated. The FLEX equipment has been procured to function in high temperatures and consideration has been given to the impacts of these high temperatures on equipment storage and deployment.

2.7 Protection of FLEX Equipment

Two pre-engineered metal storage buildings house the portable FLEX equipment used to support Phase 2 of the FLEX response design requirements set for in the NEI 12-06. The buildings are located at a distance of over 2,000' from each other perpendicular to the prominent tornado paths in order to provide adequate tornado separation (see Section 2.6.3). This separation reasonably assures that at least one of the storage buildings would be available following a BDBEE, thereby assuring at least "N" sets of FLEX equipment would be available to respond to the event. Due to this separation, the buildings are not tornado missile protected. Also, the installation of the two FLEX storage buildings does not introduce any new tornado missiles that are not already included in both the ANO-1 and ANO-2 SARs. The buildings are designed to meet local building codes using a service level wind speed of 130 mph.

Section 5.3.1 of NEI 12-06 states that large portable FLEX equipment should be tied down as appropriate and that it should be evaluated and protected from seismic interactions as to ensure that unsecured components do not damage the equipment. An evaluation was performed to determine the minimum separation distance between equipment within the building to ensure that equipment would not interact with each other due to tipping or sliding during a seismic event. Therefore, as long as the large portable FLEX equipment housed in the FLEX storage buildings is stored at a distance equal to or greater than the minimum separation distance, it is not required to be tied down. Tie-down points are provided in the building slab for equipment that may be stored closer together.

Furthermore, the FLEX equipment housed in the FLEX storage buildings is not required to be tied down due to wind. Since the FLEX storage buildings were built to withstand 130 mph winds, NRC RG 1.76, Rev. 1 (Reference 3.1.24), was reviewed to determine the tornado width at which 130 mph winds are predicted to occur. Based on this regulatory guide, the evaluation determined that ANO's FLEX buildings are separated by more than the calculated tornado width at which 130 mph winds (FLEX buildings' wind design criterion) would be predicted to occur in a tornado with maximum 230 mph winds. Therefore, it is concluded that the FLEX equipment staged in ANO's FLEX storage buildings is not required to be tied down (based on potential wind damage) and the FLEX equipment would not be "exposed to the wind" for two scenarios:

1. A tornado takes a path between the FLEX storage buildings such that neither building is impacted by winds greater than 130 mph.

2. A tornado takes a path such that one FLEX storage building and its contents is damaged by tornado winds and the other FLEX building and its contents "survives" based on the separation distance.

Debris removal equipment is also stored inside the FLEX storage buildings in order to be reasonably protected from the applicable external events such that the equipment is likely to remain functional and deployable to clear obstructions from the pathway between the FLEX equipment's storage location and its deployment location(s). This includes mobile equipment such as a front end loader, or tow vehicle, that are stored inside the FLEX storage buildings.

Deployments of the FLEX and debris removal equipment from the FLEX storage buildings are not dependent on offsite power. All actions are accomplished manually.

NEI 12-06, Rev 0, stipulates that provisions for an additional set of portable onsite equipment is essential to provide reasonable assurance that N set of FLEX equipment would remain deployable to assure success of the FLEX strategies. A subset of this portable onsite equipment includes hoses and cables required to implement the FLEX strategies. The N set of hoses and cables are protected from all extreme external hazards. As an alternate approach, an additional length of hoses and cables would be stored with the N set of equipment rather than storing a complete second set in each of the FLEX storage buildings. This spare capability supports the safety functional requirements beyond the minimum necessary to support the N-units onsite, and is consistent with the NRC endorsement (Reference 3.1.56) of the NEI guidance entitled "Alternative Approach to NEI 12-06 Guidance for Hoses and Cables" (Reference 3.1.57).

The additional length of hoses and cables to be stored with the N set of equipment would be the longer of 10% of the total hose/cable run or the longest segment of hose/cable. The 10% criterion extends separately to each size or type of hoses and cables. The hoses and cables utilized by the ANO FLEX strategy are not one continuous hose or cable but rather are composed of smaller sections joined together to form a sufficient length.

This alternate method would be used on the SFP makeup hose for makeup and spray strategies and for the hose used to implement the ANO-2 charging pump to supply makeup to the ANO-1 RCS for inventory control. In these cases the N set of hoses for these strategies would be stored within portions of the auxiliary building at various locations that are robust for all BDBEEs. At least 10% of total hose run is stored in the auxiliary building at various locations that are robust for all BDBEE for the ANO-1 RCS inventory control. Each storage building would contain at least 10% of the total hose run required to implement the spent fuel pool makeup hose for makeup and spray strategies.

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Paths and Accessibility

Pre-determined, preferred haul paths have been identified and documented in the FSGs. Figure 1 illustrates the haul path from each of the FLEX storage buildings to the various deployment locations. These haul paths have been reviewed for potential soil liquefaction and have been determined that soil liquefaction would not preclude FLEX implementation. Additionally, the haul paths attempt to avoid areas with trees, power lines, narrow passages, etc. when practical. However, high winds can cause debris from distant sources to interfere with planned haul paths. Debris removal equipment is stored inside the FLEX storage buildings to be protected from the severe storm and high wind hazards such that the equipment remains functional and deployable to clear obstructions from the pathway between the FLEX storage buildings and the deployment location(s).

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 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 high energy line break (HELB). As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following a BDBEE and subsequent ELAP 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) would be opened and remain opened. This violation of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies.

The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms are barriers of concern. The security force would initiate an access contingency upon loss of the security diesel and all AC/DC power as part of the security plan and security procedures. Access to the owner controlled area, site protected area, and areas within the plant structures would be controlled under this access contingency as implemented by security personnel.

To implement the coping strategies beyond the initial plant capabilities, the pathway would be suitably cleared to allow for the deployment of onsite FLEX equipment between the FLEX storage building(s) and various staging locations. The stored FLEX equipment includes a front end loader to clear obstructions from haul paths and the loaders and heavy duty pickup trucks to tow FLEX equipment from the FLEX storage buildings location to the point of use.

2.9 Deployment of strategies

2.9.1 EFW Makeup Strategy

The FLEX inventory transfer pump would refill the QCST from the ECP for the duration of the Phase 2 coping time using hose connections provided at the QCST. The FLEX inventory transfer pump would be transported from one of the FLEX storage buildings to the staging platform located near the ECP. A hose would be routed from the FLEX inventory transfer pump discharge to the QCST tie-in connection.

If the QCST is compromised due to a missile strike, the diesel-driven fire pump, P-6B, would be used to provide suction to the TDEFW pumps from the ECP or Lake Dardanelle. The fire water system to SW system cross-tie piping is located in the ANO-1 intake structure at plant grade elevation 354' (see Section 2.3.5.4).

The FLEX SG makeup pumps would be transported from one of the FLEX storage buildings to the staging location west of the PASS building. Before the operating conditions of the TDEFW pump cannot be maintained, hoses would be provided to connect the suction of the FLEX SG makeup pump to the QCST tie-in connection. Hoses would then be routed from the FLEX SG makeup pumps' discharges to either the primary or alternate connection for the ANO-1/2 SGs.

The primary and alternate FLEX SG makeup pump discharge connections are located within the seismic Category I, tornado missile protected auxiliary building of each unit. The primary and alternate connection points inject through separate trains of EFW. The FLEX inventory transfer pump and the FLEX SG makeup pumps would be stored in the FLEX storage buildings and are, therefore, protected from the BDBEE hazards identified in Section 0.

2.9.2 RCS Strategy

The FLEX RCS strategy relies on the utilization of the ANO-2 charging pumps for RCS makeup in Modes 1 through 4 (see Section 2.3.7.2) and the utilization of the SG makeup pump for RCS makeup when a unit is in Modes 5 or 6.

The primary suction to the ANO-2 charging pumps is provided by the BAMTs or the RWT. If these tanks are not available, the ANO-2 charging pumps may be aligned to take suction from the ANO-1 BWST utilizing hoses (Figure 3).

For both units, the primary and the alternate RCS tie-in connections are located inside of the auxiliary building (see Sections 2.3.5.6 through 2.3.5.10). Accordingly, these connections are protected against all hazards described in Section 0.

2.9.3 Electrical Strategy

Phase 2 implements an electrical connection strategy that utilizes train diversity. For ANO-1, the primary connection would be to the 480 VAC electrical safety bus B5 and the alternate connection would be to three MCCs B55, B61 and B65 which can accomplish the same task. For ANO-2, the primary connection would be to the 480 VAC electrical safety bus 2B6. An alternate connection would be to electrical safety bus 2B5.

The FLEX PDG and temporary cables would be deployed from one of the FLEX storage buildings and connected to connection points (boxes) on or within the PASS building. One connection box is located on the PASS building roof at elevation 369' and ties into a second connection box inside the PASS building at elevation 354' (see Section 2.3.5.13). The connection box on the roof represents the flood-protection connection point and would be accessed in advance of the flood event via access ladder. The temporary cables from the FLEX PDG staged on the flood protected platform can be pulled up the ladder manually or via rope ties. The second connection box, located inside the seismic Category I missile-protected PASS Building, serves as the primary connection option following a seismic or tornado wind/missile BDBEE.

For all non-flood BDBEEs, the flood door on the west wall of the PASS building would be opened to pull electrical cables from the FLEX PDG to the connection box inside. This door would remain open following non-flood BDBEEs for staging of Phase 2 electrical equipment. In the event a missile strike or seismic event renders the exterior door inoperable, new bolted, water-tight, steel plate penetration assemblies are installed which can be easily unbolted following the applicable event to feed the cables through from the outside of the building, to be pulled through to the connection point inside (see Section 2.3.5.12).

This strategy requires one FLEX PDG to power both units instead of one FLEX PDG per unit. This is in accordance with the "N+1" criteria outlined by Section 3.2.2 of NEI 12-06 which states that, "It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site." Therefore there are two FLEX PDG available on site. Since both proposed MCCs and the related battery chargers and inverters are all Class 1E and installed inside seismic Category I, missile-protected structures, the equipment is assumed to be available following a BDBEE. In addition, the new permanent conduit and equipment required to support this strategy has been designed consistent with the plant's design basis requirements.

For Phase 3, the connection of the NSRC 4kV generator to the existing 4kV electrical bus can be made with temporary cable and connections. The craft would first pull electrical cable through the plant up to switchgear rooms A3 or A4 and 2A3 or 2A4.

Each unit has an identified point for connection of the NSRC 4kV generators, which are capable of powering all unit-specific Class 1E loads for the FLEX strategy. The FLEX PDG (480 VAC, 800 kW) would be stored in the FLEX storage buildings and are, therefore, protected from the BDBEE hazards identified in Section 2.6.

2.9.4 Fueling of FLEX 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, etc. The portable components that rely on diesel fuel are stored with at least 10 hours of fuel supply. Before this fuel supply is depleted, diesel fuel from the onsite, underground, T-57 and 2T-57 diesel fuel oil storage tanks would be utilized to refill FLEX equipment diesel tanks. To remove this diesel fuel, any of the ANO-1 and ANO-2 diesel fuel oil transfer pumps can be utilized. The P-16 diesel fuel oil transfer pumps are powered by 0.5 hp motors and the 2P-16 diesel fuel oil transfer pumps are powered by 2 hp motors. Based on the electrical strategy, each motor can be repowered utilizing the Phase 2 FLEX PDG via the respective MCCs.

Currently, a 2" flanged hose connection is located downstream of the P-16 pumps at isolation valve FO-146 and downstream of the 2P-16 pumps at isolation valve 2ED-44. These connections are utilized normally for cross-connecting the ANO-1 and ANO-2 fuel oil systems and are credited as part of the Phase 2 FLEX strategy. Following a BDBEE, hose(s) would be connected and routed from the connection point either through the upper door (in a flood scenario) or through the lower door (in a seismic scenario) to the Phase 2 staging locations. One of the four pumps may then be repowered and used to transfer fuel to the Phase 2 FLEX equipment. This strategy is manpower intensive, but offsite resources are assumed to be available to implement this strategy at approximately 6 hours following a BDBEE. The earliest time needed to refuel equipment is approximately 9.5 hours after the initiation of the event (to refuel the diesel-driven fire pump).

As the majority of FLEX equipment would be located west of the PASS building, the hydraulic requirements for providing fuel to this FLEX equipment from the P-16 and 2P-16 diesel fuel oil transfer pumps are bounded by the existing hydraulic requirements of those pumps. The P-16 and 2P-16 pumps currently discharge fuel oil to the T-30 and 2T-30 emergency diesel generator (EDG) day tanks located in the EDG rooms in the ANO-1 and ANO-2 auxiliary buildings at elevation 369'. The highest elevation the FLEX equipment would be staged is on the flood platform, which is designed above the 361' CLB probable maximum flood elevation, but below elevation 369' where the existing fuel lines terminate. Therefore, it is reasonable that the P-16 and 2P-16 pumps would provide adequate flow to the FLEX staging area west of the PASS building for refueling FLEX equipment.

As noted in Section 2.3.5.11, a flood platform is constructed in close proximity to the ECP. This platform would be used for staging of the Phase 2 FLEX inventory transfer pump. In addition to the pump, sufficient area on the platform is available to pre-stage sufficient diesel fuel to operate the pump for 72 hours. The diesel fuel would be stored in barrels on the platform. Beyond 72 hours, offsite resources, including boats, could be used to refuel the FLEX inventory transfer pump, if necessary.

In addition, fuel from the diesel fuel oil storage tanks can be transferred to a FLEX trailer mounted 500 gallon fuel tank. After fuel has been transferred to the FLEX trailer mounted fuel tank, the trailer would be transported to supply fuel to Phase 2 portable FLEX equipment which require diesel fuel to operate and not located in the staging area west of the PASS building, as in the case of the diesel-driven fire pump, P-6B. Additionally, smaller fuel caddies with manual pumps are available to be staged with equipment such as the communications diesels, in order to extend run time of equipment having smaller fuel tanks.

The strategy described above for resupplying the diesel powered portable FLEX components involved transferring diesel fuel directly to the components from the diesel fuel oil storage tanks via hoses. If a BDBEE occurs during extreme cold temperatures, the fuel may be susceptible to gelling. Thus a separate strategy, as described below, is utilized during extreme cold ambient temperatures.

The initial fuel supply in the portable FLEX equipment stored in the FLEX storage buildings have chemical additives that lower the cloud point of the fuel below -15°F. Once the initial fuel supply in the portable equipment is depleted (~10 hours), fuel would be transferred from the T-57 and 2T-57 diesel fuel oil storage tanks to portable FLEX fuel trailers via the existing fuel storage hoses. Prior to filling the fuel trailers each time, chemical additives would be poured into the trailers and then the trailers filled with fuel from the vaults to prevent fuel gelling. The fuel trailers would then be transferred to the portable equipment staging locations to refuel equipment. With the use of fuel trailers, the hoses from the T-57 and 2T-57 storage tanks can be returned to the diesel fuel vaults once the fuel trailers have been filled, thus protecting the hoses from the elements and preventing fuel gelling when the hoses are not in continuous use.

For ANO-1, the minimum volume of fuel available in each underground fuel oil storage tanks is 20,000 gallons (Reference 3.1.27, LCO 3.8.3, Surveillance Requirement 3.8.3.1). For ANO-2, the minimum volume of fuel available in each underground fuel oil storage tanks is 22,500 gallons (Reference 3.1.28, LCO 3.8.1.3). For ANO-1, the EDGs are rated at 2600 kW and the ANO-2 EDGs are rated at 2850 kW. Per the ANO-1 SAR, Section 8.3.1.1.7.2, and ANO-2 SAR, Section 9.5.4.1 (References 0 and 3.1.10), there is sufficient diesel fuel in the onsite EDG storage tanks to power a combined ANO-1 and ANO-2 load of 5450 kW for seven days of continuous operation with one fuel oil storage tank per unit unavailable. The following FLEX equipment would be operated following a BDBEE to directly maintain core cooling, containment integrity, and SFP cooling: One 800 kW PDG for both units, one ANO-1 SG makeup pump, one ANO-2 SG makeup pump, one SFP makeup and spray pump, and one inventory transfer pump. Based on the pump specifications in Table 3, the SG makeup pumps are approximately 250 hp, and the SFP makeup and spray and inventory transfer pumps are each approximately 100 hp. Based on the size of the FLEX equipment (800 kW + 700 hp*0.746 kW/hp = 1322 kW), there is sufficient diesel fuel onsite to power the diesel driven FLEX equipment well beyond 72 hours since the combined FLEX equipment load would be well below the rating of a single EDG. After existing plant sources of fuel are exhausted, there would be ample time to have additional fuel provided from offsite resources as necessary during Phase 3.

The emergency preparedness (EP) communications diesel generators total fuel consumption for continuous operation requirement for a 72 hour period is approximately 346 gallons (Reference 3.1.65).

2.10 Offsite Resources

2.10.1 National SAFER Response Center

The industry has established two NSRCs to support utilities during BDBEE. 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 contains five sets of equipment, four of which would be able to be fully deployed when requested. The fifth set allows for equipment to be in a maintenance cycle. In addition, onsite BDBEE 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 would be moved from the NSRC to a local assembly area at either the Morrilton Airport (Charlie Staging Area) or Clarksville Airport (Delta Staging Area) established by the SAFER team. The equipment can be taken to the ANO site Bravo Staging Area (Cooling Tower Parking Lot) or staged at the FLEX Storage Building 1 where it would be deployed to the protected area for final setup. Communications would be established between the ANO plant site and the SAFER team via satellite phones and required equipment moved to the site as needed. First arriving equipment would be delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in ANO's "SAFER Response Plan".

2.10.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE at ANO is listed in Table 4. Table 4 identifies the equipment that is specifically credited in the FLEX strategies for ANO.

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

Following a BDBEE and subsequent ELAP event at ANO, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment would 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. Loss of ventilation analyses were performed to quantify the maximum steady state temperatures expected in specific areas related to FLEX implementation to ensure the environmental conditions remain acceptable for personnel habitability and within equipment qualification limits.

The key areas identified for all phases of execution of the FLEX strategy activities are the MCR, the TDEFW pump room, the auxiliary building electrical equipment rooms, and the SFP area. These areas have been evaluated to determine the temperature profiles following an ELAP/LUHS event.

Spent Fuel Pool Area

Establishing a vent pathway for steam and condensate from the SFP area is required as a baseline capability of NEI 12-06 (Reference 3.1.3). A vent pathway is required as steam from a boiling SFP can cause access and equipment problems in other parts of the plant. The vent pathway should consist of a low point and a high point opening to the atmosphere to create a stack effect to facilitate the flow of steam out of the SFP area and out of the high point vent. The following doors would be opened for ventilation of the area: 87, 89, 94, 95, 96, 188, 316, 321, the ANO-1 Turbine Building Roof Access Hatch, and the ANO-2 Turbine Building Roof Access Hatch.

Main Control Room

For ANO-1, the analysis (Reference 3.1.29) concluded that by performing mitigating actions the temperature in the MCR would not exceed 110 °F for the first 120 hours. These actions are:

- Shedding any permanent lighting in favor of portable lighting 6 hours after the event,
- Opening MCR Doors (64, 65, 66, 67, and 198) 6 hours after the event,
- And staging a fan to supply a minimum of 10,000 cfm of air in the doorway of Door 64 at 10 hours after the event.

For ANO-2, the analysis (Reference 3.1.30) concluded that by performing mitigating actions the temperature in the MCR would not exceed 110 °F for the first 120 hours. These actions are:

- Shedding any permanent lighting in favor of portable lighting 6 hours after the event,
- Opening MCR Doors (Door 342 and 343) no later than 4 hours after the event,
- And placing a 12,000 cfm fan in door 342 to exhaust air from the MCR no later than 10 hours after the event.

Long-term (i.e. after 120 hours) ventilation and cooling capability is accomplished by repowering existing safety-related heating, ventilating and air conditioning (HVAC) equipment, which is protected from all BDBEEs. There is margin remaining on the load capacity of the NSRC FLEX diesel generators and low pressure / high flow pumps that can be utilized to accommodate repowering the necessary fans/chiller units and support supplying necessary cooling water to equipment. Long-term habitability can be assured by monitoring of MCR conditions, heat stress countermeasures, and rotation of personnel to the extent feasible. In addition, FLEX support guidelines provide guidance for control room staff to evaluate MCR temperature and take actions as necessary. Bags containing door stops, rope, and cutting tools are included in the MCR FLEX kit and on mechanical trailers to assist in blocking open doors for the MCR, the SFP area, auxiliary building, etc.

Auxiliary Building

The auxiliary building electrical equipment rooms selected for the analysis are rooms that would have operating equipment required for the FLEX coping strategy (battery rooms, switchgear rooms, MCC room, and DC electrical equipment room). For ANO-1, the analysis (Reference 3.1.29) determined that mitigating actions are required to meet the acceptance criteria for the first 120 hours after the event. These mitigating actions consist of opening a combination of auxiliary building doors (Doors 46, 47, 48, 49, 56, 62, and 480) no later than 10 hours after the event and staging a 10,000 cfm fan at Door 56, exhausting air into the turbine building by 10 hours into the event. For ANO-2, the analysis (Reference 3.1.30) determined that mitigating actions are required to meet the acceptance criteria for the first 120 hours. These mitigating actions consist of opening Doors 257, 265, 266, 268, 269, 270, and 340 no later than 3 hours after the event, and placing a 12,000 cfm fan at Door 340 by 10 hours into the event to exhaust air from the electrical equipment area. Long term (i.e. after 120 hours) ventilation and cooling capability is accomplished by repowering existing safety-related HVAC equipment, which is protected from all BDBEEs. There is margin remaining on the load capacity of the NSRC FLEX diesel generators and low pressure high / flow pumps that can be utilized to accommodate repowering the necessary fans/chiller units and support supplying necessary cooling water to equipment.

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 the Phase 2 FLEX PDG is available and the station Class 1E batteries begin recharging, power is also restored to the battery room ventilation exhaust fans VEF-33 and VEF-34 (ANO-1) and 2VEF-49, 2VEF-61, and 2VEF-65 (ANO-2) to maintain hydrogen accumulation below 1%.

Turbine Driven Emergency Feedwater Pump Room

For ANO-1, Reference 3.1.32 determined the room temperature heat-up within the ANO-1 TDEFW pump room following actuation of EFW and loss of normal HVAC. This calculation determined that the temperature in the EFW pump room does not exceed 120 °F over the duration of the analysis period of 72 hours. A temperature of less than 120 °F is deemed acceptable for infrequent occupancy to allow local operation of turbine-driven EFW pump controls as required. Following plant cooldown and depressurization, SG makeup can be transitioned to onsite portable FLEX SG makeup pump, if necessary, and occupancy of this room would not be required.

For ANO-2, Reference 3.1.33 determined the room temperature heat-up within the ANO-2 TDEFW pump room (Room 2024) following actuation of EFW and loss of HVAC. This calculation (Reference 3.1.33) concludes that the operation of pump 2P-7A is not challenged by the elevated room temperatures in Room 2024 up to 150 °F. The calculation determined that this temperature would not be reached until approximately 108 hours after the BDBEE. The only time the operators need to access the room continually is when the RCS is undergoing cooldown, from hour 2 to approximately hour 5, as documented in CN-SEE-II-13-2 (Reference 3.1.14). During this period of time, the temperature is calculated to be approximately 125 °F (Reference 3.1.33). This temperature is deemed acceptable for infrequent occupancy to allow local operation of TDEFW pump controls as required. Following plant cooldown and depressurization, SG makeup can be transitioned to onsite portable FLEX SG makeup pump, if necessary, and occupancy of this room would not be required.

ADV Penthouse

Continuous, local manual control of the ADVs is not required for operation. Initial cooldown may require frequent valve adjustments and pressure monitoring; however, after the initial transient, ADV position would be effectively constant once SG pressure had been "dialed in" within the desired operating band. Only small, infrequent adjustments would be needed to compensate for changes in decay heat. Calculations (References 3.1.29 and 3.1.30) have been performed to model the worst case ADV area temperature responses following a BDBEE. The results of the calculations show that for ANO-1, the temperatures in the ADV area remain below 128 °F with no compensatory actions up to 120 hours post-event. There are no additional required actions to cope with ADV area temperatures at ANO-1 as the temperatures do not challenge the personnel habitability limits.

For ANO-2, Door 405 is opened no later than 3 hours to mitigate the temperature increase in the ADV room. The ADV penthouse was evaluated with two different cases. The first case evaluated the ADV penthouse with a 49 ft^2 ventilation path opened in the roof at 24 hours following a BDBEE, and the second case evaluated the ADV penthouse without the opened roof ventilation path. In both cases, Door 405 is opened at 3 hours. In both cases, the peak temperature in the ADV penthouse remains below the acceptance criteria for personnel habitability of 150 °F. This limit is consistent with the existing design basis under NFPA-805 (Reference 3.1.61). The acceptance criteria for personal habitability for short intervals of exposure is 150 °F, which is derived from an aero medical laboratory report titled "Human Tolerance for Short Exposures to Heat" (Serial No. TSEAL-3-695-49A) (Reference 3.1.62). As discussed above, long term SG pressure control by manual ADV operation is not expected to require continuous operator action.

2.11.2 Heat Tracing

The ANO FLEX Strategy does not depend on heat tracing for any required equipment after the initiation of the event. The FLEX equipment is protected from low temperatures and freezing using block heaters where required.

2.12 Personnel Habitability

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

2.13 Lighting

Lighting during Phase 1 would be limited to the 6-hour battery backed emergency lights and portable flashlights and lanterns.

Phase 2 equipment includes portable diesel-powered light towers and LED battery operated lighting with 12-18 hour battery life before recharging attached to the pumps. Portable flashlights and helmet lights would be required for work in some areas of the plant (limited to indoor areas where lighting was not determined to be vital).

2.14 Communications

ANO has communications capabilities with offsite response organizations (OROs), the NRC, between emergency response facilities (ERFs), with field and offsite monitoring teams, and with in-plant and offsite emergency response organization staff. An assessment of communications assuming a large-scale natural event, which would lead to an extended loss of all AC power (References 3.1.34 and 3.1.35) was performed. As part of this assessment, ANO identified enhancements/changes to maintain communications capabilities for responding to emergency events.

As an interim measure prior to the implementation of all planned enhancements, Entergy has distributed hand held and deployable satellite phones to the technical support center (TSC), operations support center (OSC), control rooms, and emergency operations facility (EOF). Additional radios and spare batteries for both radios and SAT phones have been purchased for the site and staged in the ERFs. This purchased equipment would be used in conjunction with existing satellite phones and site radios. The radios are able to function without repeaters; however, three designated onsite repeaters (Operations ANO-1, Operations ANO-2 and

Maintenance/In Plant Emergencies) have backup power via uninterruptible power supplies (UPS) and portable diesel generators. User aids are stored with the satellite phones, and there is an existing staff familiarity with the radios. The satellite phones and radios are stored in hardened/cushioned cases or storage lockers for protection.

If a seismic or wind event damages the radio repeater antenna used for areas outside the power block that is located on top of the administration building, a backup radio repeater antenna can be staged in a short time frame by security personnel. The replacement antenna, mounting pole, spare cable and tools are mounted in a protective box on the 6th floor penthouse area for rapid deployment to a new antenna base mount located just south of the AC unit.

Entergy plans ensure that portable satellite telephones or radio communications are available for each communication link outlined in Section 4 of NEI 12-01 (Reference 3.1.36). Communications between ERFs would use both satellite phones and radios. Enhancements to equipment protection, such as anchoring equipment to prevent impacts from a seismic event, have been completed to help ensure that the equipment is available following a large-scale natural event. Entergy has implemented improvements for communications with OROs, by ensuring each organization has a portable satellite phone.

The communications equipment would be available after a large-scale natural event and stored in a reasonably protected area from seismic, flooding, and high-wind events as discussed in NEI-12-01. FLEX auxiliary equipment, such as batteries, is also reasonably protected from seismic, flooding, and high-wind events.

A combination of batteries and UPSs to power site communications equipment including satellite phones, radios, and extra batteries for this equipment is available. The site strategies include 1) each satellite phone is provided with a 24-hour power supply capability through batteries, 2) radios are provided for a 24-hour power supply capability through batteries, and 3) UPS units provide 24 hours of back-up power for three critical radio repeater systems (ANO-1 Operations, ANO-2 Operations, and Maintenance). Portable diesel generators supporting the MCRs, TSC, OSC, Generation Support Building (GSB), and EOF are distributed prior to 24 hours by augmented staff to ensure communications equipment is recharged or directly operated off the AC power.

Communications between Entergy ERFs would also utilize radios in addition to portable satellite phones.

2.15 Water sources

2.15.1 Secondary Water Sources

Section 2.3.10.3 provides a list of credited water sources that may be used to provide cooling water to the SGs, and/or to refill the QCST. Other sources of water that are not credited but may be used, if available after a BDBEE, are:

- The ANO-1 and ANO-2 CSTs,
- The ANO-1 and ANO-2 reactor makeup water tanks (RMWTs), and
- The raw water holdup tank

Section 2.3.10.4 provides a list of credited borated water sources that may be used to provide RCS makeup. Other sources of borated water that are not credited but may be used, if available after a BDBEE, include the ANO-1 boric acid addition tank (BAAT).

2.16 Shutdown and Refueling Strategy and Analysis

ANO would abide by the NEI position paper entitled "Shutdown/Refueling Modes" addressing mitigating strategies in shutdown and refueling modes. This position paper is dated September 18, 2013 (Reference 3.1.39), and has been endorsed by the NRC staff (Reference 3.1.40).

For ANO-1 during operation in Modes 5 and 6 with the SGs not available, RCS makeup would be provided using either the tie-in located upstream of CV-1220 (Section 2.3.5.6) or the tie-in located on elevation 335'. The ANO-1 SG makeup pump and hoses would be utilized to provide the RCS makeup.

For ANO-2 during operation in Modes 5 and 6 with the SGs not available, RCS makeup would be provided using either the tie-in connection located in the discharge line of HPSI pump A or the tie-in connection located on the discharge line of HPSI pump B (Section 2.3.5.10). The ANO-2 SG makeup pump and hoses would be utilized to provide RCS makeup.

Decay heat removal, inventory control, and reactivity control for Phase 2 with the plants operating in Modes 5 or 6 are all accomplished by injecting borated water from the ANO-2 RWT, ANO-2 BAMT, or ANO-1 BWST into the RCS using the FLEX SG makeup pump (Figures 3 and 4).

The initial makeup requirements to the RCS for boil off in Mode 5 with SGs unavailable are a maximum of 100 gpm and 120 gpm for ANO-1 and ANO-2, respectively (References 3.1.12 and 3.1.14), to prevent both spill of makeup fluid and precipitation of boric acid. However, the RCS makeup flow rates are reduced 72 hours following a BDBEE to approximately 71.5 gpm and 91 gpm for ANO-1 and ANO-2, respectively. This equates to an average flow rate required for the first 72 hours following a BDBEE of 80 gpm and 100 gpm for ANO-1 and ANO-2, respectively (Reference 3.1.46).

In operating Modes 5 and 6, plant operating procedures require that containment be manually isolated following the event. Thus, the containment is assumed to be isolated following the event while in shutdown, which results in a more conservative condition for mitigating the consequences of the event. Following the event, with the reactor scrammed and containment isolated, the containment pressure and temperature would begin to slowly increase due to reactor coolant leakage and direct heat transfer from the RCS. Thus, the containment building would eventually need to be vented to reduce pressure. Containment building evaluations for both units (References 3.1.20 and 3.1.21) determined that a vent path is required (see Section 0) within 6 hours into the event to maintain containment pressure under the design limits.

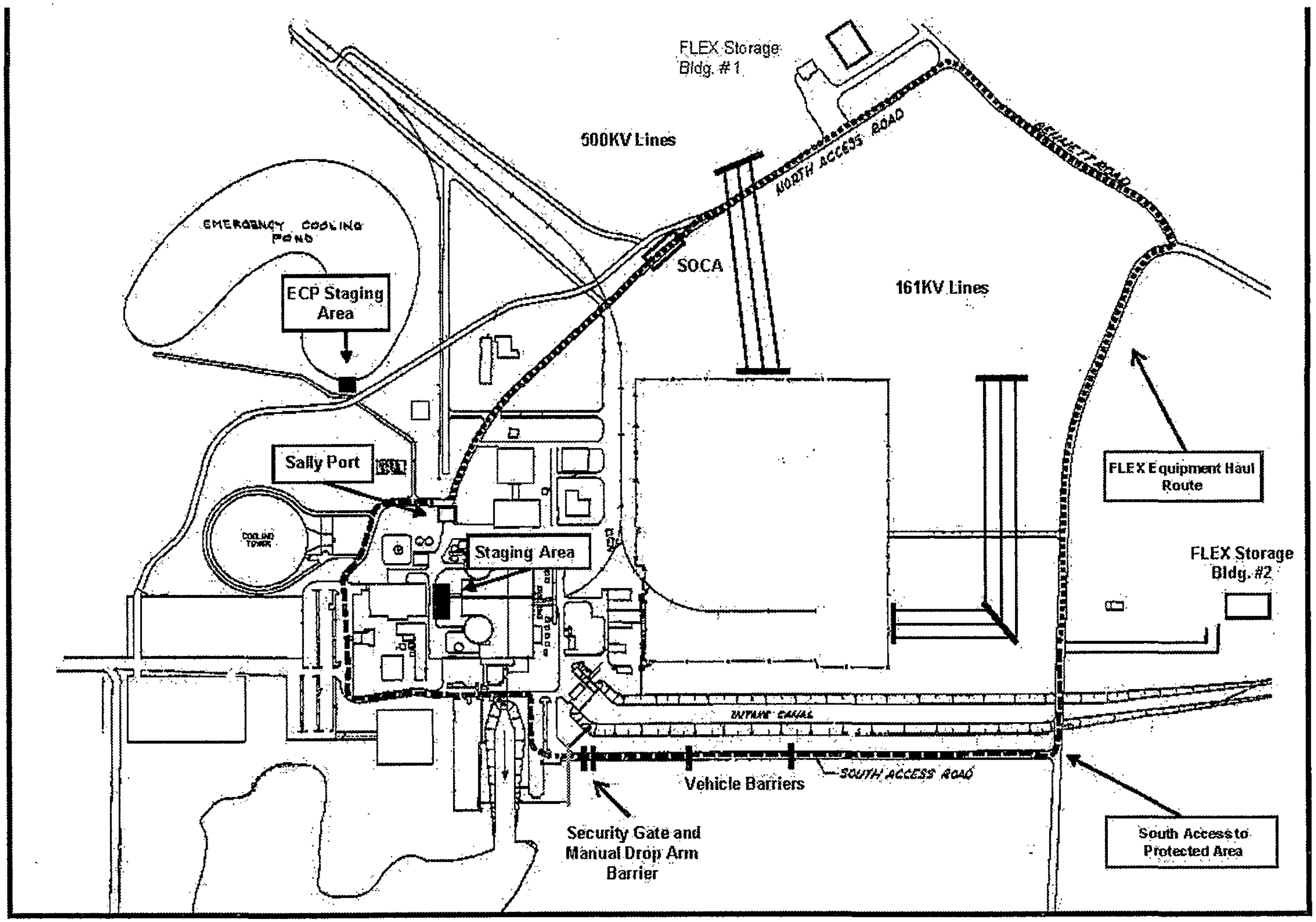

Figure 1: Site Deployment Pathway

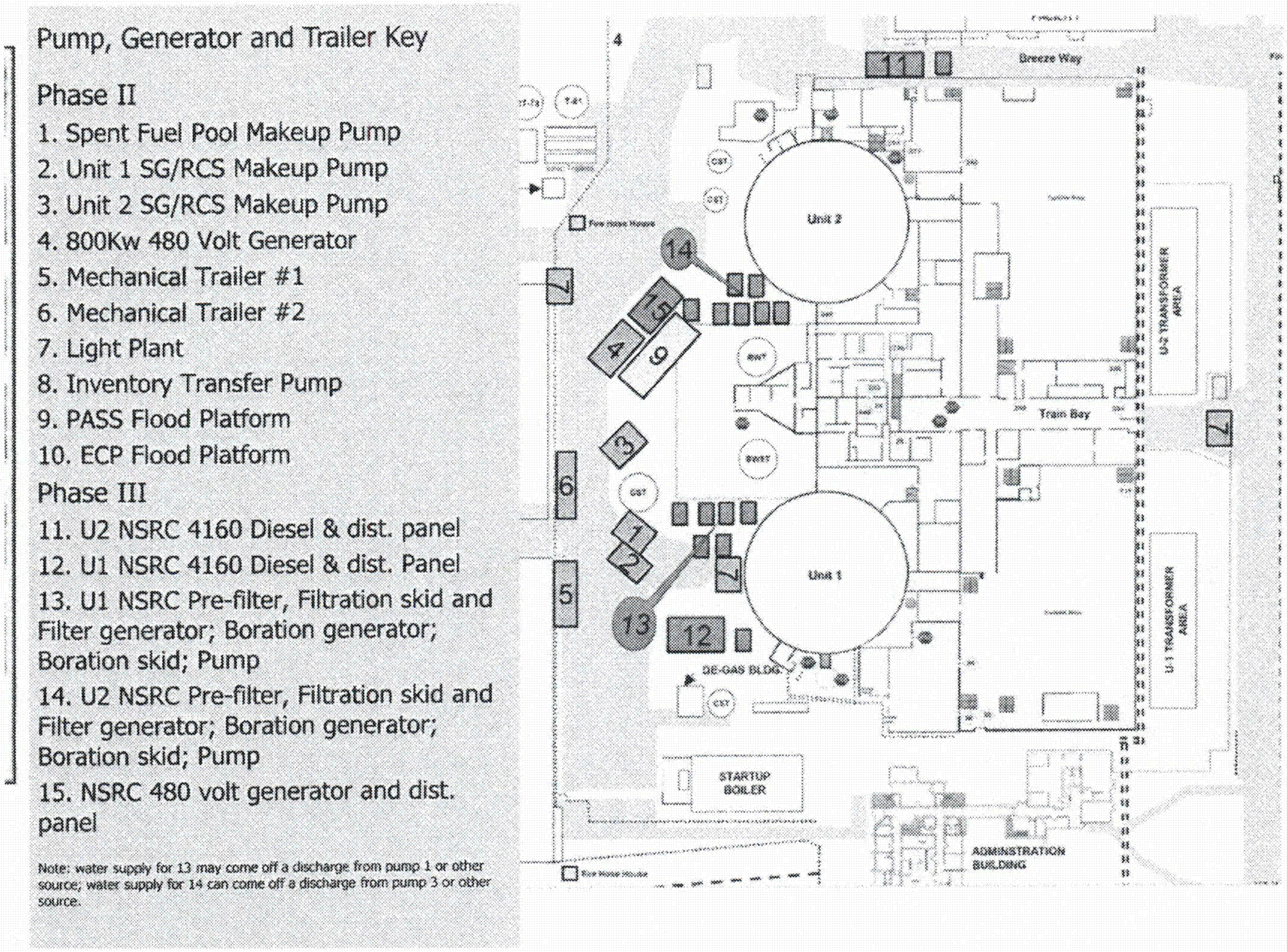

Figure 2: Phase 2 and Phase 3 FLEX Equipment Staging Area

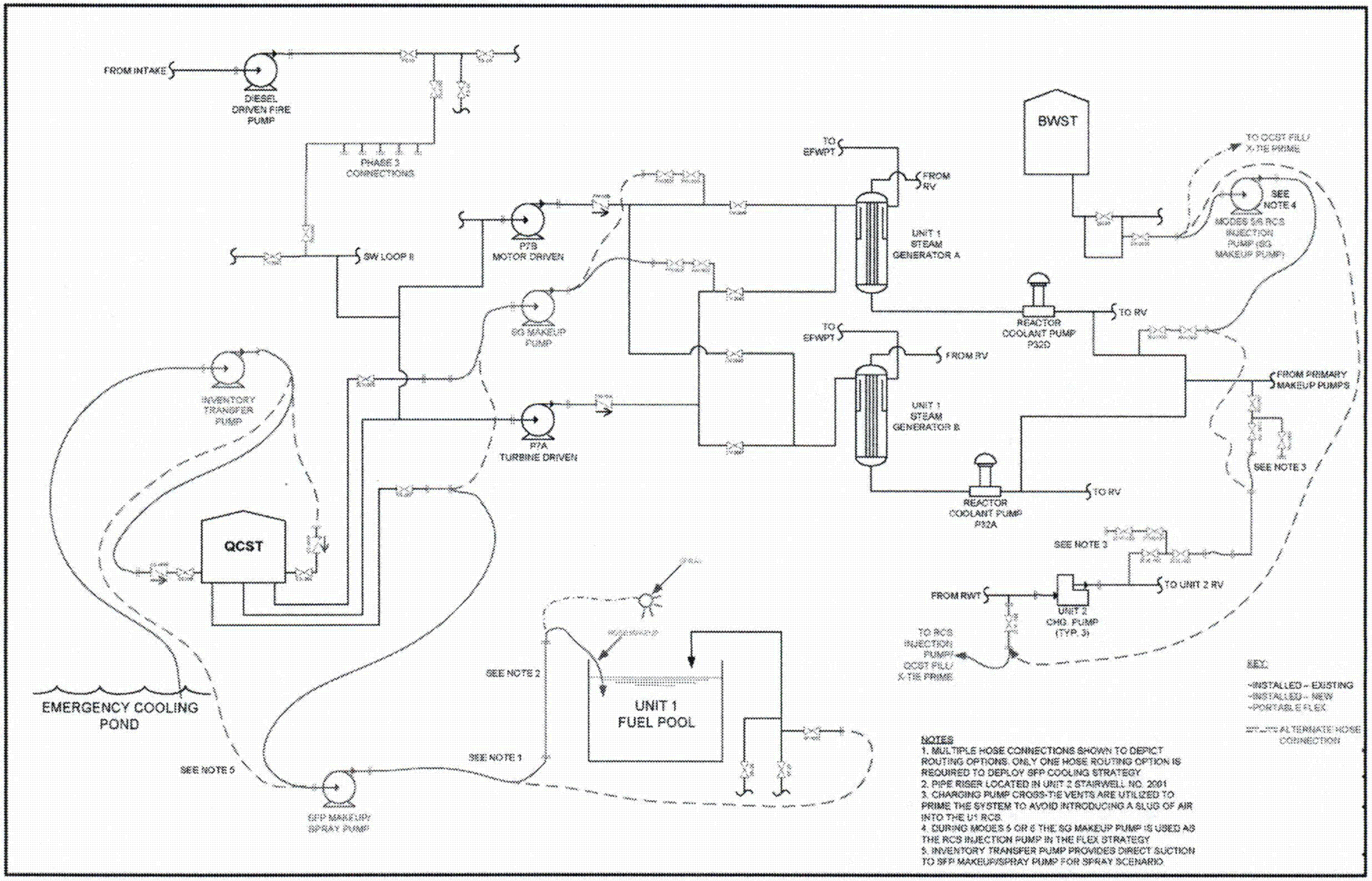

Figure 3: ANO-1 FLEX Flow Diagram Phases 1 and 2

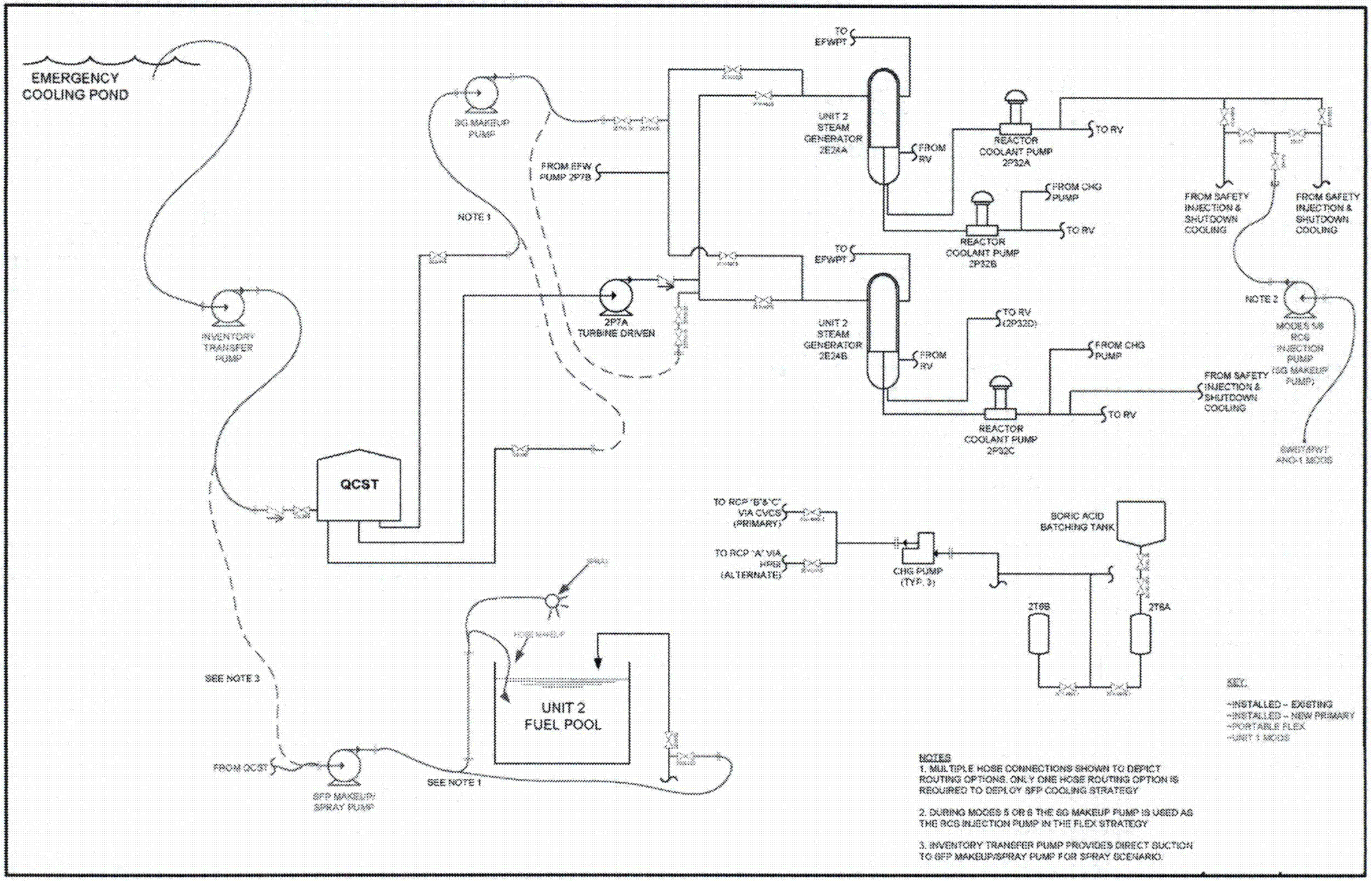

Figure 4: ANO-2 FLEX Flow Diagram Phases 1 and 2

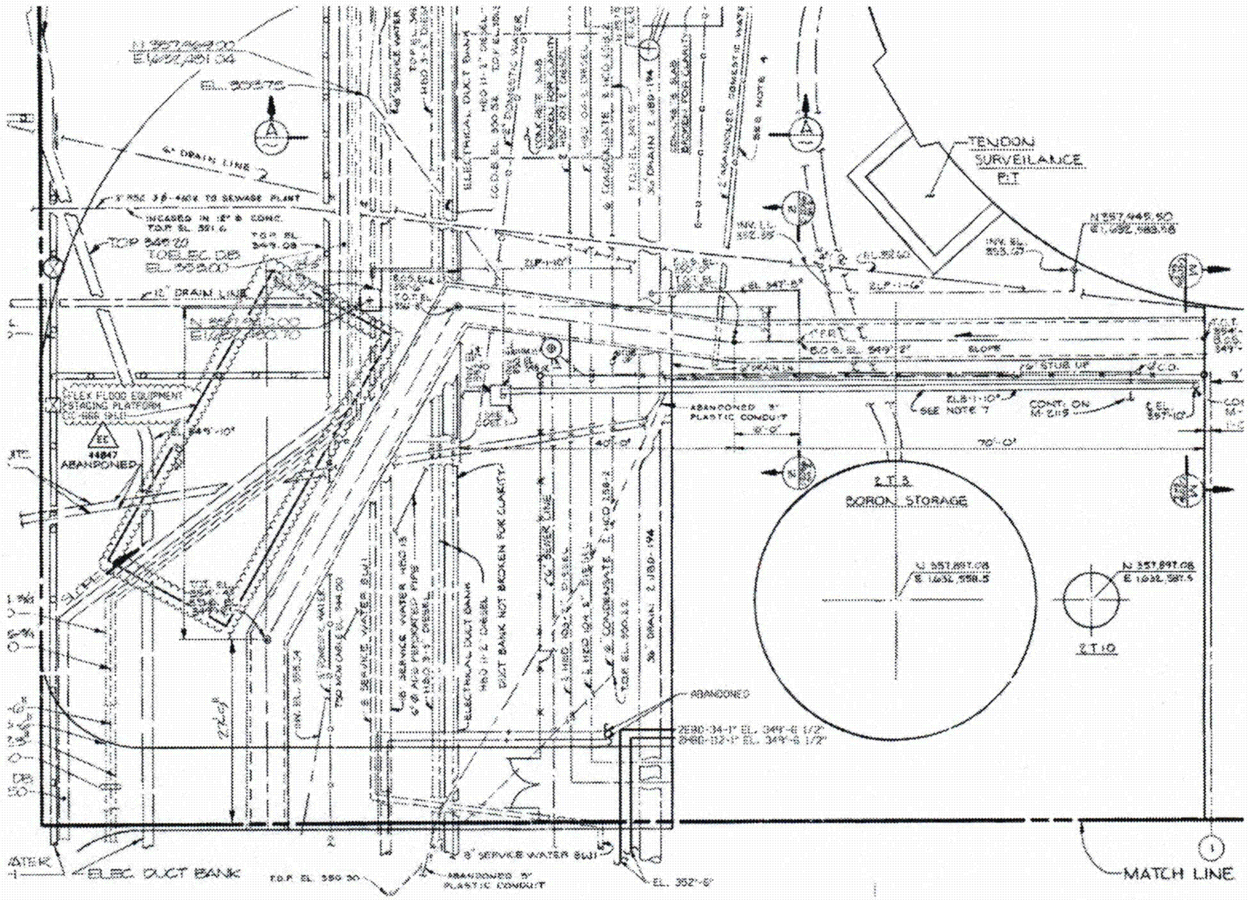

Figure 5: PAD for Non-Flooding Staging and Erecting the Flood Platform west of the PASS Building

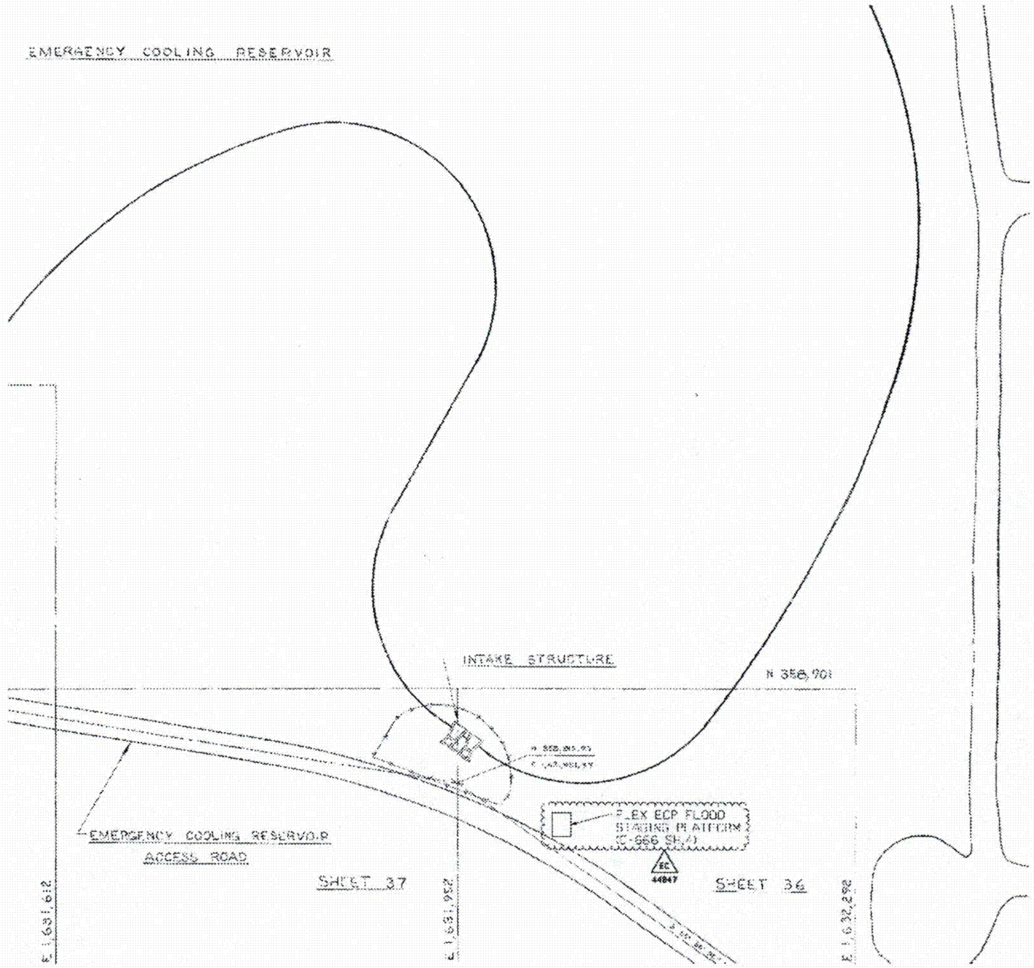

Figure 6: Flood Staging Platform near the ECP

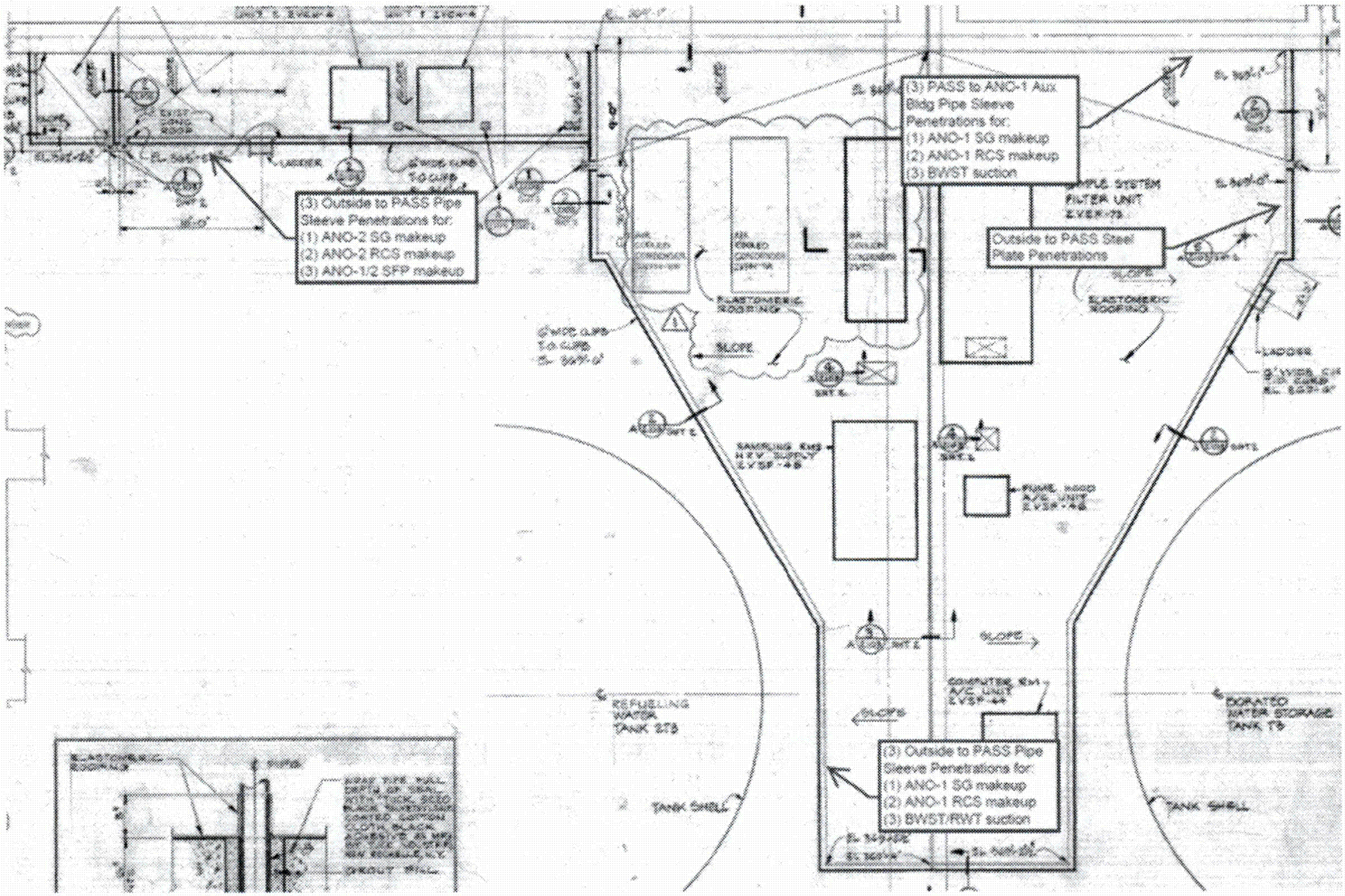

Figure 7: PASS Penetrations

2.17 Sequence of Events

Tables 1 and 2 below present a Sequence of Events (SOE) Timeline for an ELAP/LUHS event at ANO-1 and ANO-2, respectively. Validation of each of the FLEX time constraint actions has been completed in accordance with the FLEX Validation Process document issued by NEI and includes consideration for staffing. Based on the applicable hazards and potential quantities, sizes, and types of debris that can be expected along deployment routes, clearing a pathway within a nominal two hour period is deemed feasible. Once clear, a nominal one hour period is judged sufficient for the transportation of the time-sensitive equipment and trailers from the storage building locations to the planned staging areas. This time is considered to be reasonable based on site reviews and the location of the FLEX Storage Buildings. Debris removal equipment is stored in the FLEX Storage Buildings.

Table 1: ANO-1 Sequence of Events Timeline

Action Item	Elapsed Time (hours)	Action	Time Constraint Y/N	Remarks / Applicability
	0	Event Starts	N/A	Plant at 100% power
	0	Perform Actions Consistent with Station Blackout Procedure	N/A	Actions performed per EOP (Reference 3.1.41)
1	0.33	Isolate RCP seals CBO	Y	Controlled bleed off is isolated as directed in the SBO procedures.
1a	1	Declare ELAP	Y	ELAP declared when power sources cannot be restored
2	3	Perform Battery Load Shed	Y	Extended battery load shedding performed to extend life to Phase 2
2a	4	Open Doors to SFP	Y	Open doors 87, 89, 94, 95, 96, 188, 316, 321, the ANO-1 Turbine Building Roof Access Hatch, and the ANO-2 Turbine Building Roof Access Hatch.
3	5	Clear Debris	Y	Debris cleared for deployment paths for equipment
4	6	Perform Damage Assessment	Y	FSG requirement to devise coping strategies

Table 1: ANO-1 Sequence of Events Timeline				
Action Item	**Elapsed Time (hours)**	**Action**	**Time Constraint Y/N**	**Remarks / Applicability**
5	6	Deploy and Connect FLEX 480V Generator	Y	Establish connections to provide power to ANO-2 charging pumps and ANO-1 battery charger. Diesel generator is shared between units and is adequately sized to provide power to both ANO-1 and ANO-2.
6	6	Align ANO-2 Charging Pump for ANO-1 RCS Injection	Y	A makeup flow rate of 35 gpm (with a cooldown at 20 °F/hour). BAMT and RWT volume should last throughout the 72 hour ELAP event. ANO-2 charging pumps are capable of supplying 44 gpm each.
7	6	Open Control Room Doors	Y	Open control room doors (64, 65, 66, 67, 198 and 643), so temperature would not exceed 110 °F.
8	7	Backfill the QCST from the BWST	Y	For a non-wind/missile strike event where the QCST is not compromised, backfilling from the BWST to the QCST delays the required staging time of the FLEX inventory transfer pump.
8a	7	Align P-6B to provide suction to the TDEFW Pumps	Y	Only needed if CSTs not available and QCST is damaged.
9	8	Commence Plant Cooldown	Y	Cooldown at 20 °F/hour by CN-SEE-II-13-4 analysis (Reference 3.1.12)

Table 1: ANO-1 Sequence of Events Timeline				
Action Item	**Elapsed Time (hours)**	**Action**	**Time Constraint Y/N**	**Remarks / Applicability**
10	9	Deploy hose for SFP makeup	Y	Prior to onset of boiling. Normal decay heat in pool, boiling occurs at 9.13 hours, makeup at 47.65 hours once level gets to 15'. Max decay heat, boiling occurs at 3.86 hours, makeup at 20.14 hours once level gets to 15'.
11	9	Refuel Firewater System Pump P-6B	Y	For a wind/missile strike event where the QCST is compromised, diesel-driven pump P-6B would be used to provide suction to the TDEFW from the lake or ECP.
12	10	Provide Portable Fans to the Control Room	Y	Deploy portable fan(s) to supply 10,000 cubic feet per minute (cfm) of air, so the temperature would not exceed 110 °F for 72 hours.
13	10	Open Doors 46, 47, 48, 49, 56, 62 and 480 in the Auxiliary Building and Stage a Portable Fan in D56 doorway.	Y	Opening the selected doors and staging a 10,000 cfm portable fan ensure that the credited electrical equipment located inside the Auxiliary Building rooms would not exceed the limiting component qualification temperature.

Table 1: ANO-1 Sequence of Events Timeline				
Action Item	**Elapsed Time (hours)**	**Action**	**Time Constraint Y/N**	**Remarks / Applicability**
14	16	Refuel Diesel Equipment	Y	Assuming 10 hours of fuel is available in all FLEX diesel equipment, the FLEX 480 V PDG needs to be refueled at ANO-1 starting at 16 hours. The FLEX inventory transfer pump needs to be refueled at 35 hours. Requires hose to be staged from fuel oil storage building to diesel equipment staging areas. Re-power fuel oil transfer pumps using the FLEX 480V portable diesel generator.
15	24	Prepare site for receipt of NSRC equipment	N	NSRC equipment expected to be able to arrive 24 hours after the request has been made for support from the NSRC (mobile boration unit and water purification skid)
16	25	Align FLEX Inventory Transfer Pump	Y	Inventory transfer pump staged and aligned to provide makeup from the ECP via service water piping to the QCST prior to exhausting its normal operating volume.
17	N/A	Align FLEX SG Makeup Pump	N	Steam pressure is expected to be sufficient to operate the turbine-driven EFW pumps throughout the 72-hour ELAP event. The backup FLEX SG makeup pumps should be deployed when time/resources permit.

Table 1: ANO-1 Sequence of Events Timeline				
Action Item	**Elapsed Time (hours)**	**Action**	**Time Constraint Y/N**	**Remarks / Applicability**
18	47	Align SFP Makeup Pump to SFP	N	Assuming 15' of water is needed above the fuel racks for shielding; makeup to the ANO-1 SFP is not required until 47.65 hours after the event. SFP makeup pump is shared between units and is adequately sized to provide necessary makeup flow for both ANO-1 and ANO-2.
19	N/A	Align 4160V Generators	N	The NSRC 4160V generator aligned when possible
20	N/A	Establish Large Fuel Truck Service	N	Onsite fuel resources expected to last for over 72 hours
21	N/A	Establish FLEX SW NSRC Pump	N	3000 gpm based on the design flow rates for the ANO-1 Decay Heat Removal (DHR) cooler (1600 gpm), reactor building cooling unit (1200 gpm) and low pressure injection room cooler (70 gpm). The pump would connect to blind flanges installed on the service water to feedwater cross-tie.

Table 2: ANO-2 Sequence of Events Timeline

Action Item	Elapsed Time (hours)	Action	Time Constraint Y/N	Remarks / Applicability
	0	Event Starts	N/A	Plant at 100% power
	0	Perform Actions Consistent with Station Blackout Procedure	N/A	Actions performed per EOP (Reference 3.1.42)
1	1	Declare ELAP	Y	ELAP declared when power sources cannot be restored
2	2	Commence Plant Cooldown	Y	Cooldown at 75 °F/hour to reach a hot standby RCS temperature of 350 °F (Reference 3.1.14)
3	3	Open Doors 257, 265, 266, 268, 269, 270 and 340 in the Auxiliary Building.	Y	Opening the selected doors ensures that the credited electrical equipment located inside the auxiliary building rooms would not exceed the limiting component qualification temperature.
4	3	Open Door 405 in the ADV Penthouse	Y	Open ADV penthouse Door 405
5	3	Perform Battery Load Shed	Y	Extended battery load shedding performed to extend life to Phase 2
6	4	Open Control Room Doors	Y	Open control room doors 341, 342, 343 and 642 so temperature would not exceed 110 °F.
7	4	Deploy Hose For SFP Makeup	Y	Normal decay heat in pool, boiling occurs at 4.17 hours, makeup at 24.74 hours once level gets to 15' Max decay heat, boiling occurs at 2.19 hours, makeup at 12.99 hours once level gets to 15'

Table 2: ANO-2 Sequence of Events Timeline				
Action Item	**Elapsed Time (hours)**	**Action**	**Time Constraint Y/N**	**Remarks / Applicability**
7a	4	Open Doors for SFP Ventilation	Y	Open doors 87, 89, 94, 95, 96, 188, 316, 321, the ANO-1 Turbine Building Roof Access Hatch, and the ANO-2 Turbine Building Roof Access Hatch.
8	5	Clear Debris	Y	Debris cleared for deployment paths for equipment
9	6	Perform Damage Assessment	Y	FSG requirement to devise coping strategies
10	6	Deploy and Connect FLEX 480V Generator	Y	Establish connections to provide power to ANO-2 charging pumps and ANO-2 battery charger. Diesel generator is shared between units and is adequately sized to provide power to both ANO-1 and ANO-2.
11	7	Backfill the QCST from the BWST	Y	For a non-wind/missile strike event, where the QCST is not compromised, backfilling from the BWST to the QCST delays the required staging time of the FLEX inventory transfer pump.
11a	7	Align P-6B to provide suction to the TDEFW Pumps	Y	Only needed if CSTs not available and QCST is damaged.
12	9	Refuel Firewater System Pump P-6B	Y	For a wind/missile strike event where the QCST is compromised, diesel-driven pump P-6B would be used to provide suction to the TDEFW from the lake or ECP. Firewater System Pump would provide inventory to both ANO-1 and ANO-2.

Table 2: ANO-2 Sequence of Events Timeline				
Action Item	**Elapsed Time (hours)**	**Action**	**Time Constraint Y/N**	**Remarks / Applicability**
13	10	Provide Portable Fans to the Control Room	Y	Deploy portable fan(s) to supply 12,000 cubic feet per minute (cfm) of air, so the temperature would not exceed 110 °F for 72 hours.
14	10	Provide Portable Fan to the Corridor outside the DC Rooms	Y	Deploy 12,000 cfm portable fan to exhaust air from the electrical equipment area
15	16	Refuel Diesel Equipment	Y	Assuming 10 hours of fuel is available in all FLEX diesel equipment, the FLEX 480 V PDG needs to be refueled at ANO-2 starting at 16 hours. The FLEX inventory transfer pump needs to be refueled at 35 hours. If used, P-6B needs to be re-fueled by 18 hours. Requires hose to be staged from fuel oil storage building to diesel equipment staging areas. Re-power fuel oil transfer pumps using the FLEX 480 V portable diesel generator.
16	17.5	Align ANO-2 Charging Pump for RCS makeup.	Y	ANO-2 RCS makeup flow rate of 20 gpm is provided to ensure ANO-2 RCS maintains natural circulation (Reference 3.1.18)
17	24	Prepare site for receipt of NSRC equipment	N	NSRC equipment expected to be able to arrive 24 hours after the request has been made for support from the NSRC (mobile boration unit and water filtration skid).

Table 2: ANO-2 Sequence of Events Timeline				
Action Item	**Elapsed Time (hours)**	**Action**	**Time Constraint Y/N**	**Remarks / Applicability**
18	24	Align SFP Makeup Pump to SFP	Y	Assuming 15' of water is needed above the fuel racks for shielding; makeup to the ANO-2 SFP is not required until 24.74 hours after the event. SFP makeup pump is shared between units and is adequately sized to provide necessary makeup flow for both ANO-1 and ANO-2.
19	25	Align FLEX Inventory Transfer Pump	Y	Inventory transfer pump staged and aligned to provide makeup from the ECP via service water piping to the QCST prior to exhausting its normal operating volume.
20	N/A	Align 4160V Generators	N	The 4160 V generator aligned when possible
21	N/A	Establish Large Fuel Truck Service	N	Onsite fuel resources expected to last for over 72 hours
22	N/A	Establish FLEX SW NSRC Pump	N	5000 gpm based on the design flow rates for the ANO-2 shutdown cooling heat exchanger (3350 gpm), reactor building cooling unit (1250 gpm), and shutdown cooling heat exchanger room cooler (69 gpm). The pump would connect to an adapter bolted onto the top of one of the SW pump discharge in the intake building.

2.18 Programmatic Elements

2.18.1 Overall Program Document

The ANO Program Document provides a description of the FLEX Program for ANO. 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 are 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 would 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

FLEX developed strategies are focused on maintaining or restoring key plant safety functions under the conditions of an ELAP and LUHS and are not tied to any specific damage state or mechanistic assessment of external events. FDSs are analogous to an EOP and would be directed from the governing procedure/document in use at time of the BDBEE. This would be an EOP (Station Blackout) or abnormal operating procedure (Loss of Decay Heat Removal or Loss of Shutdown Cooling/Lower Mode Functional Recovery). As the FDSs are implemented the FLEX documents (FDSs and FSGs) would be performed in conjunction with the controlling document in use.

FSGs are guidelines that provide strategies relying on the use of installed and onsite portable equipment (which includes stripping DC busses to maintain battery life) and resources to maintain or restore core cooling, containment, and SFP cooling capabilities during certain beyond design basis events. An FSG is analogous to an ANO-1 EOP Repetitive Task or (RT) (ANO-2 Standard Attachment) and would be utilized in conjunction with (in parallel with) an ANO FDS.

The FLEX FDSs are designed to protect the fuel by enabling a plant to cope with the consequences of a BDBEE. Guidance for declaring an ELAP is incorporated directly into Station Blackout EOP. The FDSs and FSGs are implemented in conjunction with the controlling procedure.

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 FDSs/FSGs would provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FDSs/FSGs would 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 operating procedures (AOPs) strategies, the EOP or AOP would direct the entry into and exit from the appropriate FDS/FSG.

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

Procedural Interfaces have been incorporated into OP-1202.008 and OP-2202.008, (station blackout procedures), to the extent necessary to include appropriate reference to FDSs and provide command and control for the ELAP.

FSGs and FDSs have been reviewed and validated by the involved groups to the extent necessary to ensure the strategy is feasible. Validation was accomplished via table-tops of guidelines, walk-throughs, and/or drills of the guidelines.

2.18.3 Staffing

Using the methodology of NEI 12-01 (Reference 3.1.36), an assessment of the capability of the ANO on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDBEE was performed. The results were provided to the NRC in a letter dated September 22, 2014.

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 units (all units are operating at full power at the time of the event)
- impeded access to the units by onsite 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. The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft and approved FSGs for coping with a BDBEE using minimum on-shift staff. 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 staff is sufficient to support the implementation of the mitigating strategies (FLEX strategies) on ANO-1 and ANO-2, 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 staff, 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.

This assessment also concluded that sufficient personnel resources exist in the current ANO augmented ERO to fill positions for the expanded emergency response functions. Thus, the ERO resources and capabilities necessary to implement transition phase coping strategies performed after the end of the "no site access" 6-hour time exist in the current program.

2.18.4 Training

ANO's Nuclear Training Program has a tracking action in place to assure personnel training in the mitigation of BDBEE is adequate and maintained. These programs and controls are being developed and are planned to be implemented in accordance with the Systematic Approach to Training (SAT) process.

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

"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 have not been upgraded to accommodate FLEX training or drills.

2.18.5 Equipment List

The key equipment stored and maintained at the ANO FLEX storage building necessary for the implementation of the FLEX strategies in response to a BDBEE at ANO is listed in Table 3, *Portable Equipment Phase 2*. Table 3 identifies the quantity, applicable strategy, and capacity/rating for the FLEX equipment components, as well as, various clarifying notes.

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 of NEI 12-06, Section 11.5.

The Entergy PM Basis Templates include activities such as:

- Periodic Static Inspections
- Operational Inspections
- Fluid analysis
- Periodic functional verifications
- Periodic performance validation 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, PM actions were developed based on manufacturer provided information/recommendations.

Additionally, the 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 (emergency communications equipment such as UPS', radios, batteries, battery chargers, satellite phones, etc.). These facility functional readiness checks provide assurance that emergency 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 is managed such that risk to mitigating strategy capability is minimized. Maintenance/risk guidance is addressed in the ANO-1 and ANO-2 Technical Requirements Manual Section 3.10.

Table 3 Portable Equipment Phase 2

Use and (potential/flexibility) diverse uses						*Performance Criteria*
List portable equipment	**Core**	**Containment**	**SFP**	**Instrumentation**	**Accessibility**	
Four (4) SG Makeup Pumps	X					300 gpm @ (650' TDH required for ANO-1 and 710' TDH required for ANO-2
Two (2) Inventory Transfer Pumps	X					850 gpm @ 277' TDH
Two (2) SFP Pumps			X			500 gpm @ 320' TDH
Two (2) 480 VAC 800 kW Generators	X			X		800 kW standby
Two (2) Debris Removal Equipment					X	4 Wheel Loader with fork, blade and bucket attachment.
Two (2) Pickup Trucks	X		X	X	X	Diesel, > 22,000 lbs. towing capacity
Two (2) Fuel Transportation Equipment	X		X	X	X	500 gallons, trailer mounted, 12 Vdc transfer pump and hose reel
Hose	X		X			
Cable				X	X	
Eight (8) Diesel Light Towers					X	
Fans						10,000 cfm for ANO-1 and 12,000 cfm for ANO-2

Table 4							
PWR Portable Equipment Phase 3							
Use and (potential/flexibility) diverse uses						***Performance Criteria***	***Notes***
List portable equipment	**Core**	**Containment**	**SFP**	**Instrumentation**	**Accessibility**		
Two (2) Low Pressure High Flow Pumps	X	X				--	Followed EPRI template requirements
Two (2) Suction Lift Booster Pumps	X	X				--	Followed EPRI template requirements
Four (4) 4160 V Generators	X	X		X	X		Followed EPRI template requirements
Two (2) Mobile Boration Units	X		X				Followed EPRI template requirements
Two (2) Mobile Water Treatment System	X		X			250 gpm output flow	Followed EPRI template requirements
Hose	X	X	X				Followed EPRI template requirements
Cable	X	X	X	X	X		Followed EPRI template requirements

3. References

3.1 Mitigation Strategies (FLEX) References

3.1.1 SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," (ADAMS Accession No. ML 11186A950)

3.1.2 NRC Order EA-12-049, "Order to Modify Licenses With Regard to Requirements for Mitigation Strategies For Beyond-Design-Basis External Events," dated March 12, 2012, (ADAMS Accession No. ML 12056A045)

3.1.3 NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0, dated August 2012 (ADAMS Accession No. ML12221A205)

3.1.4 NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events", Revision 0, dated August 29, 2012 (ADAMS Accession No. ML 12229A174)

3.1.5 NRC Order Number, EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March, 12, 2012 (ADAMS Accession No. ML12054A679)

3.1.6 NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable SFP Instrumentation, Revision 1, dated August 2012 (ADAMS Accession No. ML12240A307)

3.1.7 NRC Interim Staff Guidance JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable SFP Instrumentation, Revision 0, dated August 29, 2012 (ADAMS Accession No. ML12221A339)

3.1.8 NRC Correspondence, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(F) regarding Recommendations 2.1, 2.3 and 9.3 of The Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident: March 12, 2012."

3.1.9 Task Interface Agreement 2004-04, "Acceptability of Proceduralized Departures from TSs Requirements at the Surry Power Station," (TAC Nos. MC4331 and MC4332)," dated September 12, 2006. (Accession No. ML060590273)

3.1.10 ANO-2, Updated Final Safety Analysis Report, SAR Amendment 25

3.1.11 CALC-13-E-0005-11, Rev. 000, "ANO-1 FLEX Phase 2 Utilization of Charging Pump for Reactor Coolant System Makeup"

3.1.12 CALC-ANOC-ME-13-00002, Rev. 0, ANO FLEX Westinghouse Support Documents, Calculation CN-SEE-II-13-4, Rev. 1, Arkansas Nuclear One Unit 1 Reactor Coolant System Inventory, Boron Concentration, and Mode 5/6 Boric Acid Precipitation Analyses to Support the Diverse and Flexible Coping Strategies (FLEX), dated February 19, 2013

3.1.13 WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs," January 2013

3.1.14 CALC-ANOC-ME-13-00002, Rev. 0, ANO FLEX Westinghouse Support Documents, Calculation CN-SEE-II-13-2, Rev. 1, Arkansas Nuclear One Unit 2 Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Analyses to Support the Diverse and Flexible Coping Strategies (FLEX), dated February 19, 2013.

3.1.15 Westinghouse Position Paper, "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Boron Mixing in Support of the Pressurized Water Reactor Owners Group (PWROG)," dated August 16, 2013 (ADAMS Accession No. ML13235A135)

3.1.16 NRC Letter, Boron Mixing Endorsement Letter in Regards to Mitigation Strategies Order EA-12-049, dated January 8, 2014 (ADAMS Accession No. ML13276A183)

3.1.17 ANO-1, Updated Final Safety Analysis Report, SAR Amendment 26

3.1.18 CALC-ANOC-ME-13-00002, Rev. 0, ANO FLEX Westinghouse Support Documents, Calculation, CN-SEE-II-12-43, Rev. 2, Determination of the Time to Boil in the Arkansas Nuclear One (ANO) 1 & 2 Spent Fuel Pools after an Earthquake, dated February 20, 2013

3.1.19 CALC-89-E-0098-01, Rev. 000, Assessment of SF Pool Cooling Line HCC-12-6 Inch for Maximum Earthquake

3.1.20 CALC-13-E-0005-02, Rev. 0, ANO-1 MAAP Containment Analysis for BDBEE

3.1.21 CALC-14-E-0002-01, Rev. 0, ANO-2 MAAP Containment Analysis for BDBEE

3.1.22 Not used

3.1.23 EN-OU-108, Rev. 006, Shutdown Safety Management Program (SSMP)

3.1.24 NRC Regulatory Guide 1.76, Rev. 1, Design Basis Tornado and Tornado Missiles for Nuclear Power Plants, March 2007

3.1.25 ENERCON Report No. ENTGANO083-RPT-001, Rev. 0, Arkansas Nuclear One FLEX Storage Location Separation Distance, April, 2014

3.1.26 Calculation CALC-14-E-0002-10, Rev.0, ANO-FLEX – Extreme Cold Weather Evaluation, May 2014

3.1.27 ANO-1 Technical Specifications, Amendment 248

3.1.28 ANO-2 Technical Specifications, Amendment 296

3.1.29 Calculation CALC-13-E-0005-01, Rev. 1, ANO-1-- FLEX Heat-Up, July 2015

3.1.30 Calculation CALC-14-E-0002-03, Rev. 0, ANO-2 FLEX Room Heat-Up, October 2015

3.1.31 NUMARC 87-00, Rev. 1, Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors, August 1991

3.1.32 Calculation CALC-10-E-0010-01, Rev.000, ANO-1 Auxiliary Building Integrated Room Heat-up Model

3.1.33 Calculation CALC-91-E-0139-01, Rev. 002, Heatup Rate of Room 2024 (2P7A) With No Room Cooling

3.1.34 Entergy Letter 0CAN101205, Entergy's Response to the March 12, 2012, Information Request Pursuant to 10 CFR 50.54(f) Regarding Recommendation 9.3 for Completing Emergency Communication Assessments Arkansas Nuclear One – Units 1 and 2, dated October 31, 2012 (ADAMS Accession No. ML12305A534)

3.1.35 Entergy Letter 0CAN021304, Entergy's Response to the March 12, 2012, Information Request Pursuant to 10 CFR 50.54(f) Regarding Recommendation 9.3 for Completing Emergency Communication Assessments Arkansas Nuclear One – Units 1 and 2, dated February 20, 2013 (ADAMS Accession No. ML13053A193)

3.1.36 Nuclear Energy Institute (NEI) 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, Revision 0, dated May 3, 2012 (ADAMS Accession No. ML12125A410)

3.1.37 Calculation CALC-13-E-0005-03, Rev. 0, OTSG Heat Transfer Capability using ECP or Lake Water for EFW Makeup, May 2014

3.1.38 Calculation CALC-14-E-0002-02, Rev. 000, ANO-2 FLEX Steam Generator Degraded Heat Transfer Analysis, May 2014

3.1.39 Nuclear Energy Institute, Position Paper: Shutdown/Refueling Modes, dated September 18, 2013 (ADAMS Accession No. ML13273A514)

3.1.40 NRC letter, dated September 30, 2013 (ADAMS Accession No. ML13267A382)

3.1.41 ANO-1 Procedure 1202.008, Blackout

3.1.42 ANO-2 Procedure 2202.008, Station Blackout

3.1.43 DAR-SEE-II-12-13, Rev. 0, Evaluation of Alternate Coolant Sources for Responding to a Postulated Extended Loss of All AC Power at the Arkansas Nuclear One (ANO) Site, January 2013

3.1.44 CALC-ANOC-CS-13-00012, Rev. 0, ANO FLEX Tank Tornado Missile Impact Evaluation, Rev. 0

3.1.45 Drawing C-2016, Sh. 1, Rev. 000, Plan and Sections T41B Condensate Storage Tank

3.1.46 Calculation CALC-ANOC-ME-13-00001, Rev. 003, ANO Flex Strategy Development

3.1.47 Calculation CALC-13-E-0005-09, Rev. 001, ANO-1 FLEX Phase 2 Steam Generator Makeup Pump Sizing

3.1.48 Calculation CALC-14-E-0002-04, Rev. 000, ANO-2 FLEX Phase 2 Steam Generator Makeup Pump Sizing

3.1.49 Calculation CALC-13-E-0005-12, Rev. 001, ANO FLEX Phase 2 Inventory Transfer Pump Sizing

3.1.50 Calculation CALC-13-E-0005-10, Rev. 001, ANO FLEX Phase 2 Spent Fuel Pool Makeup and Spray Pump Sizing

3.1.51 Calculation CALC-13-E-0005-13, Rev. 001, ANO FLEX Phase 3 Requirements for Regional Response Center Pumps

3.1.52 Calculation CALC-14-E-0002-08, Rev. 000, ANO-2 FLEX Phase 3 Requirements for Regional Response Center Pumps

3.1.53 Calculation CALC-13-E-0005-14, Revision 000, ANO-1 FLEX Battery Load Shed Calculation

3.1.54 Calculation CALC-14-E-0002-07, Rev. 000, ANO-2 FLEX Battery Load Shed Calculation

3.1.55 Calculation CALC-13-E-0005-30, Rev. 000, FLEX BWST Gravity Drain to QCST for Short-Term Makeup

3.1.56 NRC Endorsement Letter of NEI Alternate Approach Hoses and Cables, dated May 18, 2015 (ML 15125A442)

3.1.57 NEI Letter "Alternative Approach to NEI 12-06 Guidance for Hoses and Cables", dated May 1, 2015 (ML15126A135)

3.1.58 Calculation CALC-13-E-0005-51, ANO FLEX Drain Time of Tanks due to Missile Puncture

3.1.59 Specification SPEC-6600-M-291, Rev. 002, Spec for BWST

3.1.60 Engineering Change EC 44045, ANO FLEX Storage Building Rev. 0

3.1.61 Engineering Change EC 35075, Rev. 1 ANO-2 Room Heat-Up Gothic Model for Transition to NFPA-805

3.1.62 TSEAL-3-695-49A, Human Tolerance for Short Exposures to Heat

3.1.63 Procedure OP-1203.025, ANO-1, Natural Emergencies

3.1.64 Procedure OP-2203.008, ANO-2, Natural Emergencies

3.1.65 Engineering Change EC 48342, ANO-1 and ANO-2 FLEX Strategy and Basis, Attachment 6.004