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NLS2016070
January 4, 2017

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

Subject: Completion of Required Action by NRC Order EA-12-049 - Mitigation Strategies for Beyond-Design-Basis External Events
Cooper Nuclear Station, Docket No. 50-298, DPR-46

Dear Sir or Madam:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, to Nebraska Public Power District (NPPD). This Order was effective immediately and directed NPPD to develop, implement, and maintain guidance and strategies to restore or maintain core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event at Cooper Nuclear Station (CNS). This letter, along with its attachments and enclosure, provide the notification required by Section IV.C.3 of the Order that full compliance with the requirements described in Attachment 2 of the Order has been achieved for CNS.

This letter contains no new NRC commitments. If you have any questions, please contact Jim Shaw, Licensing Manager, at (402) 825-2788.

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

Executed on: 1/4/17

Sincerely,

Kenneth Higginbotham
Vice President - Nuclear and
Chief Nuclear Officer

/bk

A151
NRR

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Attachments:
1. Compliance Report for Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events
2. Nebraska Public Power District's Response to NRC Audit Open Item

Enclosure: Cooper Nuclear Station FLEX Final Integrated Plan

cc: Regional Administrator, w/attachments and enclosure
USNRC - Region IV

Director, w/attachments and enclosure
USNRC - Office of Nuclear Reactor Regulation

Cooper Project Manager, w/attachments and enclosure
USNRC - NRR Plant Licensing Branch IV

Senior Resident Inspector, w/attachments and enclosure
USNRC - CNS

NPG Distribution, w/attachments and w/o enclosure

CNS Records, w/attachments and enclosure

ATTACHMENT 1

Compliance Report for Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events

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BACKGROUND

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Reference 1), to Nebraska Public Power District (NPPD). This Order was effective immediately and directed NPPD to develop, implement, and maintain guidance and strategies to restore or maintain core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event at Cooper Nuclear Station (CNS).

The Order required compliance prior to plant startup from the second refueling outage following submittal of the Overall Integrated Plan (OIP), or by December 31, 2016, whichever comes first. NPPD is hereby reporting that full compliance with the Order was achieved prior to CNS entering Mode 2 (Startup) on November 6, 2016.

The information provided herein, and referenced docketed correspondence, documents full compliance for NPPD in response to the Order.

COMPLIANCE

NPPD developed an initial OIP for CNS (Reference 3) which documented the diverse and flexible strategies (FLEX), in response to Reference 1.

In References 2, 4, 6, 7, 8, 9, 10, and 11, NPPD provided status reports to the NRC with regard to implementation of Order EA-12-049 at CNS. Subsequent revisions to the initial OIP were reported to the NRC in the second, third, and sixth status updates (References 6, 7, and 10).

<u>Open Item Resolution</u>

Licensee Identified Open Items – Licensee identified open items in the OIP, and subsequent OIP revisions, are complete.

Audit Questions / Audit Report Open Items - In Reference 14, the NRC issued a report for an audit conducted at CNS from May 23 through May 26, 2016, regarding implementation of mitigating strategies and reliable spent fuel pool instrumentation for Orders EA-12-049 and EA-12-051, Reliable Spent Fuel Pool Instrumentation. The audit activities included detailed analysis and calculation discussions, walk-throughs of strategies and equipment laydown, visualization of portable equipment storage and deployment, review of staging and deployment of offsite

equipment, and review of NPPD responses to the NRC Interim Staff Evaluation (ISE) confirmatory items, audit questions, and safety evaluation technical review items.

One item related to implementation of mitigating strategies remained open at the conclusion of the onsite audit, Audit Item Safety Evaluation (SE) 2. All other ISE confirmatory items and audit questions that required review were closed as documented in Reference 14. Attachment 2 to this letter provides NPPD's response to Audit Item SE 2. This item is considered complete pending NRC review.

ISE Confirmatory Items - By Reference 5, the NRC provided its ISE which contained confirmatory items identified as part of the NRC staff's review. NPPD responded to the ISE confirmatory items in the final six-month status report (Reference 11). As noted above, these items were considered closed as a result of the May 2016 onsite NRC audit (Reference 14). There were no open items documented in the ISE.

ORDER EA-12-049 COMPLIANCE ELEMENTS SUMMARY

Strategies - Complete

CNS strategies are in compliance with Order EA-12-049. There are no strategy related open items or confirmatory items. Audit Item SE 2 remained open at the conclusion of the May 2016 onsite audit. Attachment 2 to this letter provides NPPD's response to Audit Item SE 2. This item is considered complete pending NRC review.

Modifications - Complete

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

Equipment - Procured and Maintenance/Testing - Complete

The equipment required to implement the FLEX strategies for CNS has been procured in accordance with Nuclear Energy Institute (NEI) 12-06 (Reference 15), Sections 11.1 and 11.2, received at CNS, initially tested/performance verified as identified in NEI 12-06, Section 11.5, and is available for use. Maintenance and testing will be conducted through the use of the CNS preventative maintenance program such that equipment reliability is achieved.

Protected Storage - Complete

The storage facilities required to implement the FLEX strategies for CNS have been completed and provide protection from the applicable site hazards. The equipment required to implement the FLEX strategies for CNS is stored in its protected configuration.

Procedures - Complete

FLEX Support Guidelines (FSG) for CNS have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been verified and are available for use in accordance with the site procedure control program.

Training - Complete

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

Staffing - Complete

The staffing study for CNS has been completed in accordance with Reference 12, as documented in Reference 13.

National Safer Response Centers - Complete

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

Validation - Complete

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

Milestone Schedule - Items Complete

CNS Milestone	Status
Submittals:	
60 Day Status Report	Complete (Reference 2)
Overall Integrated Plan	Complete (Reference 3)
6 Month Updates	Complete (References 4, 6, 7, 8, 9, 10, 11)
Compliance Report	Complete with this submittal
Phase 2 Staffing Assessment	Complete (Reference 13)
Strategies/Equipment:	
Establish Contract with Regional Response Centers	Complete

CNS Milestone	Status
FLEX Equipment Procurement and Storage	Complete
Develop/Implement FLEX Strategies	Complete
Modifications:	
Online and Outage Modifications Tested and In-service	Complete
Procedures:	
Develop/Implement Procedures and FSGs	Complete
Training:	
Develop/Implement Training	Complete

REFERENCES

The following references support this compliance report for Order EA-12-049:

1. NRC Order Number EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ML12054A736)

2. NPPD Letter to NRC, "Initial Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated October 29, 2012 (NLS2012109)

3. NPPD Letter to NRC, "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 28, 2013 (NLS2013024)

4. NPPD Letter to NRC, "Cooper Nuclear Station's First Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 27, 2013 (NLS2013079)

5. NRC Letter to NPPD, "Cooper Nuclear Station - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC No. MF0972)," dated February 11, 2014

6. NPPD Letter to NRC, "Nebraska Public Power District's Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2014 (NLS2014019)

7. NPPD Letter to NRC, "Nebraska Public Power District's Third Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 26, 2014 (NLS2014082)

8. NPPD Letter to NRC, "Nebraska Public Power District's Fourth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 23, 2015 (NLS2015019)

9. NPPD Letter to NRC, "Nebraska Public Power District's Fifth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 27, 2015 (NLS2015100)

10. NPPD Letter to NRC, "Nebraska Public Power District's Sixth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 16, 2016 (NLS2016008)

11. NPPD Letter to NRC, "Nebraska Public Power District's Final Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 26, 2016 (NLS2016048)

12. NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012

13. NPPD 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 May 18, 2016 (NLS2016029)

14. NRC Letter to NPPD, "Cooper Nuclear Station - 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 (CAC NOS. MF0971 and MF0972)," dated August 29, 2016 (ML16217A475)

15. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 2, dated December 2015

ATTACHMENT 2

Nebraska Public Power District's Response to NRC Audit Open Item

An onsite audit of the implementation of Orders EA-12-049 and EA-12-051 was conducted by the Nuclear Regulatory Commission (NRC) from May 23 through May 26, 2016. One open item was documented in the audit report for Order EA-12-049. This attachment provides Nebraska Public Power District's (NPPD) response to the audit open item.

NRC Audit Item SE 2 Description and Licensee Input Needed:

Provide a discussion/analysis on the ability of electrical and mechanical equipment (i.e., valve solenoids, instruments, relays, etc.) located within containment and other areas of the plant (i.e., main control room, reactor core isolation cooling/High Pressure Coolant Injection System Pump Rooms, atmospheric dump valves/ safety relief valve rooms, switchgear rooms, battery rooms, etc.) that is relied upon during an ELAP to function in the expected environmental conditions for the duration of the ELAP event (i.e., indefinitely).

Licensee to provide a discussion on the expected high and low temperatures in containment, battery rooms, and switchgear rooms (including the battery chargers and inverters) with an explanation as to why credited equipment will continue to function (e.g., temperatures remain below/above design limits).

NPPD Response:

The calculation that establishes the basis for 72 hour temperature profiles for both the Reactor Building and Control Building during the FLEX scenario, NEDC 15-002, Portable Equipment Calculations in support of Cooper Nuclear Station's (CNS) FLEX Strategy, was revised to accommodate 72 hours from 24, and extra sensitivity studies were generated to document how the model changes with various parameters.

For the FLEX scenario with extended loss of AC power (ELAP), loss of ultimate heat sink, 97°F outside air temperature with no nighttime relief, the model demonstrates that 932' elevation Control Building Control Room temperatures are slightly above the 110°F limit after approximately 40 hours. The peak temperature at 72 hours is approximately 112°F. The compensatory measures associated with this peak temperature are a 40" (~11,000 cfm) fan in the Control Room with doors H300, D301, D304, R208, R209, and R210 open at 8 hours.

Impact to Control Room personnel at this temperature can be managed with reducing individual stay times through personnel rotation and controls per Procedure 0.36.1, Heat Stress Prevention Program. Should the opportunity exist to implement flexible ducting on the 40" portable fan from the outside through doors R208/R209/R210, the high temperatures will be rapidly mitigated. With the prescribed compensatory measures, the peak temperature for the Control

Room is acceptable for personnel and equipment. Note that the 110°F limit applied here is for personnel; equipment operability limit is 120°F.

For the 903' elevation of the Control Building where the battery rooms and switchgear rooms are located, the base case with no compensatory actions demonstrates peak temperatures are less than 120°F for all rooms up to 6 hours prior to simulated heat loads from the -A, -B, or -C chargers coming online. 120°F is used as the temperature limit for DC SWGR A/B and the Instrument Repair Room with the C Charger. Documentation shows that the actual operability limit for this equipment is 130°F. Door H110 to DC SWGR A is opened at 30 minutes by guidance currently in CNS Procedure 5.3SBO, Station Blackout, slightly improving results. The model shows that beyond 6 hours with battery charging heat loads coming online, medium (~4,000 cfm) fans are required directed through doors H109 (-C Charger), H103 (-A Charger), or H104 (-B Charger). Only rooms with an operating charger will require a fan, no more than two of the chargers will be run concurrently. Additionally, in order to manage the temperature in the controlled corridor outside of these rooms, a medium (~4,000 cfm) fan will be placed in door H105 from the Turbine Building. With these prescribed compensatory measures, the peak temperatures in these rooms are acceptable for the electrical equipment required for FLEX for the 72 hour duration modeled.

The GOTHIC model was iterated into 31 cases with various combinations of compensatory actions and timings. Additionally, multiple sensitivity studies are also iterated from select cases to demonstrate area temperature relationships with several inputs. Extensive documentation of the FLEX scenario in this regard allows for a bounding determination on required actions for FLEX coping. Sensitivity Study 9 provided in Attachment 11.3AF in NEDC 15-002 establishes a bounding temperature profile for the primary FLEX strategy. All rooms of interest on the 903' elevation of the Control Building remain below their temperature limit for the entire 72 hour duration. The general ventilation requirement established in the previous paragraph for a medium sized (4,000 cfm) fan in both doors H112 ('C' Charger operating) and H105 (Turbine Building) is confirmed by Sensitivity Study 9 temperature results.

For the Reactor Building, the GOTHIC model demonstrates that opening and closing doors is not sufficient to preclude exceeding the 148°F temperature limit in the Reactor Core Isolation Cooling (RCIC) quad to support RCIC operation. A small (~1,500 cfm) fan is required with a substantial amount of ducting to effectively displace the hot air in the room and turn it over with cooler air from the controlled corridor elevation 903'-6" just outside the Reactor Building personnel airlock. The portable fan will be located in the controlled corridor with ducting going through doors R101, R102, and R103 down to at least the 881'-9" elevation of the RCIC quad. The model demonstrates required implementation of this fan is somewhere between 8 and 12 hours. Additionally, it is expected that in order to promote natural circulation throughout the Reactor Building general areas all the way from the 903'-6" elevation to 1001'-0", the combination of doors R101, R102, R103, R110, X110, and Reactor Building Roof Hatch will be opened at 3 hours (prior to the requirement of ventilation in the RCIC quad specifically). The model demonstrates that opening these doors an hour later at 4 hours in the prescribed combination, is acceptable and bulk air flow throughout the general Reactor Building volume does occur.

The Steam Tunnel does not require any portable ventilation or opening of door R104. The temperature peaks in the Steam Tunnel after 5 minutes at just above 275°F, then decays away with the heat load from the steam lines. The operability limit in the Steam Tunnel is 308°F for RCIC-MOV-MO16.

The Reactor Building GOTHIC model was iterated into 26 cases with various combinations of compensatory actions and timings. Multiple sensitivity studies will go along with the model to demonstrate the relationship between RCIC room and Steam Tunnel area temperatures and several inputs.

Results from calculation NEDC 14-026, Review of ERIN Calculation C122140001-11622, "MAPP Analysis to Support Cooper FLEX Strategy," show that the drywell airspace temperature reaches steady state at approximately 250°F at 24 hours. This steady state temperature is well below the maximum temperature of 340°F at which the Automatic Depressurization System is qualified. As the temperature profile has reached steady state at 24 hours, it is expected to remain at this temperature or decrease in the time between 24 hours and 72 hours.

Results of Environmental Qualification Data Package 2.118, Revision 4, show that the temperature profile described in the discussion above is bounded by the Target Rock solenoid valves (safety relief valves) peak and continuous test temperatures of 355°F and 265°F, respectively.

ENCLOSURE

Cooper Nuclear Station
FLEX Final Integrated Plan

COOPER
NUCLEAR
STATION

FLEX Final Integrated Plan (FIP)

Effective Date: **1/4/2017**
Approval Authority: **ITR-RDM**
Procedure Owner: **OSG SUPV**

REV.	DATE	CHANGES
0	1/4/2017	INITAL ISSUANCE

TABLE OF CONTENTS

REV.	DATE	CHANGES
0	1/4/2017	Initial issue

1. Background

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

The US Nuclear Regulatory Commission (NRC) assembled a Near-Term Task Force (NTTF) to advise the Commission on actions the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 3.71) 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) on March 12, 2012 to implement mitigation strategies for Beyond-Design-Basis (BDB) External Events (BDBEEs). The order provided the following requirements for strategies to mitigate BDBEEs:

1.1 Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities following a beyond-design-basis external event.

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

1.3 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.

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

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

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

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

NRC Order EA-12-049 (Reference 3.1) required licensees of operating reactors to submit an overall integrated plan, including a description of how compliance with these requirements would be achieved by February 28, 2013. The Order also required licensees to complete implementation of the requirements no later than two refueling cycles after submittal of the overall integrated plan or December 31, 2016, whichever comes first.

The Nuclear Energy Institute (NEI) developed NEI 12-06 Revision 2, (Reference 3.15), 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 Revision 1 (Reference 3.7), dated January 22, 2016, which endorsed NEI 12-06 Revision 2 with certain clarifications, exceptions and additions as an acceptable method for satisfying the requirements in Order EA-12-049..

NRC Order EA-12-051 (Reference 3.3) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level. This order was prompted by NTTF Recommendation 7.1 (Reference 3.1).

NEI 12-02 (Reference 3.14) 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 3.9), conformance with the guidance in NEI 12-02 is an acceptable method for satisfying the requirements in Order EA-12-051.

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

2.1 General Elements

2.1.1 Conformance to NEI 12-06

Cooper Nuclear Station (CNS) has developed its FLEX strategies to conform to NEI 12-06 Revision 2, with no exceptions.

2.1.2 Assumptions

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

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

- Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are not complete and therefore not assumed in this submittal. Mitigating Strategy Assessments (MSAs) will be completed using NRC approved guidance within the NRC and Industry agreed to time-table.
- Following conditions exist for the baseline case:
  - Seismically designed DC battery banks are available.
  - Seismically designed AC and DC distribution systems are available.
  - Plant initial response is the same as Station Blackout (SBO).
  - Best estimate analysis and decay heat is used to establish operator time and action.
  - No single failure of Structure, System or Component assumed.
  - The water in the Emergency Condensate Storage Tanks (ECST) is available for use. The ECSTs are located in a seismically robust structure.
  - The water in the main condenser hotwells is available for use. CNS is an Alternate Source Term plant, and as such, the hotwells have been shown to survive a design basis earthquake (Reference 3.23).

- The design hardened connection is protected against external event using redundant locations.

- Implementation strategies and roads are assessed for hazards impact.

- All Phase II components are stored at site and available after the event they were designed to be protected against.

- Additional staff resources are expected to arrive beginning at 6 hours and the site is fully staffed 24 hours after the event.

- This plan defines strategies capable of mitigating a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink resulting from a beyond-design-basis event by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety are incorporated into the unit emergency procedures and guidelines in accordance with established change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

  The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the beyond-design-basis event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x), 10 CFR 73.55(p) and/or 10 CFR 72.32(d). (Reference 3.24)

- NEI 12-06, Section 3.2.1, General Criteria and Baseline Assumptions:

  - The assumptions listed in NEI 12-06, Section 3.2.1, are applicable to CNS.

2.2 Strategies

The objective of the FLEX Strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactor, 2) maintain the containment function and 3) maintain cooling and prevent damage to fuel in the spent fuel pool (SFP) using installed equipment, on-site portable equipment, and pre-staged off-site resources. This indefinite coping capability will address an extended loss of all ac power (ELAP) – loss of off-site power, emergency diesel generators and any alternate ac source (as defined in 10 CFR 50.2) but not the loss of ac power to buses fed by station batteries through inverters – with a simultaneous loss of access to the ultimate heat sink (LUHS). This condition could arise following external events that are within the existing design basis with additional failures and conditions that could arise from a beyond-design-basis external event.

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

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

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

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

The strategies described below are capable of mitigating an ELAP/LHUS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at CNS. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety are incorporated into the CNS emergency operating procedures in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

2.3 Reactor Core Coolant and Heat Removal Strategy

2.3.1 Phase 1 Strategy

During MODES 1, 2, and 3, the primary strategy for core cooling is to supply high quality water via RCIC with suction from the ECSTs. Two 50,000-gallon ECSTs are installed for the exclusive use of the RCIC and HPCI systems (Reference 3.22, Section VI-5.2.7). While not expected to be necessary, it is possible to swap the RCIC suction to the suppression pool if makeup to the ECSTs is delayed.

At the initiation of the Beyond-Design-Basis External Event (BDBEE), MSIVs automatically close, feedwater is lost, and Safety Relief Valves (SRVs) automatically cycle to control pressure, causing reactor water level to decrease. When reactor water level reaches -42 inches, HPCI and RCIC automatically start with suction from the ECST (Reference 3.63, Table 3.3.5.1-1, Function 3A, and Table 3.3.5.2-1, Function 1) and operate to inject makeup water to the reactor vessel. This injection recovers the reactor level to the high level setpoint of 54" (Reference 3.63, Tables 3.3.5.1-1 (Function 3c) and 3.3.5.2-1 (Function 2)). The SRVs are used to control reactor pressure between approximately 800-1000 psig per EOP-1A RPV Control (Reference 3.28).

In a typical SBO event (and in the ELAP event), RCIC is able to provide make-up and maintain RPV level. HPCI is secured after one cycle or 10 minutes of operation (Reference 3.25).

After determination that Emergency Diesel Generators cannot be restarted, the operating crew determines the event is a BDBEE and anticipates an extended loss of AC power (ELAP) by 1 hour into the event. RCIC is maintained feeding the reactor vessel with suction from the ECST. The RCIC trip signals and isolation signals that could possibly prevent RCIC operation when needed during the ELAP are overridden in accordance with EOPs (Reference 3.28). Additionally, the Automatic Depressurization System (ADS) is either placed in 'inhibit' or closely monitored to prevent automatic initiation of ADS. This is necessary to ensure reactor pressure is not reduced to a pressure which would prevent operation of RCIC.

The primary method of reactor pressure control is by operation of the SRVs. Operator control of reactor pressure using SRVs requires DC control power and pneumatic pressure (supplied by station batteries and the drywell pneumatics system (Reference 3.22, Section IV-4.6) to open. For Phase 1, the power for the SRVs is supplied by the station batteries. At event initiation, the normal pneumatic supply is lost due to loss of power; however, each SRV is provided an accumulator which contains enough pneumatic pressure to operate each valve for multiple open/close cycles. The combined capacity of the accumulators is sufficient to allow operation of the SRVs until Phase 2 when pneumatics is restored with FLEX equipment.

Based on experience derived from Fukushima, the RCIC system can run at a much higher lube oil temperature and suction source temperature than that originally assumed for the operation of RCIC. Additionally, the BWROG has developed a RCIC Functionality Assessment (Reference 3.64) shows that operation of RCIC to pump process fluids with temperatures below 250°F should result in no loss of functionality without any additional modifications.

2.3.2 Phase 2 Strategy

Primary Strategy:

During Phase 2, as in Phase 1, reactor core cooling is maintained using RCIC in automatic mode (i.e., with operators controlling the RCIC flow controller) with suction from the ECST. When ECST water becomes depleted, the ECST is refilled first from the hotwell, and then, from an on-site well.

An installed pump will transfer condensate from the hotwell to the ECST through a combination of hoses and installed piping. An additional 80,625 gallons is available in the Main Condenser Hotwells (Reference 3.30). The hotwells have been evaluated to be available after a seismic event (Reference 3.23). The combined capacity of the ECSTs, hotwells, and suppression pool is sufficient to support RPV makeup for at least 24 hours without external makeup sources.

The on-site well is hardened, sized for the required makeup capacity, and powered by a portable FLEX generator (Reference 3.84). The well water is pumped to the ECST connection point through hose. The torus water level is influenced both by the addition of water from the SRV discharge as well as evaporation through the Hardened Containment Venting System, which is placed in service prior to reaching a containment pressure of 15 psig into the event to maintain containment parameters below design limits.

During Phase 2, reactor pressure is controlled by operation of SRVs as described in Phase 1 with the use of a portable FLEX pneumatic source. The FLEX portable air compressor is connected to supply the Reactor Building Reliable Air header, which provides a pneumatic source for the SRVs (Reference 3.78).

Alternate Strategy:

Providing defense in depth for RCIC, a FLEX pump is deployed which can provide RPV injection of well water through one of two connections. The primary connection is via the normal Residual Heat Removal Service Water (RHRSW) crosstie to the Division 1 Residual Heat Removal (RHR) injection flow path. RPV pressure is reduced to below the shutoff head of the FLEX pump after which the RHRSW to RHR flow path is established by opening valve SW-120 (Reference 3.62) to allow flow into the 24" line to the Low Pressure Coolant Injection valves, RHR-MO-27A and RHR-MO-25A. This provides the flow path into the RPV (References 3.28 and 3.63). The FLEX pump will supply water to the connection point via hose. The alternate connection uses the same portable FLEX pump but connects through the Division 2 RHR Torus Spray line to the Division 2 RHR injection flow path. After aligning valves in the Division 2 RHR system, RHR-MO-27B and RHR-MO-25B are opened to inject to the RPV.

Electrical Power

The 125 VDC Division I batteries are available for approximately 9 hours without recharging. Two fusible disconnect switches have been installed to allow the FLEX 175kW DG to provide power to 125 VDC Battery Charger C and 250 VDC Battery Charger C (Reference 3.81). The FLEX 175kW DG is connected by approximately 5 hours and is sized to power the125/250 VDC Battery Chargers C and either division of DC Busses. The deployment area of the FLEX 175kW DG is near the North side of the Turbine Building.

As an alternate strategy to power the batteries from the 'C' Chargers, pre-staged cables can be used to connect the FLEX 175KW DG directly to the feeder breakers for the 'A' or 'B' 125/250 VDC Battery Chargers on MCC LX or TX.

Vital Instrumentation

CED 6037040 (Reference 3.83) installed backup 120VAC power to the following vital instrumentation in the Main Control Room:

- RPV Wide Range Level Indication (LI-85C)
- RPV Fuel Zone Level Indication (LI-91C)
- Torus Wide Range Level Indication (PC-LRPR-1A Ch 2)
- Reactor Level Nozzle Range Indicator (LI-92)

Two Manual Transfer Switches (MTS) have been added as part of the modification. These Manual Transfer Switches allow transferring power to:

- NBPP
- FLEX 175 KW DG via a cable
- Division 2 power

Fueling Portable Equipment

At CNS, FLEX portable equipment is stored fully fueled, allowing for a quicker deployment. Once operating, diesel fuel oil is obtained from any of a number of potential sources, including the DG Fuel Oil Storage Tanks, the DG Day Tanks, the Diesel Fire Pump Fuel Tank, and the Diesel Fuel Supply Tanks.

A diesel fuel oil transfer trailer is used to replenish each piece of FLEX portable equipment. A trailer mounted pump is able to transfer diesel fuel from any of the aforementioned tanks to a trailer mounted 100 gallon storage tank. The trailer is then towed to each piece of equipment and diesel fuel is pumped to the equipment from the trailer mounted 100 gallon storage tank.

The diversity of diesel fuel storage tanks ensures ready availability of diesel fuel on-site. The Tech Spec requirement to maintain at least 49,500 gallons of diesel fuel in the DG Fuel Oil Storage Tanks ensures sufficient capacity to allow required diesel replenishment to begin well beyond the 72 hour time frame.

2.3.3 Phase 3 Strategy

Primary Strategy:

For Phase 3, the reactor core cooling strategy is to place one loop of RHR into the Shutdown Cooling (SDC) mode. This is accomplished by powering up a Division I RHR pump from the Class 1E emergency 4160 VAC Bus F, utilizing two 4160 VAC SAFER portable diesel generators from the National Safer Response Center (NSRC). The RHR Heat Exchanger is supplied with river water by a large portable SAFER pump from the Missouri River via the RHRSW piping connection point.

Alternate Strategy:

Alternate means of core cooling can be provided by connecting to and using the Division 2 components of RHR and RHRSW from 4160 VAC Bus G.

Electric Power

The two 4160 VAC SAFER Diesel Generators are capable of carrying approximately 2000 kW load, which is sufficient to carry all of the loads on 4160 VAC bus F or G necessary to support the Phase 3 FLEX strategies which includes an RHR pump and its support equipment (i.e., Motor Operator Valves, Reactor Equipment Cooling (REC) System, room coolers, etc.).

Vital Instrumentation

During Phase 3 of the ELAP, the SAFER DGs will resupply either 4160VAC Division 1 or 2. This will allow power to the vital instrumentation to be transferred to either 120/240VAC EE-PNL-CCP1A (Division 1) or EE-PNL-CCP1B (Division 2).

Equipment Cooling

Equipment cooling is necessary during Phase 3 to support the use of the RHR pumps to provide torus cooling or Shutdown Cooling. The Reactor Equipment Cooling system is returned to service during Phase 3 when the SAFER DG is used to repower a 4160 VAC bus. Reactor Equipment Cooling is used to supply flow to the RHR pump bearing and seal oil coolers, as well as the RHR Pump Room FCU.

2.3.4 Systems, Structures, Components

2.3.4.1 Reactor Core Isolation Cooling (RCIC)

The RCIC system consists of a steam driven turbine - pump unit and associated valves and piping capable of delivering makeup water to the reactor vessel. The Steam supply comes from the reactor vessel. The steam exhaust from the turbine dumps to the suppression pool. (Reference 3.22, Section IV-7.5)

The pump normally takes suction from Emergency Condensate Storage Tank (ECST) with a backup supply line from the suppression pool. The pump discharges either to the feedwater line or to a full flow return test line to the ECST. (Reference 3.22, Section IV-7.5)

The RCIC system water supply is automatically determined depending upon the ECST water level. When the water level in the ECST reaches a predetermined low water level setpoint, the suction valve between the suppression pool and the RCIC pump automatically opens. Once the suppression pool to RCIC pump suction valve is fully open, the ECST suction valve to the RCIC pump will automatically go closed. The capability of remote manual switchover (in addition to automatic switchover) is also available. (Reference 3.22, Section IV-7)

The RCIC system is designed for startup and short-term operation without AC power. Components necessary for initiating operation of the RCIC system require only DC power from the station battery to operate the valves and controls.

DC power from the 125-volt batteries is required for operation of the RCIC system. RCIC system operation does not depend on operation of the non-essential gland seal (barometric) condenser or either the condenser condensate or vacuum pump; however these are left in service for at least 5 hours, unless 250 VDC 1A Battery Charger is restored, to minimize steam and condensate buildup in the room.

The RCIC system is designed for continuous operation with ambient conditions of 148°F and 100% relative humidity. Without AC power, RCIC compartment temperature will increase with the rate of suppression pool temperature rise being a significant factor. Considering natural circulation of the air within the reactor building and heat losses through the building walls, air temperature will substantially lag suppression pool temperature providing time to place temporary ventilation into service to control compartment temperature (see 2.12.2) for details on ventilation requirements).

The RCIC system, suppression pool and ECSTs are located in the Reactor Building and Control Building which are Class I structures designed to be robust with respect to the site's design basis for Safe Shutdown Earthquake (SSE), wind loading, tornado loading and tornado generated missiles. (Reference 3.22, Section XII-2)

The design of the RCIC system, including instrumentation and controls needed to transfer pump suction, is to seismic Class 1 specifications (Reference 3.22, Appendix C).

The RCIC system is designed to operate automatically but has a provision for remote manual initiation of the system from the main control room. Emergency Procedure 5.3ALT-STRATEGY has provisions for operation of RCIC without DC power. (Reference 3.77)

At the initiation of the BDBEE the reactor scrams, main steam isolation valves (MSIVs) automatically close, feedwater is lost and safety relief valves (SRVs) automatically cycle to control pressure, causing reactor water level to drop. When reactor water level reaches -42 inches, RCIC automatically starts. RCIC suction from the ECST will provide RPV injection to return vessel water level to the normal band.

2.3.4.2 Safety Relief Valves (SRVs)

Operator control of reactor pressure using SRVs requires DC control power and pneumatic pressure (supplied by station batteries and the drywell pneumatics system to open). (Reference 3.22, Section IV-4.6)

For Phase 1, the power for the SRVs is supplied by the station batteries. At event initiation the normal pneumatic supply is lost due to loss of power; however, each SRV is provided an accumulator which contains enough pneumatic pressure to operate each valve for multiple open/close cycles. The accumulators for the 2 SRVs associated with Low-Low SET (LLS) are sized to allow 14 cycles of each valve. (Reference 3.22, Section IV-4.6) The accumulators for the 6 ADS valves are sized for 5 cycles and are credited for operation for approximately 40 hours after a SSE. (Reference 3.22, Section IV-4.6) The CNS FLEX Strategy is based on the results of a calculation that includes plant specific MAAP4 runs (Reference 3.54). The calculation determined that 51 SRV cycles are required in the first 24 hours. The combined capacity of the accumulators (58 cycles) is sufficient to allow operation of the SRVs until Phase 2 when pneumatics is restored with FLEX equipment.

The SRVs and controls are located in the Reactor Building and Control Building which are Class I structures designed to be robust with respect to the site's design basis for Safe Shutdown Earthquake (SSE), wind loading, tornado loading and tornado generated missiles. (Reference3.22, Section XII-2)

During Phase 2 operations the Reactor Building Reliable Air Header is re-pressurized using a portable diesel driven air compressor. This will provide the air supply to the SRVs to ensure continued operation. To minimize the potential for leaks in the system and to inhibit the effectiveness of re-pressurizing the Reactor Building Reliable Air header with the FLEX portable air compressor, the rest of the Instrument Air system is isolated.

CED 6037045 (Reference 3.78) has installed a 2-inch FLEX connection into the existing 3-inch SA-1 piping consists of one location downstream of valve SA-V-660 and upstream of valves SA-V-661 and 662 in the basement of the Control Building. A 2" hose is deployed from the portable air compressor thru doorways and down the stairwell to the connection. Calculation NEDC 04-009 change notice 1C1 (Reference 3.79) has qualified the piping system in accordance with USAS B31.1-1967 for all applicable DBE's. EE 01-0157 (Reference 3.80) established that the Class IIS piping in the Reactor and Control Buildings that has been Class I Restrained will not fail during an SSE.

2.3.4.3 Batteries

The safety related batteries and associated DC distribution systems are located within the Control Building which is a Class I structure designed to be robust with respect to the site's design basis for Safe Shutdown Earthquake (SSE), wind loading, tornado loading and tornado generated missiles. (Reference 3.22, Section XII-2) The batteries are used to initially power required key instrumentation and applicable DC components. Load shedding of non-essential equipment provides an estimated service time of approximately 9 hours of operations. (References 3.34 through 3.37)

CED 6037041 (Reference 3.81) installed disconnects and connection points to allow connection of a 175KW diesel generator to the manual transfer switches for the 125 VDC and 250 VDC 'C' battery chargers. These disconnects allow for separation of the connection points from the Class 1E electrical system during normal operation. The connection points provide the ability to charge either Division 1, or Division 2, 125 VDC and 250 VDC batteries and supply DC loads. The FLEX 175 kW DG is sized to power two 125/250 VDC Battery Chargers, the DC Busses, and three ventilation fans. Cables are routed from a point near the chargers to the exterior of the Control Building. The deployment area of the FLEX 175 kW DG is located near the north entrance to the Turbine Building.

The station batteries are located in two rooms, each containing a 125 VDC and a 250 VDC battery. During charging operations hydrogen is generated and ventilation is required to maintain the atmosphere in the battery room below combustible limits. One fan is set up to blow into the respective battery room, one into the respective switchgear/charger room and one set up to exhaust into the Turbine Building. See section 2.11.1.1 for further discussion.

2.3.4.4 Suppression Pool

The suppression pool (SP) is the heat sink for reactor vessel SRV discharges and RCIC turbine steam exhaust following a BDBEE. It is also the alternate suction source for the RCIC pump for providing core cooling anytime the ECST is not available during the BDBEE.

The suppression pool has approximately 87,650 cubic feet of high quality water. It serves both as a heat sink for postulated transients and accidents, and as a source of water for the ECCS.

The suppression pool receives energy in the form of steam and water from the reactor pressure relief valve discharge piping or the vent system downcomers which discharge under water. The steam is condensed by the suppression pool. The condensed steam and any water carryover cause an increase in pool volume and temperature. Energy can be removed from the suppression pool when the residual heat removal system is operating in the suppression pool cooling mode. (Reference 3.22, Section V-2.3.3.3)

The suppression pool level is maintained between 12' 7" and 12' 11" per LCO 3.6.2.2, Suppression Pool Water Level. (Reference 3.63, Section 3.6.2.2)

2.3.4.5 Core Cooling Connections

CED 6037045 (Reference 3.78) installed a single connection point at the combined RHRSW crosstie to the RHR injection flow path (upstream of SW-V-120). This connection will permit RPV makeup water (Alternate Strategy for RCIC failure) to be injected into the reactor vessel through the Emergency Core Flooding cross-tie to the Residual Heat Removal (RHR) 'A' Subsystem. The connection is located in the Control Building which is a Class I structure designed to be robust with respect to the site's design basis for Safe Shutdown Earthquake (SSE), wind loading, tornado loading and tornado generated missiles. (Reference 3.22, Section XII-2) Hoses are connected to a hardened well, sized appropriately to provide adequate core cooling after the plant is shutdown. Water is pumped from the well to a portable FLEX pump where it is then routed to the RHR "A" Service Water Crosstie.

2.3.4.6 Alternate Core Cooling Connections

The alternate core cooling connection when RHR Subsystem 'A' is not available uses the existing RHR Subsystem 'B' B.5.b connection to inject into the RPV through the RHR "B" injection line. This connection is located in the Reactor Building which is a Class I structure designed to be robust with respect to the site's design basis for Safe Shutdown Earthquake (SSE), wind loading, tornado loading and tornado generated missiles. (Reference 3.22, Section XII-2) This line up uses the same hardened well and portable FLEX pump to supply water to the RPV as the Primary Core Cooling method.

2.3.5 Key Reactor Parameters

Parameters to be monitored to maintain core cooling are:

Parameter	Instrument	Indicator Location
RPV Level Narrow Range	RFC-LI-94A, B and C (0 to 60")	Control Room
RPV Level Narrow Range	NBI-LIS 83A and B (0 to 60") NBI-LIS-101A, B, C and D (0 to 60")	Local rack Local rack
RPV Level Wide Range	NBI-LI-85C (-155" to + 60")	Control Room
RPV Level Wide Range	NBI-LI-185B (-155" to + 60")	Local ASDR
RPV Level Wide Range	NBI-LIS-57A and B (-150" to +60") NBI-LIS-58A and B (-150" to +60") NBI-LIS-72A, B, C and D (-150" to +60")	Local rack Local rack Local rack
RPV Level Fuel Zone	NBI-LI-91C (-320" to +60")	Control Room
RPV Level Fuel Zone	NBI-LI-191B (-320" to +60")	Local ASDR
RPV Level Fuel Zone	NBI-LITS-73A and B -260" to +40")	Local rack
RPV Level Nozzle Range	NBI-LI-92 (0" to 180")	Control Room
RPV Pressure	RFC-PI-90A, B and C (0 to 1200 psig)	Control Room
RPV Pressure	NBI-PIS-60A and B (0 to 1500 psig) NBI-PIS-52B and D (0 to 500 psig) NBI-PI-61 (0 to 1500 psig)	Local rack Local rack Local rack
Drywell Pressure	PC-PI-513 (0 to 2 psig), PC-PI-2104AG (0 to 100 psig)	Local rack
Torus Pressure	PC-PI-20 (0 to 2 psig), PC-PI-2104BG (0 to 100 psig)	Local rack
Drywell Temperature	PC-TI-505A, B, C, D and E (50 to 600F)	Control Room
Drywell Temperature	PC-TE-505A,B, C, D and E, with use of M&TE (50 to 600F)	Control Room

Parameter	Instrument	Indicator Location
Torus Temperature	PC-TE-1A thru H and PC-TE-2A thru H with use of M&TE (0 to 250F)	Local, Cable Spreading Room
Torus Temperature	PC-TI-2A, C, E and G (0 to 250F)	Local ASDR
Torus Level	PC-LI-110 (-6' to +6' H2O)	Local ASDR
Containment/Torus Wide Range Level	PC-LRPR-1A/1B (0 to 100ft) and (0 to 30ft)	Control Room
ECST Level	CM-LI-1681B (2' to 16' H2O)	Local ASDR
ECST Level	HPCI-PI-117A	Local rack
Spent Fuel Pool Level	FPC-LIT-1, FPC-LIT-2	Cable Spreading Room, Control Bldg 903 Corridor
Spent Fuel Pool Level	Visual	Local at SFP
Spent Fuel Pool Temperature	M&TE	Local at SFP

Procedure 5.3SBO (Reference 3.26) provides guidance for obtaining necessary instrument readings to support ELAP coping strategies and provides guidance on how to measure key instrument readings using a portable instrument. Procedure 5.3Alt-Strategy (Reference 3.27) includes guidance on how to control critical equipment without associated control power (RCIC and SRVs).

2.3.6 Thermal Hydraulics Analyses

The CNS FLEX Strategy is based on the results of a calculation that includes plant specific MAAP4 runs (Reference 3.54). EPRI issued a position paper in June 2013 providing technical justifications for the use of MAAP4 in support of post Fukushima applications. The NRC endorsed the use of MAAP4 as an acceptable method for establishing a timeline which meets the intent of NRC Order EA-12-049.

CNS-specific inputs were used for the plant-dependent MAAP input parameters. EPRI-recommended MAAP input values were used for input parameters identified to control the ELAP phenomena, per EPRI Technical Report 3002002749 (Reference 3.82).

The applicable MAAP case assumes HPCI and RCIC start automatically after the event occurs; taking suction from the ECST (other similar cases take suction from the torus). HPCI is secured once RPV water level is returned to the high RPV water level trip point. Within 30 minutes, operators commence a 100°F/hour reactor cooldown using SRVs. The pressure reduction is stopped at an RPV pressure of 150 psig. From that point onward, RPV pressure is maintained between 150 psig and 300 psig. RPV leakage is assumed to be 66 gpm starting at the time of the event. Containment venting occurs at a torus pressure of ~30 psia (15 psig). Following the initial torus venting, torus pressure is controlled between ~5 psig and ~15 psig.

The analysis further expects DC power availability for RCIC control, SRV control, containment vent control, and instrumentation. Additionally, it is assumed that ECST volume is very large to ensure the suction source is not lost.

The analysis concludes that the strategy ensures the following:

- RPV collapsed water level does not drop below top of active fuel (TAF).
- Reactor cooldown rate is within Technical Specification limits.
- Containment pressure remains less than the containment design pressure of 62 psig
- Drywell temperature remains less than 340°F.
- Bulk suppression pool temperature remains less than 240°F.
- The strategy is successful (no fuel damage) in providing significant time (greater than 24 hours) of event mitigation using only an installed pump (RCIC) and suction from either the torus or ECST.

2.3.7 Recirculation Pump Seal Leakage

The MAAP analysis assumed total RPV leakage of 66 gpm, which includes recirculation pump seal leakage.

The first component of the RPV leakage is the unidentified leakage, which is assumed to be 30 gpm. This is the maximum leakage allowed from the Reactor Coolant System (Reference 3.63, Section 3.4.4).

The other component, recirculation pump seal leakage is assumed to be 18 gpm per pump for a total of 36 gpm. The analysis recognized testing of similar types of pump seals under loss of pump seal cooling conditions with durations ranging from 0.5 hour to 56 hours. In all tests, the resulting pump seal leakage remained below 5 gpm. The analysis concluded that the assumed leakage of 18 gpm per pump is a reasonably conservative estimate.

2.3.8 Shutdown Margin Analysis

Not applicable to BWRs for FLEX.

2.3.9 FLEX Pump and Water Supplies

FLEX Pump

A FLEX pump capable of 925 GPM and 378' head is used for multiple functions. In the event that RCIC is not available, the FLEX pump has the capability of making up directly to the reactor vessel using a FLEX modification through the RHR Service Water line to the RHR "A" injection line. Additionally, the FLEX pump is capable of injecting to the RPV through RHR "B" injection line via an existing B.5.b connection.

During Shutdown or Refueling, the FLEX pump is capable of injecting to the RPV through the same connections as previously described.

North Well Pump

A new North Well Pump has been installed (Reference 3.84) in an enclosed structure capable of withstanding the design basis tornado missile and the design basis earthquake. The new pump was chosen considering the inherently rugged design due to the lack of extended shafts and connections. The pump is rated at 262 gallons per minute at 226' of head. The motor is 20 hp.

Early in the event, the North Well Pump is capable of discharging directly to the Emergency Condensate Storage Tank through FLEX connections in the Control Building. Maintaining adequate level in the ECST will allow continuous RCIC operation with a cold water supply.

The North Well Pump also provides a suction source for the FLEX pump.

ECST

Two Emergency Condensate Storage Tanks, located in the basement of the Control Building, provide the normal suction source for RCIC and are used as the primary source of cold water during a Beyond Design Basis External Event. The two tanks are cross connected and nominally contain 100,000 gallons of water per station commitment 910822-02 (NRC SER, 10CFR50.53 - Station Blackout). The ECSTs can be refilled via an installed connection (reference 3.78).

Hotwell

The hotwell at Cooper Nuclear Station has been evaluated to be available after an earthquake. The FLEX strategy utilizes the additional 80,625 gallons of clean water by transferring the contents of the hotwell to the ECST by use of a Hotwell Transfer Pump that was installed (reference 3.78).

Missouri River

The Missouri River is an available suction source capable of providing makeup to the RPV if a clean water source is not available.

2.3.10 Electrical Analysis

Calculations (References 3.34 through 3.37) were performed to determine the amount of time each 125VDC and 250VDC battery could operate during an Extended Loss of All AC Power (ELAP). The batteries are estimated to be able to supply all required loads for at least the following time periods:

- 125 VDC Division 1: 9 hours 5 minutes
- 125 VDC Division 2: 10 hours 30 minutes
- 250 VDC Division 1: 9 hours 30 minutes
- 250 VDC Division 2: 12 hours

A FLEX 175kW Diesel Generator is used to re-power the 1C Battery Chargers to ensure a division of batteries is re-charged within the 9 hour window available.

2.3.11 Internal Flooding

The Fire Protection system has a Diesel Fire Pump that has its own DC source and will auto start on low pressure in the system. The Fire Protection piping is not Seismic Class 1 throughout the plant; however, the Fire Protection piping is restrained to Seismic Class 1 in the Control Building Corridor (Reference 3.22, Section X-8.2.8.1) and the Reactor Building (Reference 3.80) which would effectively preclude failure of the piping during a seismic event.

CNS does not credit any safety related active AC powered dewatering systems for mitigating ground water intrusion into the portions of the plant which contain SSCs credited in the FLEX strategies or that require access for personnel during the BDBEE.

2.4 Spent Fuel Pool Cooling/Inventory

2.4.1 Phase 1 Strategy

No Phase 1 actions are required to maintain SFP cooling. The normal SFP water level at the event initiation provides for at least 21 feet, 6 inches (Reference 3.63, Specification 3.7.6) of water inventory above the top of the stored spent fuel.

The most limiting time to fuel uncovery is 45.67 hours (Reference 3.39, Attachment C), resulting from a full-core offload, 5 days after shutdown, with fuel pool gates installed, and an initial SFP temperature of 150°F (Mode 5). For other Modes, 200.56 hours (8.36 days) are available to fuel uncovery, which results from a partial core off-load of 160 bundles, 30 days after shutdown, with fuel pool gates installed, and an initial SFP temperature of 150°F.

2.4.2 Phase 2 Strategy

Phase 2 SFP Cooling equipment is staged beginning at ~24 hours into the event. A minimum of 45.67 hours is available prior to uncovery of fuel (Reference 3.39). The strategy in Phase 2 is to supply makeup water to the SFP at rates greater that the SFP boil off rate of 70 gpm (Reference 3.65).

Primary Strategy:

The primary strategy uses the portable FLEX pump to tie into a Fuel Pool Cooling (FPC) System chemical decontamination connection. Valves are aligned to supply makeup through the FPC System to the SFP through the normal fill location.

Alternate Strategy:

The alternate strategy employs a portable FLEX pump through hoses to makeup to the spent fuel pool.

2.4.3 Phase 3 Strategy

For Phase 3, CNS will employ the same SFP cooling strategy used in Phase 2.

2.4.4 Systems, Structures, Components

2.4.4.1 Primary Connection

The primary make up to the Spent Fuel Pool uses the hardened well, a bladder and portable FLEX Pump to pump water to a chemical decontamination connection. The chemical decontamination connection through a valve lineup provides a pathway to the Spent Fuel Pool.

2.4.4.2 Alternate Connection

There are no connections associated with the alternate connection strategy: all equipment is portable and does not require physical connections to permanent plant equipment. The alternate make up to the Spent Fuel Pool consists of the hardened well, bladder and portable FLEX Pump with hose run directly to the Spent Fuel Pool.

2.4.4.3 Ventilation

Per the NEI 12-06 guidance, a baseline capability for Spent Fuel Pool Cooling is to provide a vent pathway for steam and condensate from the Spent Fuel Pool. The FLEX strategy to cope with the pressurization of the refueling floor and prevent buildup of steam and condensation is to open the Reactor Building Roof Hatch. In order to establish flow of air through the Spent Fuel Pool area, it is also necessary to open the Reactor Building Personnel Airlock, Railroad Airlock Doors on ground level and Alternate Shutdown Room (ASD) doors.

2.4.5 Key Reactor Parameters

Parameters to be monitored to maintain spent fuel pool cooling are:

Parameter	Instrument	Indicator Location
Spent Fuel Pool Level	FPC-LIT-1, FPC-LIT-2	Cable Spreading Room, Control Bldg 903 Corridor
Spent Fuel Pool Level	Visual	Local at SFP
Spent Fuel Pool Temperature	M&TE	Local at SFP

2.4.6 Thermal Hydraulics Analyses

A calculation (Reference 3.39) was performed to determine times to fuel pool boiling and fuel uncovery given a loss of fuel pool cooling. The calculation assumed a full core offload with the fuel pool gates installed and an initial SFP temperature of 150°F. The initial fuel pool water level is assumed to be 36 feet, the lowest procedurally allowed.

Results were provided based on time after shutdown. For a full core offload, 5 days after shutdown the time to fuel pool boiling was 3.82 hours with a fuel uncovery time of 44.82 hours. For the power operation case where only 220 recently offloaded bundles remained in the spent fuel pool 30 days after shutdown, the time to fuel pool boiling was 13.29 hours with a fuel uncovery time of 155.82 hours.

2.4.7 FLEX Pumps and Water Supplies

FLEX Pumps

The FLEX pump may be used to provide cooling to the Spent Fuel Pool via two methods. The first method relies upon a Chemical Decontamination connection in the Fuel Pool Cooling System to supply water to the Spent Fuel Pool. The second method takes a direct approach using a 5" hose run from the discharge of the FLEX Pump to the Spent Fuel Pool.

North Well Pump

The new North Well Pump is an enclosed structure capable of withstanding the design basis tornado missile and the design basis earthquake. The new pump was chosen considering the inherently rugged design due to the lack of extended shafts and connections. The pump is rated at 262 gallons per minute at 226' of head. The motor is 20 hp.

The North Well Pump provides a suction source for the FLEX pump to provide makeup through either the Fuel Pool Cooling System or directly to the SFP.

2.4.8 Electrical Analysis

Spent Fuel Pool level is monitored by instrumentation installed to comply with NRC Order EA-12-051 (reference 3.93). The instrumentation has a backup battery installed with a seven day capacity. Additionally, if necessary, any 9 to 36 VDC battery may be installed to supplement the installed backup.

2.5 Containment Integrity

2.5.1 Phase 1 Strategy

During Phase 1, containment integrity is maintained by normal design features of the containment, such as the containment isolation valves and the Hardened Containment Venting System (HCVS) (Reference 3.94). In accordance with NEI 12-06 (Reference 3.15), the containment is assumed to be isolated following the event. As the torus heats up and the water begins to boil, the containment will begin to heat up and pressurize. Additionally, the torus level rises due to the transfer of inventory from the ECST to the torus (via RCIC and SRVs). According to BWROG analysis (Reference 3.31), containment parameters can be controlled within design limits by utilization of the HCVS to vent the containment. In this case, the HCVS is used as implemented per EA-13-109 (Reference 3.4), with control from the Main Control Room (MCR). CNS has performed a MAAP analysis (Reference 3.54) to establish the containment venting control parameters during an ELAP. The analysis determined that the containment should be vented at ~15 psig. Containment pressure should then be maintained between 5 psig and 15 psig until such time as another means of reducing torus temperature becomes available.

NEDC 13-004 (Reference 3.32) performed an initial analysis to confirm that CNS's response to an ELAP agreed with the conclusions of the generic GE analysis. In NEDC 13-004 a 10" wetwell vent was modeled with a discharge coefficient of 0.75. This analysis showed that containment parameters stayed within limits.

NEDC 14-026 (Reference 3.54) subsequently used a containment vent discharge coefficient of 0.35 in the site specific MAAP analysis.

NEDC 15-020 (Reference 3.90) then determined the required sizing of the HCVS piping. This analysis determined the flow coefficient for the 12" pipe to be 0.39 which enveloped the MAAP analysis assumption of 0.35.

CNS has implemented BWROG Emergency Procedure Guideline/Severe Accident Guideline, Revision 3 (Reference 3.28) which allows performance of the containment venting strategy and includes provisions for maintaining the containment pressure positive and operating pumps within NPSH limits.

The containment design pressure is 62 psig (Reference 3.22, Section V-2.3). Containment pressure limits are not expected to be reached during the event as indicated by MAAP analysis, because the HCVS is utilized for venting prior to exceeding any containment pressure limits.

Phase 1 (i.e., the use of permanently installed plant equipment/features) of containment integrity is maintained throughout for the first 24 hours of the event via the installed HCVS dedicated Uninterruptable Power Supply (UPS) / Battery / Battery Charger (Reference 3.94).

2.5.2 Phase 2 Strategy

Containment integrity is maintained by deploying a portable FLEX 60KW diesel generator, to power the HCVS inverter (Reference 3.81).

2.5.3 Phase 3 Strategy

The Phase 2 strategy is continued throughout the event.

2.5.4 Systems, Structures, Components

2.5.4.1 Hardened Containment Venting System (HCVS) (Reference 3.81)

The HCVS is a reliable, severe accident capable, wetwell venting system that complies with the requirements of NRC Order EA-13-109. The flow path includes a motor operated valve and two air operated valves in the line from the torus to the elevated release point on the Reactor Building roof.

The motor operated valve, PC-MOV-233MV, is provided power during an ELAP from a dedicated PC233MV UPS. Shortly after the event occurs, a transfer switch is manipulated to provide the valve power from the UPS. The valve is opened and remains open for the rest of the event.

A separate HCVS UPS provides power to the controls for the air operated valves, as well as a number of indications and alarms. Four transfer switches are used to swap power to the HCVS UPS for all available components. The air operated valves, PC-AOV-237AV and PC-AOV-AO32, have accumulators to provide sufficient pneumatic supply for operation for at least the first 24 hours of the event. A Mechanical Remote Operating Station (MROS) is installed to provide nitrogen as a pneumatic source for at least a week of valve operations.

2.5.5 Key Reactor Parameters

Parameters to be monitored to maintain containment are:

Parameter	Instrument	Indicator Location
Drywell Pressure	PC-PI-513 (0 to 2 psig), PC-PI-2104AG (0 to 100 psig)	Local rack
Torus Pressure	PC-PI-20 (0 to 2 psig), PC-PI-2104BG (0 to 100 psig)	Local rack
Drywell Temperature	PC-TI-505A, B, C, D and E (50 to 600F)	Control Room
Drywell Temperature	PC-TE-505A,B, C, D and E, with use of M&TE (50 to 600F)	Control Room
Torus Temperature	PC-TR-24 (PC-TE-2A to -2H	Control Room

Torus Temperature	PC-TE-1A thru H and PC-TE-2A thru H with use of M&TE (0 to 250F)	Local, Cable Spreading Room
Torus Temperature	PC-TI-2A, C, E and G (0 to 250F)	Local ASDR
Torus Level	PC-LI-110 (-6' to +6' H2O)	Local ASDR
Hard Pipe Vent Open Indication	PC-RIL-SPV32	Control Room
Hard Pipe Vent Closed Indication	PC-GIL-SPV32	Control Room
PC 233MV Open Indication	PC-RIL-MV233	Control Room
PC 233 MV Closed Indication	PC-GIL-MV233	Control Room
PC 237AV Open Indication	PC-RIL-SPV237	Control Room
PC 237AV Closed Indication	PC-RIL-SPV237	Control Room

2.5.6 Thermal Hydraulics Analyses

See Section 2.3.6.

2.5.7 FLEX Pumps and Water Supplies

See Section 2.3.9.

2.5.8 Electrical Analysis

See Section 2.3.10.

There is a motor operated valve, PC-MOV-233MV, in the HCVS flow path, which is powered by a dedicated UPS during the event. The UPS requires only enough capacity to open the valve once, as the valve is de-energized after being opened.

During the event, the HCVS UPS provides power to the controls and indication for the two air operated valves in the HCVS flow path, PC-AOV-237AV and PC-AOV-AO32, as well as a number of indications and alarms. The HCVS UPS has a 24 hour capacity. Beyond that time, a battery charger powered by the FLEX 60kW DG will maintain the UPS charged.

2.6 Characterization of External Hazards

2.6.1 Seismic

The seismic criteria for Cooper Nuclear Station (CNS) include two design basis earthquake spectra: Operating Basis Earthquake at 0.1g and Safe Shutdown Earthquake (SSE) at 0.2g (Reference 3.22, Section II-5). Per NEI 12-06 Section 5.2, all sites will consider the seismic hazard.

An Engineering Report (Reference 3.73) was completed and determined that potential soil liquefaction from the severe seismic event will not impede FLEX equipment deployment.

2.6.2 External Flooding

Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are not complete and therefore not assumed in this submittal. Mitigating Strategy Assessments (MSAs) will be completed using NRC approved guidance within the NRC and Industry agreed to time-table.

The design basis flood is a value of 903.0 Mean Sea Level (MSL) for the Probable Maximum Flood (PMF) (Reference 3.22, Section II-4). The general ground elevation surrounding CNS Class I Structures is elevated 13 feet above the natural floodplain to 903 feet MSL. The finished floor elevation of all Class I Structures is placed at elevation 903.5 feet MSL, or 1/2 feet above the PMF event. These structures were designed for a hydraulic load equivalent to a groundwater elevation of 903 feet. The station site grade level of 903 feet MSL has been raised 13 feet above the natural grade level of 890 feet MSL, in order to bring final grade one foot above the existing 902 feet MSL levee constructed by the Corps of Engineers. This levee was raised above its original design level and presently has a three foot minimum free board over the 1952 flood of record (899 feet MSL). Flooding of the station is considered to be extremely unlikely due to the combination of upstream Missouri River flood control and the high final site grade. With respect to the 1,000 year, 10,000 year, and 1,000,000 year (PMF) floods, these water levels will provide 3-½ feet, 1-½ feet, and 6 inches of freeboard respectively below the 903'6" grade floor elevation of the principle structures.

The FSBs have a minimum floor elevation of 903.5ft MSL; which is equal to the finished floor elevation of all Class I structures, or 0.5ft above the Probable Maximum Flood (PMF) event specified in CNS USAR Section 4.2.2.1 Note: During a Probable Maximum Precipitation (PMP) event CNS USAR Vol. II - Section 3.0 Meteorological Design Bases, sub-section 3.2.3 Precipitation states; "......Class I and Class II buildings are protected from the effects of precipitation through the use of roof drains and overflow scuppers. ... The remaining local site drainage is designed such that any excess rainfall not immediately absorbed into the ground will flow away from the buildings to be discharged into drywells or low lying areas adjacent to the plant site. Accordingly, these designs can safely remove the accumulated water from the probable maximum precipitation rate described in Section II-3.1.3, and can also accommodate the AEC's estimated 9.7 in./hr in one hour rainfall rate without adverse effects on the safety-related systems necessary for safe shutdown."

Per NEI 12-06, the site is considered a "dry" site, i.e., the plant is built above the design basis flood level and the external flooding hazard need not be considered.

2.6.3 Severe Storms with High Wind

The design wind pressure for the station and structures is 30 lbs per square foot which is the equivalent of sustained winds up to 100 mph (Reference 3.22, Section II-3). Station structures have been designed to withstand this wind velocity in accordance with ASCE Paper 3269. Additionally, Class I structures are designed to the following (Reference 3.22, Section XII-2):

- Tornado design criteria
    - A tangential velocity of 300 mph.
    - A transverse velocity of 60 mph.
    - A pressure drop of 3 psi occurring over a 3 second time interval.
- Tornado generated missile criteria
    - A 35 foot long utility pole with a 14 inch butt with an impact velocity of 200 mph.
    - A one-ton missile such as compact-type automobile with an impact velocity of 100 mph and a contact area of 25 square feet.
    - A 2 inch extra heavy pipe, 12 feet long.

- Any other missile resulting from failure of a structure or component or one which has potential of being lifted from storage or working areas at the site.

The CNS site is located in an area characterized by the Nuclear Regulatory Commission (NRC) as having tornado design wind speeds greater than 130 mph per NEI 12-06, Diverse and Flexible coping Strategies (FLEX) (Reference 3.15, Figure 7-2) and as such, the tornado hazard has been considered.

2.6.4 Ice, Snow and Extreme Cold

The design low outside temperature is -5°F dry bulb which will only be exceeded 1% of the time during the winter (Reference 3.22, Section II-3). The CNS site is located within the region characterized by the National Oceanic and Atmospheric Administration as having a 3-day snowfall of up to 18" (Reference 3.15, Figure 8-1) and would need to consider snow removal in the deployment of the FLEX strategy. The CNS site is also located within the region characterized by Electric Power Research institute (EPRI) as ice severity level 4 (Reference 3.15, Figure 8-2). As such, the CNS site is subject to severe damage to power lines and/or existence of large amounts of ice. Cold temperatures, snow, and ice has been considered (Reference 3.15).

2.6.5 High Temperatures

All sites will address high temperatures (Reference 3.15) and as such the CNS design high outside temperature is 97°F dry bulb (79°F wet bulb) (Reference 3.22, Section II-3). Based on historical records, this temperature is only expected to be exceeded 1% of the time during the summer.

2.7 Planned Protection of FLEX Equipment

FLEX equipment is stored in two facilities, one located inside the Protected Area in close proximity to the Fire Pump House, the second outside the Protected Area at the southwest corner of the Low Level radioactive Water (LLRW) Storage pad. The structures are constructed of standard light gauge metal having 6-20 foot long ISO containers in combination with two additional vehicle bays constructed of light gauge metal. (Reference 3.74)
Cooper Nuclear Station is located in High Wind Hazard (Tornado) Region 1 with anticipated wind speeds greater than 200 mph (Reference 3.15, Figure 7-2). Cooper Nuclear Station's FLEX Storage Buildings (FSB) are designed utilizing NEI 12-06, Section 7.3.1.1, Configuration b, and in

accordance with the Wind Load requirements of ASCE 7-10.

ER 2016-25 compared the CNS USAR description of tornado path and size to a statistical analysis of all tornados reported by the National Weather Service Storm Prediction Center from 1950 to 2015

Subsets of the NOAA Severe Weather GIS Data were chosen for evaluation:

- Continental the United States
- 400 Mile Radius Originating at Cooper Nuclear Station
- Four State region consisting of Nebraska, Iowa, Kansas, and Missouri
- 250 Mile Radius originating at Cooper Nuclear Station
- 100 Mile Radius originating at Cooper

No notable differences were apparent in any of the data sets that would impact the evaluation.

The predominant vector of tornadoes within 250 miles of CNS is 22.2 degrees south of east, there are also a significant portion of tornados that approach directly from the south west; larger tornados move more West Southwest to East Northeast.

As two trajectories are prominent in the subsets both were considered applicable for the evaluation. These trajectories are:

- Directly along the Southwest to Northeast line.
- 22.2 degrees south of east line

Based on the analysis; tornado size distribution shows that 90% of all tornados in the data set are 600ft (200 yds) in width. Tornado size was conservatively taken as the USAR defined tornado with a width of 750ft, based on the trajectories evaluated it has been determined that the minimum separation distance that exists between the facilities is 869ft which is larger than required.

The FSBs are located in diverse locations; one of the buildings is located next to robust structures including the Radwaste Building, Condensate Storage Tanks, Fire Protection Tanks, Control Building, and to some extent the Reactor Building. The other FLEX Storage Facility is located approximately halfway between the Missouri River and the Western Bluffs.

Both buildings are identical in design and utilize a reinforced concrete slab to support and retain all structures from postulated environmental conditions (Reference 3.15).

Protection of equipment from impacts due to extreme high temperatures is performed in accordance with NEI 12-06 Section 9.3.1, which states that equipment should be maintained at a temperature within a range to ensure its likely function when called upon. The FSB's ventilation system

is designed to limit high temperatures within the storage spaces to within 6 degrees of outside ambient temperature using power ventilators.

An electric unit heater rating of 2 KW maintains the subject building storage areas at a minimum indoor design temperature of 60 degrees on a design basis winter day with an ambient temperature of -30 Degrees.

A Fire detection system is installed in each of the storage buildings. The systems are designed and installed per the latest edition of NFPA 70, National Electrical Code and NFPA 72, National Fire Alarm Code. The fire detection/alarm system includes a dedicated phone located in the Final Access Control area which will provide quick response in the event of a fire.

Protection of FLEX equipment against external flooding events is performed in accordance with NEI 12-06, Section 6.2.3.1.1a, which states that equipment is protected from floods if it is stored above the flood elevation from the most recent site flood analysis. The design basis flood level at CNS is 903 feet at Mean Sea Level. The finished floor elevation of the slabs is at 903' 6" to ensure protection against a PMF (probable maximum flood) consistent with all other major site buildings and facilities.

Seismic Events - The structures are designed utilizing NEI 12-06 Section 5.3.1 configuration b), in accordance with the Seismic requirements of ASCE 7-10, *"Minimum Design Loads for Buildings and Other Structures".*

During subsequent reviews of the FSB design, it was determined that the buildings were designed using values less that the SSE. Subsequently, ER 2016-003 (Reference 3.86) was completed and determined that other loadings on the buildings were sufficient to bound the loadings that would be experienced during an SSE and the buildings would remain operational following the SSE.

Tie down points are provided inside the FSBs to secure equipment and protect the equipment from interacting with each other in the event of an earthquake.

2.8 Planned Deployment of FLEX Equipment

2.8.1 Haul Path and Accessibility

Wind and Debris

Pre-determined haul paths have been identified and documented in the FSGs. Figure Attachment 1 shows the haul paths from the FLEX storage buildings to the various deployment locations. 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. Additionally, CNS obtained a front end loader for removing large debris in the event of a beyond-design-basis external event. The loader was originally planned to be stored inside the Turbine Building in the ISO-Phase area. Fire Protection has determined that vehicles should not be stored permanently in that area without installed fire suppression. Accordingly, the LLRW Pad near the FLEX Storage Building (FSB) has been determined to be an acceptable location.

Engineering Report 16-025 documented the acceptability of the location of the FFSBs from a tornado/missile hazard standpoint and found them to be acceptable from a diverse location standpoint such the site's FLEX capability will remain functional following a high wind/tornado event. The rationale is that there is sufficient separation between the FSBs such that the event can only affect one. The FSBs each contain a smaller tractor/loader that can move all debris likely to be generated on-site except for vehicles.

The same rationale applies to the debris that the loader is needed to remove, i.e. vehicles. The vehicles that the loader would have to move are all located in the parking lots outside of the protected area between LLRW pad and the FLEX deployment area on the north side of the plant. For high wind/tornado events that affect the FSB on the LLRW pad, the FSB on the north side of the plant will be unaffected, clear of large debris and not require the loader to be used. For high wind/tornado events that affect the FSB on the north side of the plant, the FSB and loader on the LLRW pad will be unaffected and able to clear the debris. Therefore, at least one piece of equipment remains functional and deployable to clear obstructions from the pathway between the FLEX storage buildings and its deployment location(s).

Soil Liquefaction

ER 2016-002 (Reference 3.73) evaluated potential soil liquefaction from a severe seismic event.

The deployment path covers two unique soil types. The first is in CNS Structural Fill. The second is in Native Alluvium that surrounds the CNS Structural Fill. The FSB inside the protected area at CNS is in Type II Structural Fill which is not expected to

liquefy. At CNS Type II Structural Fill covers underlying Alluvium; which is expected to liquefy. One facility and the two deployment paths from this facility are built in structural fill; expected settlements are minimal; 0.47 to 1.17 inches. ER 2016-002 estimates the settlement due to liquefaction of the native alluvium to be between about 4 and 14 inches following the Review Level Earthquake (RLE). The median settlement is 8.7 inches with a mean of 8.7 inches. The RLE is 0.3g which is greater than the Safe Shutdown Earthquake (SSE) of 0.2g. This indicates that the expected settlements will be on the lower end of the estimates.

Equipment Considerations

The FLEX Equipment has the ability to cope with some finite amount of differential settlement; in regards to CNS FLEX equipment this ability can be limited to the smallest distance from the ground to the any part of the equipment. For CNS this distance is at least 8.7 inches. Furthermore the FLEX Equipment includes Earthmoving Equipment of which have the capacity to handle the settlements described above.

Three conclusions were made in relation to liquefaction and Cooper Nuclear Station's FLEX Portable Equipment Deployment Paths.

1. Portions of the Deployment Path in Structural Fill will produce minimal settlements.
2. Portions of the Deployment Path not in Structural Fill will experience settlements averaging 8.7 inches.
3. CNS has adequate measures in place to cope with the expected settlements produced from soil liquefaction during severe seismic events. These measures include: diverse deployment pathways, rugged equipment selection, and FLEX Strategy including earthwork equipment.

Therefore potential soil liquefaction from the severe seismic event will not impede FLEX equipment deployment.

Snow and Ice

CNS is in an area that experiences snow and ice during the winter and, as such, develops a snow removal plan each season. The FSBs each contain a small tractor/loader that is capable of removing any accumulation if the site's removal equipment is unavailable.

Additionally, in the event that the backup source of water (Missouri River) would need to be used, any ice that forms along the bank can be removed by the site's debris removal equipment.

Generally speaking, along rivers and streams, ice formation takes place as frazil ice in the center of a stream and shore ice growth along the borders of the stream (Reference 3.87).

During the winter, the US Army Corps of Engineers will closely monitor ice conditions below Garrison, Oahe and Gavins Point dams and make reservoir regulation adjustments to lessen the impact of river ice formation.

Doors and Gates

The potential impairments to required access are:

- doors and gates
- 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 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, and tornado. 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 through various barriers in order to connect FLEX equipment to station fluid and electric systems. For this reason, certain barriers (gates and doors) are opened and remain open. This violation of normal administrative controls is acknowledged and is acceptable during implementation of FLEX coping strategies. Non-licensed operators have a key ring on their person which allows access to all areas of the plant. Licensed operators may obtain a key ring from Security.

The ability to open doors for ingress and egress, ventilation, or routing of temporary cables/hoses is necessary to implement the FLEX coping strategies. The deployment of onsite FLEX equipment to implement coping strategies beyond the initial plant capabilities (Phase 1) requires that pathways between the FLEX storage building(s) and various deployment locations be clear of debris resulting from BDB seismic, high wind (tornado) or flooding events.

Vehicle access to the protected area is via the double gated sally-port at the security building. As part of the security access contingency, the sally-port gates are manually controlled to allow delivery of FLEX equipment (e.g., generators, pumps) and other vehicles such as debris removal equipment into the protected area.

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

2.9 Deployment of Strategies

2.9.1 Core Cooling Strategy

Section 2.3.2 provides additional detail for the core cooling strategy. Prior to transitioning to Phase 2, FLEX 175 kW and FLEX 60 kW diesel generators are staged near the OWC building.

The FLEX 175 kW diesel generator is deployed approximately 2 hours into the BDBEE and is operational supporting battery charger operation around 5 hours into the event. Color coded cables are routed from the FLEX 175kW diesel generator through the North Turbine Double Doors, west to the Control Building Doors on 903'6 elevation. The cables will pass through the Control Building Doors down the Control Building Hallway to the "C" Battery Charger Room.

The FLEX 60 kW diesel generator is deployed approximately 2 hours into the BDBEE and is operational around 8 hours into the event. Color coded cables are ran from the FLEX 60 kW diesel generator to a portable fused disconnect located on the south side of the fence leading to the cask storage area. A single cable is run from the portable fused disconnect in the North East direction towards the North Well. A hole is cut in the exterior fence; a piece of PVC is placed through the fence and the serpentine wire which will allow the cable to be routed through the PVC and on to the North Well.

The North Well will support refilling the Emergency Condensate Storage Tank by routing a 5" hose from the well South through the previously placed PVC; the hose is then routed east along the paved path towards the North Turbine double doors. Once the hose is through the Turbine Bldg. doors it is routed though the Control Building 903'6" doors and down the Control Building corridor to a FLEX ECST connection.

2.9.2 Alternate Core Cooling Strategy

Section 2.3.2 provides additional detail for the alternate core cooling strategy. The North Well can provide makeup to the vessel via FLEX pump with hose routed to either the RHRSW FLEX connection or the RHR "B" B.5.b connection. The makeup water is then injected to the RPV through the RHR "A" or "B" injection lines.

Hose from the North Well is routed South to the laydown area west of the MPF. A 20,000 gallon bladder can also be staged in this area to be used as a surge volume, if required, and will can receive the discharge from the North Well pump. The bladder or the North Well pump will provide a suction source for a FLEX pump, also staged in the laydown area. A 5" hose is routed from the discharge of the FLEX pump along the North side of the MPF and into the double doors on the North side of the Turbine Bldg. Once inside the Turbine Bldg. the hose is routed East through the Control bldg. doors on 903'6" elevation. The 5" hose will continue down the Control Bldg. corridor to the RHRSW FLEX connection where the hose is connected and ready for RPV injection.

The secondary alternate injection route will use the same North Well Pump to bladder to FLEX pump alignment. The discharge of the pump is routed into the MPF through the West MPF door, into and through Radwaste. The 5" hose will route through the Airlock doors into the Reactor Bldg. traversing through the Reactor Bldg. to the Southwest stairwell and down the stairwell to the RHR "B" B.5.b connection.

2.9.3 Containment Strategy

Section 2.5.2 provides additional detail for the containment strategy. The HCVS is utilized to maintain containment at 5 to 15 psig thereby ensuring containment integrity. FLEX equipment is staged to provide a power supply to the HCVS UPS / battery charger, this in turn will maintain the ability to open and close PC-AOV-AO32 during the event.

The FLEX 60 kW diesel generator previously staged in section 2.9.1 is used to provide the power source for the HCVS battery charger. Color coded cables are routed through the North Turbine Double Doors, West to the Control Bldg. doors 903'6" and down the corridor and then to the Northeast corner where the FLEX connection for the HCVS battery charger is located.

2.9.4 Electrical Strategy

Section 2.3.2 provides additional detail for the electrical strategy. As discussed in the core cooling section, the FLEX 175 kW diesel generator is deployed approximately 2 hours into the BDBEE and is operational supporting battery charger operation around 5 hours into the event. Color coded cables are routed from the FLEX 175kW diesel generator through the North Turbine Double Doors, West to the Control Building Doors on 903'6" elevation. The cables will pass through the Control Building Doors down the Control Building Hallway to the "C" Battery Charger Room.

Also discussed in the core cooling section was the staging of the FLEX 175 kW diesel generator. A single 120 VAC power cord is routed from the 175 kW diesel generator through the North Turbine Double Doors, West through the Control Bldg. Doors, through Door H107 to Stair A-10 (South), up the stairs to the 120VAC Vital Instrumentation receptacle located in Cable Spreading Room control building 918' Column J-8. The power cord is plugged into this receptacle powering vital level instrumentation located in the Control Room. (Reference 3.83)

2.9.5 Fueling of Equipment

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

The primary source of fuel oil for portable equipment is two bunkered, seismic Class 1 fuel oil storage tanks with two additional day tanks located in Seismic Class I structures. All the tanks are protected from winds, floods, tornados and missiles. These tanks will be the initial supply. All together these tanks contain 52,500 gallons of available fuel oil.. The two storage tanks are buried and their appendages are protected by a substantial cover. The manholes providing access to the capped fill connections and the tank vents are all located above 906 feet MSL (Reference 3.22, Section II-4).

Based on published ratings for the FLEX equipment the EDG fuel oil storage tanks have a capacity of greater than 30 days.

Equipment	Run Time		On board capacity		Refills in 24 hrs	USAGE	
175kw DG	24	hrs	440	gal	1	440	
Baldor DG 6kw	4.6 - 6	hrs	4.6	gal	~4	20	
Generac DG 5.5 kw	21.4	hrs	12	gal	~1	60	
Sulliar Air Compressor	8.3	hrs	56	gal	~3	168	
Godwin Pump	4.8	hrs	24	gal	~6	144	
55 KW DG	34	hrs	170	gal	0.7	120	
Tractor			10	gal	0	0	
						952	gallons per day
						52500	total storage on site
						55.15	days fuel available

The quality of fuel oil in EDG fuel oil storage tanks is maintained in accordance with the diesel fuel oil testing program (reference CNS Technical Specifications 5.5.9). Fuel oil in the fuel tanks of portable diesel engine driven FLEX equipment is maintained in the preventative maintenance program in accordance with the manufacturer's guidance and existing site maintenance practices.

Fuel oil is transported to FLEX equipment in a 100 gallon fuel tank mounted on a portable trailer. This self-contained trailer contains a portable generator, electric pump for pumping fuel into the 100 gallon tank and an attached fuel pump for pumping the contents of the 100 gallon tank to the FLEX equipment.

There are two trailers, one stored in each FSB.

The trailer is towed by one of two tractors, one stored in each FSB.

2.10 Offsite Resources

2.10.1 National Response Center

The industry has established two National SAFER Response Centers (NSRCs) to support utilities during BDBEEs. Cooper Nuclear Station (CNS) has established contracts with the Pooled Equipment Inventory Company (PEICO) to participate in the process for support of the NSRCs as required.

Each NSRC will hold five sets of equipment, four of which are able to be fully deployed when requested, the fifth set is assumed to be in a maintenance cycle. In addition, on-site FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC or utilize adapters stored in the FLEX storage buildings. In the event of a BDBEE and subsequent ELAP/LUHS condition, equipment is moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team.

The SAFER Response Plan for CNS (Reference 3.68) has been approved. Staging areas, travel paths and congested area flight plans have all been walked down and approved by NSRC personnel.

For CNS, Staging Area C is the Tecumseh Municipal Airport. Staging Area D is the Nebraska City Municipal Airport. From these sites, equipment can be taken to the CNS site to Staging Area B in the southwest parking lot. Staging Area B is accessible by helicopter if ground transportation is unavailable.

CNS has a Memorandum of Understanding (MOU) with the Nebraska Emergency Management Agency for support during Phases 2 and 3 of FLEX (Reference 3.89)

Communications are established between the site and the SAFER team via satellite phones and required equipment moved to the site as needed. First arriving equipment is delivered to the site within 24 hours from the initial request. The order at which equipment is delivered is identified in the CNS's "SAFER Response Plan."

2.10.2 Equipment List

The equipment stored in and maintained at the NSRC for transportation to the Staging Area C or D to support the response to a BDBEE at CNS is listed in table below. The table identifies the equipment that is specifically credited on the FLEX strategies for CNS but also lists the equipment that is available for backup/replacement should on-site equipment break down. Since all the equipment is located at the local assembly area, the time needed for the replacement of a failed component is minimal.

Provisions have been included in the FSGs to verify correct phase rotation of NSRC DGs by starting a small pump and verifying correct rotation prior to starting larger equipment.

BWR Portable Equipment from NSRC											
Use and (Potential / Flexibility) Diverse Uses											
Portable Equipment	Qty Req'd	Qty Provided	Power	Core Cooling	Cntmt	SFP	Access	Instr	Performance Criteria		Notes
Medium Voltage Generator	2	2	Turbine	x		x		x	4160 VAC	1 MW	
Low Voltage Three-Phase Generator	0	1	Turbine		x				480 VAC	1 MW	
High Pressure Injection Pump	0	1		x		x			2000 psi	60 gpm	
RPV Makeup Pump	0	1		x		x			500 psi	500 gpm	
Low Pressure / Medium Flow Pump	1	1	Diesel	x					300 psi	2500 gpm	
Low Pressure / High Flow Pump	0	1				x	x		150 psi	5000 gpm	
Mobile Lighting Tower	0	3					x		440,000 Lumens	30 Feet Tall	
Air Compressor	0	1	Diesel		x				150 psi	300 cfm	
Water Storage	0	1	N/A	x		x			20,000 gal		

2.11 Habitability and Operations

2.11.1 Equipment Operating Conditions

Following a BDBEE and subsequent ELAP event at Cooper, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment is 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.

2.11.1.1 Battery Rooms

During battery charging operations in Phase 2, ventilation is required in the main battery rooms due to hydrogen generation. Portable ventilation fans are deployed, which are powered by the FLEX 175kW DG.

Three fans are included with the 175 KW DG. One is placed in the operating battery room blowing inward from the corridor, one is placed in the operating charger room blowing inward, and the third is placed in the door at the end of the same corridor blowing out into the Turbine Building. This provides ventilation for heat removal and for hydrogen gas removal. This exhaust path is the same path that is used for the current Station Blackout strategy; which is different from the plant's design. The normal ventilation flowrate is 1100 cfm with the battery room exhaust fans running and 360 cfm with essential ventilation running and the battery room exhaust fans secured (Reference 3.91). The portable fans included with the 175KW DG are MAXXAIR model BF24TF, rated at 2800 cfm minimum and 4000 cfm maximum (low and high speeds respectively). This is more than double the plants design.

The calculation that establishes the basis for 72 hour temperature profiles for both the Reactor Building and Control Building during the FLEX scenario, NEDC 15-002 (Reference 3.55) was revised to accommodate 72 hours from 24, and extra sensitivity studies were generated to document how the model changes with various parameters.

For the 903' elevation of the Control Building where the battery rooms and switchgear rooms are located, the base case with no compensatory actions demonstrates peak temperatures are less than 120°F for all rooms up to 6 hours prior to simulated heat loads from the -A, -B, or -C chargers coming online. 120°F is used as the temperature limit for DC SWGR A/B and the Instrument Repair Room with the C Charger. Documentation shows that the actual operability limit for this equipment is 130°F. Door H110 to DC SWGR A is opened at 30 minutes by guidance currently in CNS Procedure 5.3SBO, slightly improving results. The model shows that beyond 6 hours with battery charging heat loads coming online, medium (~4,000 cfm) fans are required directed into rooms H109 (-C Charger), H103 (-A Charger), or H104 (-B Charger). Only rooms with an operating charger will require a fan, no more than two of the chargers will be run concurrently. Additionally, in order to manage the temperature in controlled corridor outside of these rooms, a medium (~4,000 cfm) fan will be placed in door H105 from the Turbine Building. With these prescribed compensatory measures, the peak temperatures in these rooms are acceptable for the electrical equipment required for FLEX for the 72 hour duration modeled.

The GOTHIC model was iterated into 31 cases with various combinations of compensatory actions and timings. Additionally, multiple sensitivity studies are also iterated from select cases to demonstrate area temperatures relationship with several inputs. Extensive documentation of the FLEX scenario in this regard allows for a bounding determination on required actions for FLEX coping. Sensitivity Study 9 provided in Attachment 11.3AF establishes a bounding temperature profile for the primary FLEX strategy. All rooms of interest on the 903' elevation of the Control Building remain below their temperature limit for the entire 72 hour duration. The general ventilation requirement established in the previous paragraph for a medium sized (4,000 cfm) fan in both doors H112 ('C' Charger operating) and H105 (Turbine Building) is confirmed by Sensitivity Study 9 temperature results

2.11.1.2 Spent Fuel Pool Area

Per the NEI 12-06 guidance, a baseline capability for Spent Fuel Cooling is to provide a vent pathway for steam and condensate from the SFP. The FLEX strategy to cope with and prevent buildup of steam and condensation is to open the Reactor Building roof hatch. In order to establish flow of air through the SFP area, it is also necessary to open the following:

- Reactor Building Personnel Airlock
- Railroad Airlock doors on the ground level
- ASD doors on the 2nd floor

2.11.1.3 RHR Pump Room

As part of Phase 3 strategies, an RHR pump is placed into service in order to perform torus cooling and shutdown cooling. This results in heat addition to the RHR pump room due to heat generated by the RHR pump motor as well as heat dissipated from the associated piping and RHR heat exchanger. For long term RHR pump operation, the RHR pump room must be cooled to maintain room temperatures within acceptable ranges (limited by maximum allowable RHR pump motor requirements). This can be accomplished once the RRC 4160 VAC FLEX DG is connected to the 4160 VAC critical bus restoring power to REC and the RHR room cooler. The SW supply to REC has been modified to allow cooling water to be supplied from the FLEX pump via an external connection point. REC can then be supplied to the RHR room cooler.

2.11.2 Heat Tracing

The FLEX Strategy does not credit any heat tracing. FLEX equipment stored in FLEX Storage Areas is maintained at a minimum temperature of 60°F on a design basis winter day of -30°F (Reference 3.74).

2.12 Personnel Habitability

2.12.1 Main Control Room Habitability

MCR habitability must be maintained for the duration of the ELAP. During the ELAP, some Control Room vital electronics, instrumentation and emergency lighting remain energized from emergency DC power sources. A new calculation for MCR heatup (Reference 3.55) documents was performed for the ELAP scenario. For the FLEX scenario with extended loss of AC power (ELAP), loss of Ultimate heat sink (LUHS), 97°F outside air temperature with no nighttime relief, the model demonstrates that 932' elevation Control Building Control Room temperatures are slightly above the 110°F limit after approximately 40 hours. The peak temperature at 72 hours is approximately 112°F. The compensatory measures associated with this peak temperature are a 40" (~11,000 cfm) fan in the Control Room with doors H300, D301, D304, R208, R209 and R210 open at 8 hours.

Impact to Control Room personnel at this temperature can be managed with reducing individual stay times through personnel rotation and controls per Procedure 0.36.1, Heat Stress Prevention Program. Should the opportunity exist to implement flexible ducting on the 40" portable fan from the outside through doors R208/209/210, the high temperatures will be rapidly mitigated. With the prescribed compensatory measures, the peak temperature for the Control Room is acceptable for personnel and equipment. Note that the 110°F limit applied here is for personnel; equipment operability limit is 120°F.

2.12.2 RCIC Availability and RCIC Room Habitability

The RCIC room will have a continuous heat load under ELAP conditions in Phases 1 and 2 of the BDBEE, since RCIC is utilized throughout the event as the primary source of core cooling. The RCIC System is designed for continuous operation at a temperature of 148°F and 100% relative humidity (Reference 3.22, Section IV-7.5). Calculations (Reference 3.55) have been performed for an ELAP that conclude for the Reactor Building, the GOTHIC model demonstrates that opening and closing doors is not sufficient to preclude exceeding the 148°F temperature limit in the Reactor Core Isolation Cooling (RCIC) quad to support RCIC operation. A small (~1,500 cfm) fan is required with a substantial amount of ducting to effectively displace the hot air in the room and turn it over with cooler air from the controlled corridor elevation 903'-6" just outside the Reactor Building personnel airlock. The portable fan is located in the controlled corridor with ducting going through doors R101, R102, and R103 down to at least the 881'-9" elevation of the RCIC quad. The model demonstrates required implementation of this fan is somewhere between 8 and 12 hours. Additionally, it is expected that in order to promote natural circulation throughout the Reactor Building general areas all the way from the 903'-6" elevation to the 1001'-0", the combination of R101, R102, R103, R110, X110, and Reactor Building Roof Hatch are opened at 3 hours (prior to the requirement of ventilation in the RCIC quad specifically). The model demonstrates that opening these doors an hour later at 4 hours in the prescribed combination, is acceptable and bulk air flow throughout the general Reactor Building volume does occur.

The Steam Tunnel does not require any portable ventilation or opening of door R104. The temperature peaks in the Steam Tunnel after 5 minutes at just above 275°F, then decays away with the heat load from the steam lines. The operability limit in the Steam Tunnel is 308°F for RCIC-MOV-MO16.

The Reactor Building GOTHIC model was iterated into 26 cases with various combinations of compensatory actions and timings. Multiple sensitivity studies will go along with the model as well to demonstrate the relationship between RCIC room and Steam Tunnel area temperatures and several inputs.. After 72 hours, Phase 3 activities will begin which will reduce the heat load in the building by either placing Suppression Pool Cooling or Shutdown Cooling in service.

For the purposes of NEI 12-06, it is not anticipated that continuous habitability would be required in the RCIC room. If personnel entry is required into the RCIC room, then personal protective measures such as ice vests will be taken.

2.13 Lighting

Battery powered emergency lighting is available throughout the plant, including the Control Room, Battery Room, Diesel Generator Rooms, critical service switchgear areas, stairways, and exits (Reference 3.22, Section X-17.0). This lighting will only be available for a short time (1.5 to 8 hours) into an event.

Portable DC and AC lighting is stored in the FSBs. 3 large battery powered portable area lights are stored in the FSB(s). One will be used in the Control Room, one at the portable DG deployment area and one at the well area. These lights have a 24 hour capacity (LED). After 24 hours a portable generator will supply AC lighting to the Control Room and additionally be able to recharge the battery powered lights during daylight hours.

Operators will have flashlights for use in areas where other lighting is minimal. Sufficient replacement batteries are stored in the FLEX Storage Areas.

2.14 Communications

NEI 12-01 (Reference 3.13) provides required emergency communications capabilities during and Extended Loss of AC Power (ELAP). CNS has chosen to credit the Public Address/Paging System (Gaitronics), handheld radios, and satellite phones to fulfill these capabilities.

The Public Address/Paging System (Gaitronics) is credited for alert and notification of on-site personnel. The system is not powered by AC sources and is available for 4 hours without taking manual actions.

Handheld radios are credited for on-site communication. Each radio has an installed battery (capacity 10 hours) and is stored in a charger-conditioner, thereby being fully charged at the start of any emergency. Beyond the installed battery capacity, there are a dry cell battery adapter and dry cell batteries for each handheld radio (capacity 20 hours) stored with emergency radios. The combination of these power sources provides greater than 24 hours of capacity for each handheld radio.

Satellite phones are credited for off-site communication. Each satellite phone has an installed battery and two backup batteries. The batteries have a 12 hour capacity each, thereby providing greater than 24 hours of capacity for each satellite phone.

Docking stations and remote antennas have been installed to allow using an analog phone to access the satellite phones (Reference 3.75).

Batteries for the Base 1 and Base 2 radios have been upgraded to 24 hour capacities (Reference 69). Prior to 24 hours a portable 6KW FLEX generator is deployed to maintain one of the base station(s) available.

For the battery operated equipment, delivery of replacement batteries is assumed to occur after 24 hours into the event. Thus, handheld radios and satellite phones will provide sufficient communication capability for the duration of the event (Reference 3.66 and 3.96).

2.15 Water Sources

The table below notes the onsite sources of water available for use during a BDBEE and whether these sources are qualified against the hazards listed in NEI 12-06. The unqualified water sources may be available during an event but cannot be credited due to lack of robustness against one or more of the hazards.

Procedures direct the use of high quality water prior to the use of lower quality water (Reference 3.26).

- The ECSTs are used first
- If available, the Condensate Storage Tanks (CST) are used to refill the ECSTs
- If available, the Hotwell is transferred to the ECSTs
- Lastly, the North Well is used to either fill the ECSTs for continued RCIC operation or to provide a source of water for the FLEX Pump.

- The North Well water is untreated or "hard" water. While it is free of loose debris that could clog fuel inlet screens it does contain suspended and dissolved solids, which if used indefinitely, potentially could plate out and foul heat transfer surfaces. In order to minimize this potential fouling, the FLEX Phase 3 strategy will be implemented as soon as NSRC equipment is available to place shutdown cooling in service. This will reduce the well water usage to only that needed to make up for leakage.

FLEX Qualified Water Sources						
Water Source	Minimum Capacity (gal)	Seismic Qual	Flood Qual	High Wind Qual	Low Temp Qual	High Temp Qual
ECST	97744 (Reference 3.30)	Y	Y	Y	Y	Y
Suppression Pool	655,667 (Reference 3.63, Section 3.6.2.2)	Y	Y	Y	Y	Y
Hotwell	80,625 (Reference 3.30)	Y	Y	Y	Y	Y
North Well	-	Y	Y	Y	Y	Y
Missouri River	-	Y	Y	Y	Y	Y
FLEX Unqualified Water Sources						
CST	684,000 combined (Reference 3.30)	N	N	N	Y	Y

2.16 Shutdown and Refueling Analysis

CNS has incorporated the supplemental guidance provided in the NEI position paper entitled "Shutdown / Refueling Modes" to enhance the shutdown risk process and procedures. A defense-in-depth approach is used to support FLEX strategies during shutdown/refueling modes.

If a BDBEE were to occur during Shutdown or Refueling operating conditions, the FLEX Strategy would immediately transition to Phase 2, as installed core cooling components, such as RCIC and HPCI, would be unavailable.

The primary core cooling FLEX Strategy would be would be to set up a FLEX Pump to receive suction directly from the North Well Pump. The flow would be directed by hose and installed piping to the RHRSW connection point. Valves would be lined up to allow this arrangement to feed the RPV through the Division 1 LPCI injection line.

The alternate core cooling FLEX Strategy would also be to set up the FLEX Pump to receive suction directly from the North Well Pump. However, this alternate strategy would direct flow through hose to the RHR B.5.b connection. Valves would then be lined up to allow feed to the RPV through the Division 2 LPCI injection line.

Other FLEX Strategies employed for a BDBEE during power operation would remain the same for a BDBEE during Shutdown or Refueling conditions.

2.17 Sequence of Events

Action item	Elapsed Time	Action	Time Constraint Y/N [1]	Remarks / Applicability
	0	Event Starts	NA	Plant @ 100% power

[1] Instructions: Provide justification if No or NA is selected in the remark column. If yes include technical basis discussion as requires by NEI 12-06 Section 3.2.1.7

1	1 - 3m	HPCI/RCIC start on low level	N	Normal plant response for trip from 100% power
2	11 -13m	Secure HPCI after one cycle or ~10 minutes after HPCI starts	N	--
3	30m	Open DC SWGR room doors and Control Room panel doors	Y	--
4	1h	Designate as ELAP, enter ELAP/FLEX Procedures	N	--
5	1.5h	Open PC-MO-233MV to prepare for containment venting	Y	--
6	3h	Establish Rx Building Alternate Ventilation	Y	--
7	4h	Deep load shed of DC distribution panels complete	N	--
8	4h	If available, begin transferring hotwell water to ECST	N	This is not driven by time, but by ECST level
9	5h	FLEX 175KW generator in service	Y	Prior to 9 hours
10	7h	Stage portable DC lighting in CR	Y	--
11	8h	Begin torus venting to maintain within limits	N	--
12	8h	Place makeup well in service to fill ECSTs	Y	--
13	8h	Place RCIC ventilation in service	Y	Prior to 12 hrs
14	9h	Place Alternate Control Building Ventilation in service	Y	Prior to 12 hrs
15	12h	Begin refueling operations	Y	--
16	13h	Place FLEX Air compressor in service.	Y	Prior to 24 hrs
17	13h	Place AC powered CR lighting in service.	N	DC lighting has 24 hr capacity and can be rotated with others

18	17h	Provide power to HCVS	Y	Prior to 24 hrs
19	18h	Provide power to radio base station(s)	Y	Prior to 24 hrs
20	24h	Stage portable pump and begin makeup to SFP.	N	
21	72h	Begin transferring to Phase 3 operations with NSRC equipment	N	

2.18 Programmatic Elements

2.18.1 Overall Program Document

The CNS FLEX Program Document provides a description of the Diverse and Flexible Coping Strategies (FLEX) Program for CNS. 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 will not adversely impact the approved FLEX strategies.

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

2.18.2 Procedural Guidance

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

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

Procedural Interfaces have been incorporated into procedural guidance for Station Blackout (Reference 3.26) to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP.

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

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

2.18.3 Staffing

Using the methodology of NEI 12-01, an assessment of the capability of the Cooper Nuclear Station (CNS) on-shift staff and augmented Emergency Response Organization (ERO) to respond to a Beyond Design Basis External Event (BDBEE) was performed (Reference 3.76.

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

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

A team of subject matter experts from Operations, Operations Training, Radiation Protection, Chemistry, Security, Emergency Planning and FLEX Project Team personnel performed a tabletop in 2016. The participants reviewed the assumptions and applied existing procedural guidance, including applicable draft and approved FLEX Support Guidelines (FSGs) for coping with a BDBEE using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and the estimated time to prepare for and perform the task.

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

2.18.4 Training

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

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

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

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

2.18.5 Equipment List

Phase	Description of Equipment	Strategy	Performance Criteria
2	FLEX Pumps (2)	Core, SPF, Ctmt	925 gpm, 378' head
2	FLEX 175kW Diesel Generators (2)	Ctmt	175 kw
2	FLEX Air Compressors (2)	Core	300 cfm @ 200 psi
2	FLEX 60kW Diesel Generators (2)	Core, SPF, Ctmt	60 kw
2	FLEX 6kW Diesel Generators (12)	Support	6 kw
2	FLEX Tractors (2)	Support	Capable of towing pumps, DG's, Refuel trailer and compressors and debris removal
2	FLEX Front End Loader	Support	Capable of moving large projected debris.
2	Refueling Trailers (2)	Support	100 gallons
2	20,000 Gallon Bladders (2)	Core, SPF, Ctmt	20,000 gallon clean water suction source
2	Portable Heaters (4)	Support	
2	Fans (2)	Support	>11,000 SCFM

Equipment Validation

FLEX Pump - Calculation NEDC 15-002 (Reference 3.55) determined the pump requirements and published performance curves and actual pump performance data were compared and verified the pump capacity is within that required. The FLEX pump hose deployment uses the existing credited B.5.b hose deployment and was not re-validated. The pumps were sent to the vendor and validated to be within published capacity.

FLEX 175 KW Generator - CED 6037041 (Reference 3.81) installed new connection points to allow the plug-and-play hookup of the generator to the 125VDC and 250VDC Battery Chargers. Engineering Evaluation 08-024 originally determined the requirements for this generator and those requirements did not change as a result of changing the connection points. The existing generator has been periodically load tested by Maintenance Plan 8000000331734. The second generator was load tested by the vendor prior to delivery and is the same make and model as the first generator.

FLEX 60 KW Generator - CED 6037041 also determined the requirements for the 60 KW generator. The limiting requirement was the starting of the new FLEX Well. EC 6037044 installed the new well via WO 5065100. Operation 0270 of the WO hooked up the generator to the well and demonstrated correct rotation, flow and pressure of the well. The generators were validated by the vendor to be within published capacity prior to delivery.

FLEX Air Compressor - Burns and Roe Calculation CA-0408 (Reference 3.88) specified the volumetric flow rate to instrument as 260 cfm with 100% margin. Of this, only 100 cfm is required for FLEX. The FLEX Air Compressor are rated for 300 cfm which gives them 200% of margin. The compressors were validated by the vendor to be within published capacity on site.

2.18.6 Equipment Maintenance and Testing

Maintenance and testing of FLEX equipment is governed by the CNS PM Program and is consistent with INPO AP-913 and utilizes the EPRI Preventive Maintenance Basis Database as an input in development of CNS PM Basis Templates. Based on this, the CNS PM program for FLEX equipment follows the guidance NEI 12-06, Section 11.5.

The CNS PM Basis Templates include activities such as:

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

The CNS PM Basis Templates provide assurance that stored or pre-staged FLEX equipment is being properly maintained and tested. In those cases where EPRI templates were not available for the specific component types, Preventative Maintenance (PM) actions were developed based on manufacturer provided information/ recommendations.

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

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

- Portable FLEX equipment may be unavailable for 90 days provided that the site FLEX capability (N) is available.
- If portable equipment becomes unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., repair equipment, use of alternate suitable equipment or supplemental personnel) within 72 hours.

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

3. References

3.1 EA-12-049, Order to Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, March 12, 2012

3.2 Deleted

3.3 EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, 3/12/2012

3.4 EA-13-109, Reliable Hardened Containment Vent NRC Order, June 6, 2013

3.5 10 CFR 50.54(x), Conditions of licenses

3.6 10 CFR 73.55(p), Physical Protection of Plants and Materials (Suspension of Security Measures).

3.7 JLD-ISG-2012-01 Revision 1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, January 22, 2016

3.8 Deleted

3.9 JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, 8/29/2012

3.10 SECY-12-0157, Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments, 11/26/2012

3.11 SRM to SECY-12-0157, Staff Requirements - SECY-12-0157 - Consideration of Additional Requirements for Boiling Water Reactors with Mark I and Mark II Containments, 3/19/2013

3.12 NEI 10-05, Assessment of On-Shift Emergency Response Organization Staffing and Capabilities, June 2011

3.13 NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, May 2012

3.14 NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," August 2012

3.15 NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Rev. 2, December 2015

3.16 INPO Event Report LI -11-1, Fukushima Daiichi Nuclear Station Fuel Damage Caused by Earthquake and Tsunami, March 18, 2011

3.17 INPO Event Report LI -11-2, Fukushima Daiichi Nuclear Station Spent Fuel Pool Loss of Cooling and Makeup, April 25, 2011

3.18 INPO Event Report LI -11-4, Near-Term Actions to Address the Effects of an Extended Loss of All AC Power in Response to the Fukushima Daiichi Event, August 1, 2011

3.19 INPO Event Report LI -13-10, Nuclear Accident at the Fukushima Daiichi Nuclear Power Station, March 28, 2013

3.20 NUMARC 87-00 Rev.1, Guidelines and Technical Bases for NUMARC initiatives Addressing Station Blackout at Light Water Reactors, August 1988.

3.21 Request for Information Pursuant to Title 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, 3/12/2012

3.22 CNS Updated Safety Analysis Report

3.23 EE-01-147, Summary of Main Steam Isolation Valve (MSIV) Leakage Pathway to the Condenser Seismic Qualification, Revision 2

3.24 Task Interface Agreement 2004-04, Acceptability of Proceduralized Departures from Technical Specifications (TS) Requirements at the Surry Power Station, (TAC Nos MC4331 and MC4332) Accession No ML060590273

3.25 NLS9100631, Response to Recommendations on Station Blackout, 10CCFR50.63

3.26 Emergency Procedure 5.3SBO, Station Blackout

3.27 Emergency Procedure 5.3ALT-STRATEGY, Alternate Core Cooling Mitigating Strategies

3.28 Emergency Operating Procedure 5.8, Emergency Operating Procedures (EOPs)

3.29 System Operating Procedure 2.2.100, 175 KW FLEX Diesel Generator System

3.30 CNS-PSA-007, Cooper PRA Deterministic Calculations Notebook Revision 1

3.31 NEDC 33771P, GEH Evaluation of FLEX Implementation Guidelines, Revision 1

3.32 NEDC 13-004, CNS Evaluation of Diverse and Flexible Coping Strategies for Extended Loss of AC Power, February 19, 2013

3.33 NEDC 89-1886, CNS Station Blackout (SBO) Condensate Inventory, August 22, 2007.

3.34 NEDC 87-131A, 250VDC Division 1 Load and Voltage Study, Revision 13C1, September 10, 2012.

3.35 NEDC 87-131B, 250VDC Division 2 Load and Voltage Study, Revision 12C2, September 10, 2012.

3.36 NEDC 87-131C, 250VDC Division 1 Load and Voltage Study, Revision 15C1, September 10, 2012.

3.37 NEDC 87-131D, 250VDC Division 2 Load and Voltage Study, Revision 13C13, September 10, 2012.

3.38 NEDC 91-261, Station Blackout with RCIC and RR Seal Leak, Rev.3, November 4, 2012

3.39 NEDC 92-147, Estimation of Time to Fuel Pool Boiling and Fuel Uncovery with Loss of Decay Heat Removal, Revision 2, November 26. 2008.

3.40 Deleted.

3.41 NEDC 07-065, Reactor Building Heatup with a Loss of Cooling, December 19, 2014.

3.42 NEDC 14-001, FLEX Storage Facility Structural Calculation

3.43 NEDC 14-002, CNS FLEX Storage Buildings Documentation for Electrical Design Basis, May 3, 2014.

3.44 NEDC 14-003, FLEX Storage Building HVAC Sizing Analysis, February 12, 2014

3.45 NEDC 14-004, SFPLI Seismic Stress Analysis, December 19, 2014

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3.90 NEDC 15-020, Owner Acceptance of TetraTech Calculation CNS001-194-4933-001 "Calculation of HCVS Flow Rate and Vent Size"

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3.92 CED 6036622, Base 1 Battery Upgrade and WO 5128980, CNS COMM TOWER REPLACE BATTERIES

3.93 CED 6036741, Reliable Spent Fuel Pool Level Instrumentation

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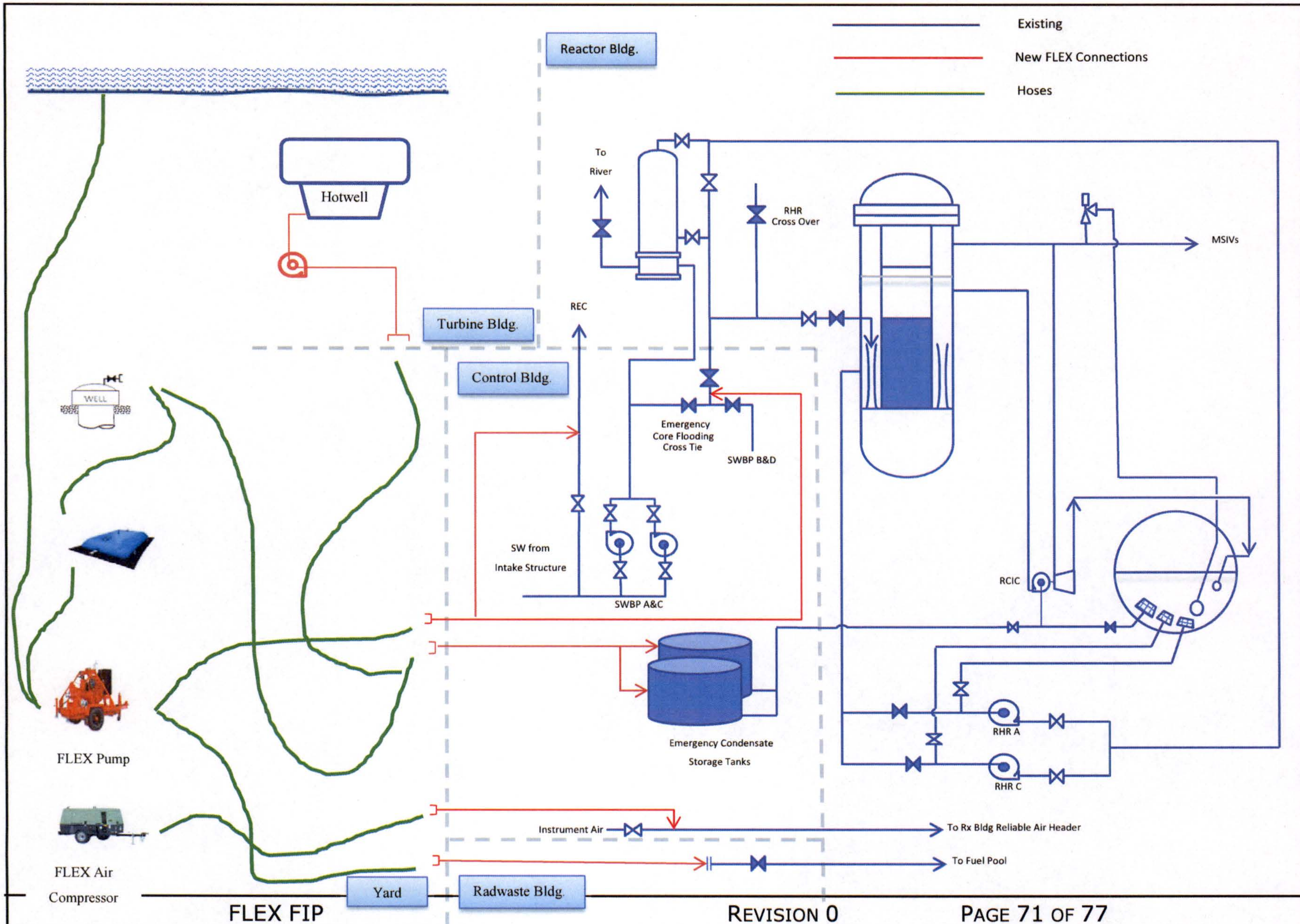
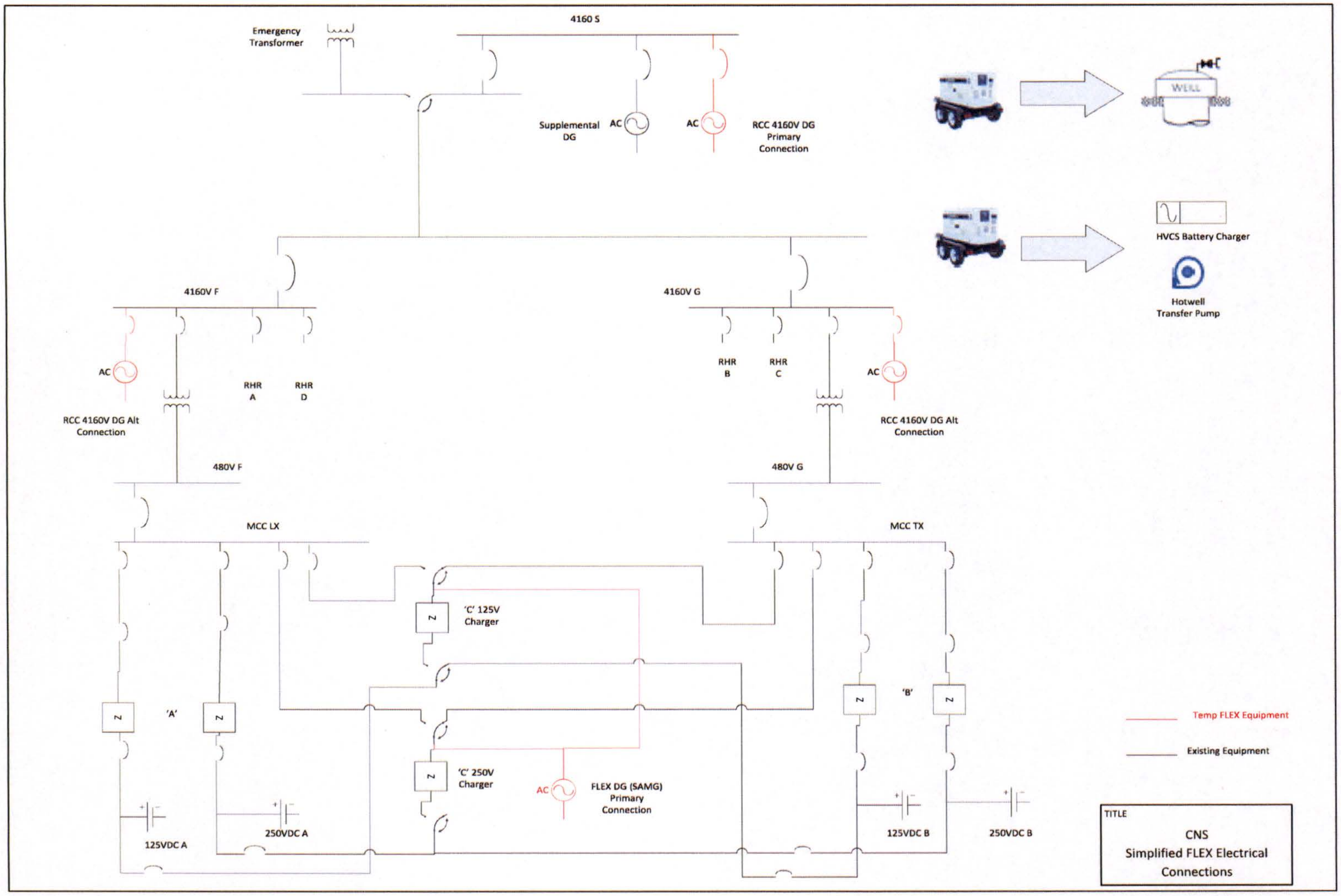
3.95 FLEX Support Guideline 5.10FLEX, FLEX Support Guidelines (FSGs)

3.96 Emergency Procedure 5.7.21, Maintaining Emergency Preparedness - Emergency Exercises, Drills, Tests, And Evaluations

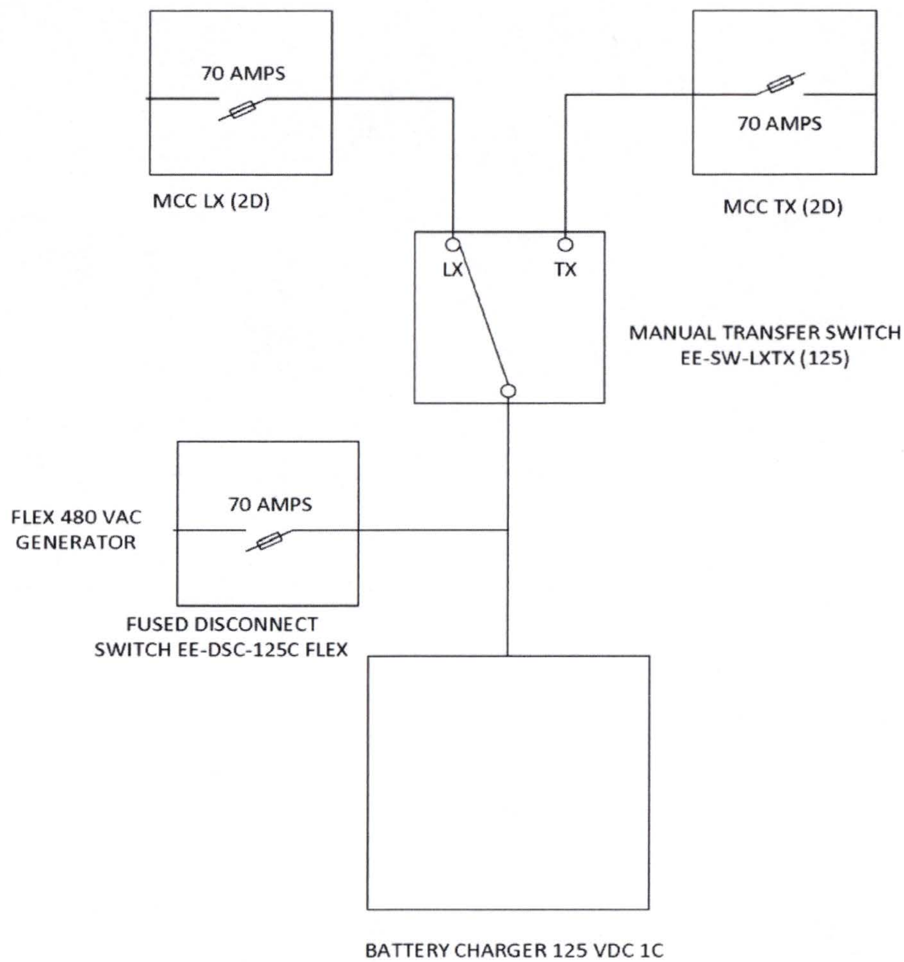
0.ATTACHMENT 1 DRAWINGS/SKETCHES

- CNS Simplified FLEX Connection Diagram
- CNS Simplified Electrical Connection Diagrams
- FLEX Flow Connections
- CNS Storage Location and Deployment Path Diagrams

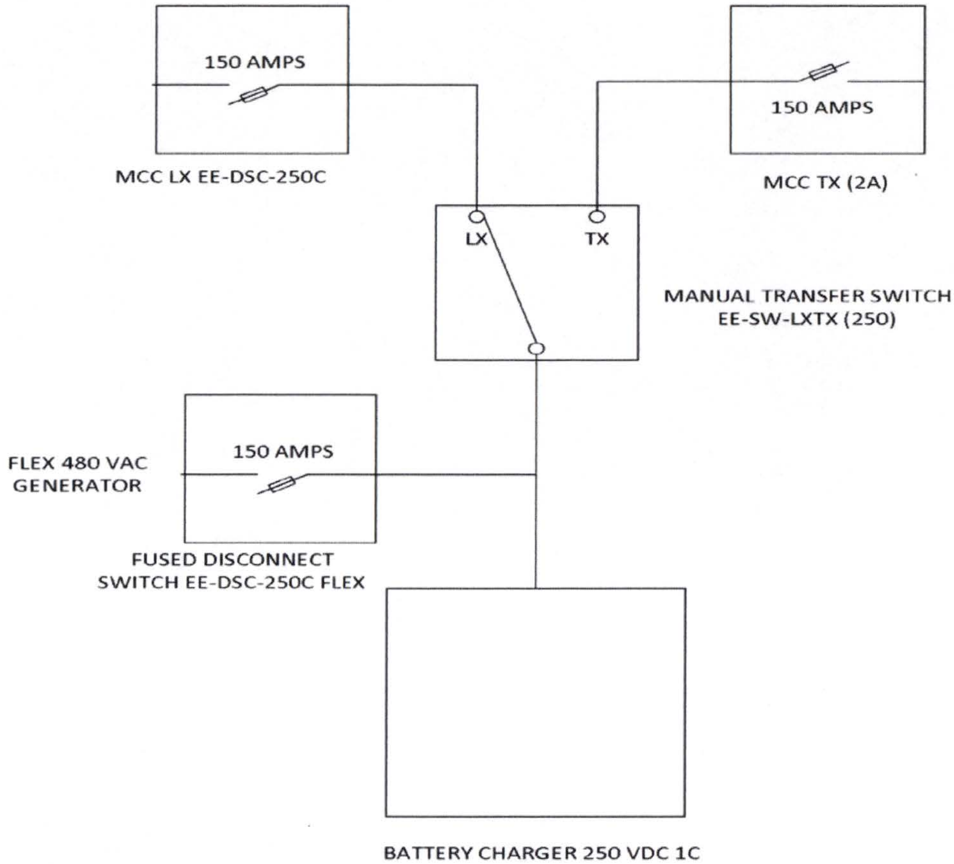

Existing
New FLEX Connections
Hoses
Reactor Bldg.
Hotwell
Turbine Bldg.
Control Bldg.
To
River
REC
RHR
Cross Over
MSIVs
Emergency
Core Flooding
Cross Tie
SWBP B&D
SW from
Intake Structure
SWBP A&C
RCIC
Emergency Condensate
Storage Tanks
RHR A
RHR C
FLEX Pump
FLEX Air
Compressor
Instrument Air
To Rx Bldg Reliable Air Header
To Fuel Pool
Yard
Radwaste Bldg.



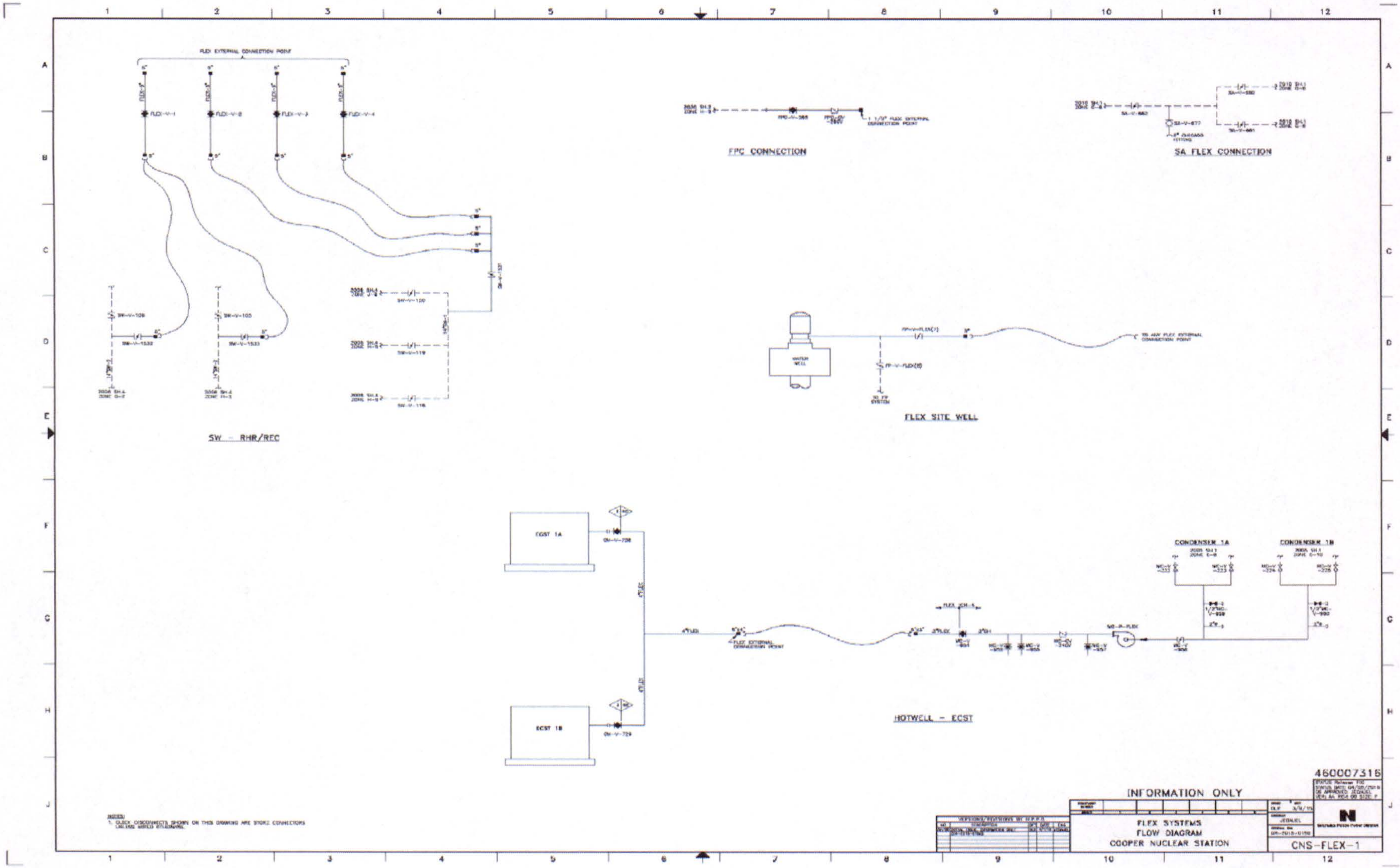
Simplified Electrical Connections



125 VDC 'C' Charger Disconnects



250 VDC 'C' Charger Disconnects


FPC CONNECTION
SA FLEX CONNECTION
SW - RHR/REC
FLEX SITE WELL
ECST 1A
ECST 1B
CONDENSER 1A
CONDENSER 1B
HOTWELL - ECST
460007316
INFORMATION ONLY
FLEX SYSTEMS
FLOW DIAGRAM
COOPER NUCLEAR STATION
CNS-FLEX-1

FLEX Storage Buildings Locations

FLEX Haul Paths