Omaha Public Power District (OPPD)

Fort Calhoun Station Diverse and Flexible Coping Strategies (FLEX) Overall Integrated Plan

February 2013

General Integrated Plan Elements (Ft. Calhoun Station)

Determine Applicable Extreme External Hazard **Ref: NEI 12-06, Section 4.0-9.0** **JLD-ISG-2012-01, Section 1.0**	*Input the hazards applicable to the site; seismic, external flood, high winds, snow, ice, cold, high temps.* *Describe how NEI 12-06 Sections 5 – 9 were applied and the basis for why the plant screened out for certain hazards.*

The applicable extreme external hazards for Fort Calhoun Station (FCS) are seismic, external flood, high winds, snow, ice, cold temperatures and high temperature as detailed below:

<u>Seismic Hazard Assessment</u>

Per FCS Updated Safety Analysis Report (USAR) Section 2.4.3 and Appendix F [Ref. 1, Sections 2.4.3 and App. F], the seismic criteria for FCS includes two types of earthquake spectra in accordance with the recommendations of the U.S. Coast and Geodetic Survey (USC&GS). The Design Basis Earthquake (DBE) values for FCS are the ground acceleration of 0.08g acting in the horizontal direction and two-thirds of 0.08g acting in the vertical direction simultaneously. The Maximum Hypothetical Earthquake values are ground acceleration of 0.17g acting in the horizontal direction and two-thirds of 0.17g acting in the vertical direction simultaneously. Per NEI 12-06 [Ref.2, Section 5.2], all sites will consider the seismic hazard.

The FCS USAR was reviewed to perform a limited evaluation of the liquefaction potential for a design basis earthquake (DBE) event. The site is underlain by 65 to 75 feet of unconsolidated alluvial and glacial deposits, largely loose to moderately compact silty sand and deeper sands and gravels resting on sedimentary bedrock [Ref. 1, Section 2.4.1]. To ensure against liquefaction, a criterion of densities of 85 percent average was established and a vibroflotation system was utilized to provide the necessary densification of soils under principal structures [Ref. 1, Section 5.7.4]. A detailed discussion of the actions against liquefaction is available in Ref. 1, Appendix C. Therefore, the likelihood of liquefaction at the site for a DBE event appears to be low.

Thus the FCS site screens in for an assessment for seismic hazard except for liquefaction for which the likelihood appears to be low.

<u>External Flood Hazard Assessment</u>

USAR Section 2.7 provides the design basis flooding information at FCS. The design basis flood level for FCS is 1014 feet, which based on the estimation by the United States Army Corp of Engineers (USACE) of the flood level that might result from the failure of Oahe or Fort Randall Dams, coincident with a probable maximum flood level of 1,009.3 feet. Flooding protection against the 1,014-foot flood in the Auxiliary Building is provided by removable flood barriers and sandbagging. When required, these flood barriers are installed in openings leading to safety related equipment on the 1,007-foot and 1,011-foot floor elevations. Sandbagging is required at the 1,013-foot elevation of the equipment hatch room (Room 66). Flooding protection in the intake structure is provided by removable flood barriers which extend to at least 1014 feet and intake cell level control maintained by the raw water (RW) pumps.

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Information on beyond design basis (BDB) floods is available in the Individual Plant Examination of External Events (IPEEE). Based on available BDB flooding information, diverse and flexible coping strategy (FLEX) related modifications are being made, where practical, to accommodate higher flood levels. For example, the storage building location being considered is on a nearby elevated spot at EL. 1090 feet.

Thus, the FCS site screens in for an assessment for external flooding.

Storms, Hurricanes, High Winds and Tornadoes

The following information is per USAR [Ref. 1, Chapter 5]:

- The fastest wind speed at the site location for a 100-year period of recurrence is 90 miles per hour (mph) at 30 feet above the ground level.
- The design basis maximum wind velocity of a tornado is 500 mph in some cases and 300 mph in other cases.

Using 500 mph wind speed, the tornado generated missiles are defined as follows [Ref. 1, Table 5.8-2]:

Item	Weight (lbs)	Impact Area, sq. ft.	Velocity, fps
3" pipe x 10' long	76	0.095	640
4" X 12" plank, 12' long	104	0.29	710
Automobile	4,000	31.5	665

Thus, the FCS site screens in for an assessment storms, high winds and tornadoes. The FCS site screens out for hurricanes because it is located several hundred miles from the nearest sea coast.

Snow, Ice Storms and Cold

Per the USAR [Ref. 1, Table 2.5-4], the maximum snow and ice accumulation in and around FCS in any 24-hour period was 18.3 inches. The lowest recorded temperature from National Weather Service data in Omaha is -32°F. Thus, the FCS site screens in for snow, ice storms and cold.

Extreme Heat

The extreme temperature recorded at the site is 114°F, per the USAR [Ref. 1, Table 2.5-5]. Thus, the FCS site screens in for extreme heat.

References:

1. FCS Updated Safety Analysis Report (USAR)
2. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (Flex) Implementation Guide, August 2012

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Key Site assumptions to implement NEI 12-06 strategies. **Ref: NEI 12-06, Section 3.2.1**	*Provide key assumptions associated with implementation of FLEX Strategies:* • *Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are not completed and therefore not assumed in this submittal. As the re-evaluations are completed, appropriate issues will be entered into the corrective action system and addressed on a schedule commensurate with other licensing bases changes.* • *Exceptions for the site security plan or other (license/site specific) requirements of 10CFR may be required.* • *Deployment resources are assumed to begin arriving at hour 6 and fully staffed by 24 hours.* • *Certain Technical Specifications cannot be complied with during FLEX implementation.*

- Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 are not completed and therefore not assumed in this submittal. As the re-evaluations are completed, appropriate issues will be entered into the corrective action system and addressed on a schedule commensurate with other licensing bases changes.
- Initial conditions assumed are in accordance with Ref. 1:

(1) No specific initiating event is used. The initial condition is assumed to be a loss of offsite power (LOOP) at a plant site resulting from an external event that affects the offsite power system either throughout the grid or at the plant with no prospect for recovery of off-site power for an extended period.

(2) All installed sources of emergency on-site AC power sources are assumed to be not available and not imminently recoverable.

(3) Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, high winds and associated missiles are available.

(4) Normal access to the Ultimate Heat Sink (UHS) is lost, but the water inventory in the UHS remains available and robust piping connecting the UHS to plant systems remains intact. The motive force for UHS flow, i.e., pumps, is assumed to be lost with no prospect for recovery.

(5) Fuel for FLEX equipment stored in structures with designs which are robust with respect to seismic events, floods and high winds and associated missiles, remains available.

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

(7) Other equipment, such as portable AC power sources, portable back up DC power supplies, spare batteries, and equipment for 10CFR50.54(hh)(2), may be used provided it is reasonably protected from the applicable external hazards per Sections 5 through 9 and Section 11.3 of Reference 1 guidance, and has predetermined hookup strategies with appropriate procedures/guidance, and the equipment is stored in a relatively close vicinity of the site.

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

(9) No additional events or failures are assumed to occur immediately prior to or during the event, including security events.

- The key assumptions associated with secondary cooling are in accordance with Ref. 3:

  (1) The installed (design) AC independent AFW/EFW system will function for the mission time required to stage the portable pump following initiation of ELAP event.

  (2) The portable SG feed system is capable of maintaining SG level at the RCS pressure required to prevent nitrogen injection from the NSSS applicable passive injection system - Cold Leg Accumulators (CLA), Safety Injection Tanks (SIT), or Core Flood Tanks (CFT) – generic capability of 300 gallons per minute (gpm) at 300 psig at SG injection point.

  (3) The portable SG feed system is capable of maintaining SG level at the RCS temperature required to maintain the reactor subcritical prior to RCS boration.

  (4) The steam relief capability will support the RCS cooldown rate as defined in the NSSS generic ELAP analysis.

  (5) The steam relief capability will maintain the final RCS temperature defined in the NSSS generic ELAP analysis.

- Exceptions for the site security plan or other (license/site specific) requirements of 10CFR may be required and will be communicated later.

- Additional staff resources are assumed to arrive beginning at 6 hours, per Reference 2.

- 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 at all units on a site. Though specific strategies are being developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety will be incorporated into the unit emergency operating procedures in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59. The 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) and/or 10 CFR 73.55(p). The determination to invoke 10 CFR 50.54(x) and/or 10 CFR 73.55 will be made by senior licensed staff, based on observed conditions and available mitigating strategies.

<u>Non-Flooded and Flooded Conditions</u>

Based on historical experience, flooded (external) conditions up to the design basis flood level provide a two-day advance warning. During the two-day advance warning period, the plant is expected to have, as a minimum, normal onsite power and equipment available, with which

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the plant can be brought to a Mode 4 or 5 condition. Mitigation strategies for flooded condition are not required for initiation from modes other than 4 and 5. Mitigation strategies for Modes 4 and 5 are developed for both flooded and non-flooded conditions, and are described in Appendix B, Actions 23 and 24.

References:

1. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (Flex) Implementation Guide, August 2012
2. NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities, Revision 0, May 2012
3. OG-12-434, PWROG Core Cooling Position Paper

Extent to which the guidance, JLD-ISG-2012-01 and NEI 12-06, are being followed. Identify any deviations to JLD-ISG-2012-01 and NEI 12-06. **Ref: JLD-ISG-2012-01 NEI 12-06 13.1**	*Include a description of any alternatives to the guidance, and provide a milestone schedule of planned action.*

FCS expects full compliance with the guidance, with no deviations.

Provide a sequence of events and identify any time constraint required for success including the technical basis for the time constraint. **Ref: NEI 12-06, Section 3.2.1.7 JLD-ISG-2012-01, Section 2.1**	*Strategies that have a time constraint to be successful should be identified with a technical basis and a justification provided that the time can reasonably be met (for example, a walk-through of deployment).* *Describe in detail in this section the technical basis for the time constraint identified on the sequence of events timeline Attachment 1A.* *See attached sequence of events timeline (Attachment 1A).* *Technical basis support information, see attached NSSS Significant Reference Analysis Deviation Table (Attachment 1B).*

General :

1. A site specific NSSS evaluation has been performed for FCS [Refs. 1 and 2]. The analysis was performed using computer code CENTS. The analysis is consistent with WCAP-17601-P [Ref. 3]; Attachment 1B provides a summary of key parameters of interest.

2. Containment integrity was reviewed by use of computer code CONTRANS version ctn2m1.0702. [See Ref. 4.]

The sequence of events described in this section provides an overview of the time constraints and actions taken in response to an Extended Loss of AC Power (ELAP) and/or Loss of Ultimate Heat Sink (LUHS) at FCS. The sequence described below is a general description of plant response and actions by station personnel. It is not intended to define exact completion times.

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- A timeline is provided in Attachment 1A.
- The technical bases for the time constraints and strategies listed in this section and Attachment 1A are provided in Appendix B.
- The timeline provided in Attachment 1A also relates the actions described in this section to the FLEX implementation strategies described in Appendix B and supporting station modifications described in Appendix C that are needed to mitigate the effects of an ELAP/LUHS event.

Deployment strategies for actions to be completed in less than 8 hours have been deemed feasible within the identified time constraints based on preliminary walkdowns conducted by Engineering and Operations personnel. Formal timeline walkthroughs will be completed during the FLEX equipment design and procurement process.

T=0: Initiation of Station Blackout (SBO).

T+1 min: Reactor/Turbine Trip, Turbine Driven Auxiliary Feedwater (TDAFW) pump automatic start on low steam generator (SG) level. SG heat removal via main steam safety valves (SBO credited method), or manual operation of atmospheric dump valve (ADV) or air assisted main steam safety valves. RCS cooling by natural circulation. RCS inventory maintained by isolation of letdown (occurs automatically on high letdown temperature due to loss of Charging/CCW if not manually isolated). 125 VDC/120VAC buses powered from station batteries. Operators enter emergency operating procedures (EOPs), transitioning from Reactor Trip response procedure to SBO procedure. Key actions within procedures include:

- Verification of system response to ensure safety functions is satisfied.
- Attempting alternate methods of starting/loading station Emergency Diesel Generators (EDG)

T+10 min: Isolation of RCP Controlled Bleed-off (CBO) to minimize seal leakage. See discussion of this strategy in Appendix B, Action 2.

T+15 min: Initial shedding of non-vital loads to extend battery life (this is an existing SBO action which will assure at least 8 hours of Station Battery availability).

T+1 hr: Initial actions taken under EOP direction complete (some DC bus load shed actions continue until T+2 hr). Operations personnel survey plant for damage and evaluate likelihood of EDG recovery within 4 hours (FCS design SBO coping period). See discussion of this strategy in Appendix B, Action 3.

T+2 hr: Assessment of EDG status indicates recovery not likely within 4 hours. ELAP declared. Operators transition to functional recovery procedure and implement FLEX response guideline. Initiate rapid cooldown using air assisted main steam safety valves. See discussion of this strategy in Appendix B, Action 5. Begin FLEX equipment deployment. See discussion of this strategy in Appendix B, Action 6.

T+4 hr: Transition from Phase 1 to Phase 2 for Core cooling function by beginning makeup to Emergency Feedwater Storage Tank (EFWST) from Safety Injection Refueling Water Tank (SIRWT). See discussion of this strategy in Appendix B, Actions 8 & 9. If EFWST makeup from the SIRWT is not available, the Ultimate Heat Sink (UHS – Missouri River) or other water source, if available will be used. See discussion of this strategy in Appendix B, Actions 7&10. EFWST makeup is required within 5.2 hours of Auxiliary Feedwater (AFW) initiation during rapid cooldown. EFWST makeup is required within 8 hours of AFW initiation if Hot Shutdown (Mode 3) condition is

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maintained. Rapid cooldown will not be initiated until EFWST makeup has been initiated. See discussion of this strategy in Appendix B, Action 5.

T+7 hr: Establish power to at least one 125VDC bus using a portable diesel generator. Power must be established within 8 hours to prevent battery depletion using current load shed strategy. If it is determined during the design of the portable generator interface that power cannot be reliably restored to at least one DC bus within 8 hours, contingency plans have been developed to either provide additional load shed actions or implement a modification to move certain non-1E loads from the station batteries to a new dedicated non-vital battery. See discussion of this strategy in Appendix B, Actions11 & 12.

T+9 hr: Establish control room ventilation and lighting by either re-powering the control room lighting panel and a control room exhaust fan via a portable diesel generator or using temporary fans and light strings powered from a portable generator. Based on existing calculations and equipment limits, it is estimated that this action must be completed within 10 hours. A control room heatup calculation using the heat inputs and environmental conditions expected during an ELAP caused by a BDBEE will be conducted to validate this estimation. This is considered an open item. See discussion of this strategy in Appendix B, Actions 13 & 14.

T+16 hr: Establish Spent Fuel Pool (SFP) cooling by starting SFP makeup. Boiling in the SFP will start in approximately 19 hours. Boil off from SFP will result in SFP level reduction to 8 ft. above active fuel in approximately 100 hours. Makeup flow rate will be established to maintain SFP level between normal water level and 8 ft. above active fuel. See discussion of this strategy in Appendix B, Actions 15, 16 & 17.

T+24 hr: Establish makeup to SIRWT from an alternate source of water (UHS - Missouri River, water from a FLEX proposed qualified well). Based on makeup needs to the Steam Generators and SFP and using conservative assumptions for available water from the SIRWT, the SIRWT will be depleted in approximately 24 hours. See discussion of this strategy in Appendix B, Action 18.

T+40 hr: Establish makeup to RCS using Charging pumps, FLEX SIRWT Pump or backup FLEX pumps taking suction from SIRWT. Current calculations indicate that core uncovery will occur in approximately 42 hours. See discussion of this strategy in Appendix B, Actions 19 and 20.

T+72 hr: Establish Containment Cooling using equipment supplied from Regional Response Center – 4160 VAC portable diesel generator and high volume water pump to supply containment cooling units and/or Containment Spray. Current calculations indicate that containment cooling will not be required for approximately 250 hours following an ELAP/LUHS. However, implementation of a planned modification to ensure that RCP CBO is isolated during an ELAP will significantly reduce RCP seal leakage, extending the time to challenge containment design limits. An updated analysis will be performed to establish a more accurate time constraint on RCS makeup when the feasibility of the RCP CBO modification is confirmed. See the "Maintain Containment – Phase 3" section of this plan and Appendix B, Action 25 for further details on this strategy.

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T+72hr: Additional resources from Regional Response Center arrive to establish long term methods of:

- Makeup water treatment
- Spent Fuel Pool cooling
- RCS cooling
- Effluent water treatment
- Restoration of installed plant equipment

References:

1. Letter LTR-TDA-11-72, Rev. 0, Analysis of the Fort Calhoun Station NSSS Response to an Extended Station Blackout, dated October 27, 2011
2. Letter LTR-TDA-12-31, Rev. 0-A, Analysis of the Fort Calhoun Station NSSS Response to an Extended Station Blackout, dated May 30, 2012
3. WCAP-17601-P, Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs, Rev. 0, dated August 2012
4. Letter LTR-OA-11-37, Rev. 0, Analysis of the Fort Calhoun Station Containment Response to an Extended Station Blackout, dated November 8, 2011

Identify how strategies will be deployed in all modes. **Ref: NEI 12-06 Section 13.1.6**	*Describe how the strategies will be deployed in all modes.*

FCS has defined the storage and deployment locations of FLEX equipment. Preliminary deployment paths have been identified and are illustrated in Attachment 3. The final deployment paths and storage locations will be identified during the FLEX equipment design process.

To ensure deployment can be achieved within the time constraints for strategies that must be in place within 8 hours, FLEX equipment necessary to accomplish those strategies will be stored in a robust structure (auxiliary building) within the plant power block. Equipment stored within the power block is depicted on the deployment path drawings in Attachment 3.

FCS will develop procedures and administrative guidance to keep the deployment paths open, or define actions to make them open during all modes.

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Provide a milestone schedule. This schedule should include:
• **Modifications timeline**
  o **Phase 1 Modifications**
  o **Phase 2 Modifications**
  o **Phase 3 Modifications**
• **Procedure guidance development complete**
  o **Strategies**
  o **Maintenance**
• **Storage plan (reasonable protection)**
• **Staffing analysis completion**
• **FLEX equipment acquisition timeline**
• **Training completion for the strategies**
• **Regional Response Centers operational**
 	
Ref: NEI 12-06, Section 13.1
	The dates specifically required by the order are obligated or committed dates. Other dates are planned dates subject to change. Updates will be provided in the periodic (six month) status reports.
	
	See attached milestone schedule Attachment 2.

See milestone schedule in Attachment 2. Milestone updates will be communicated in a future 6-month update following identification.

Identify how the programmatic controls will be met. **Ref: NEI 12-06, Section 11** **JLD-ISG-2012-01, Section 6.0**	*Provide a description of the programmatic controls equipment protection, storage and deployment and equipment quality. See section 11 in NEI 12-06. Storage of equipment, 11.3, will be documented in later sections of this template and need not be included in this section.* *See section 6.0 of JLD-ISG-2012-01.*

FCS will implement an administrative program for FLEX to establish responsibilities, and testing and maintenance requirements. A plant system designation will be assigned to FLEX which will require configuration controls associated with systems. This will establish responsibilities, maintenance and testing requirements for all components associated with FLEX. Unique identification numbers will be assigned to all FLEX components included in the system. Equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in JLD-ISG-2012-01, Section 6 and NEI 12-06, Section 11. Installed structures, systems and components pursuant to 10CFR50.63(a) will continue to meet the augmented quality guidelines of Regulatory Guide 1.155, Station Blackout. Standard industry PMs will be developed to establish maintenance and testing frequencies based on type of equipment and will be within EPRI guidelines. Testing procedures will be developed based on the industry PM templates.

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Describe training plan	*List training plans for affected organizations or describe the plan for training development.*
Training materials for FLEX will be developed for all station staff involved in implementing FLEX strategies. These programs and controls will be implemented in accordance with the Systematic Approach to Training.	

Describe Regional Response Center plan	*Describe plans for implementation of a Regional Response Center (RRC) plan.*
The industry will establish two (2) RRCs to support utilities during beyond design basis events. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request. FCS has signed a contract to participate in the RRC agreement.	
Notes:	

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Maintain Core Cooling & Heat Removal

Determine Baseline coping capability with installed coping[1] modifications not including FLEX modifications, utilizing methods described in Table 3-2 of NEI 12-06:

- **AFW/EFW**
- **Depressurize SG for Makeup with Portable Injection Source**
- **Sustained Source of Water**

Ref: JLD-ISG-2012-01, Sections 2 and 3

PWR Installed Equipment Phase 1

Provide a general description of the coping strategies using installed equipment including station modifications that are proposed to maintain core cooling. Identify methods (AFW/EFW)and strategy(ies) utilized to achieve this coping time.

FCS has developed the "required" coping strategies that rely upon resources which meet the NEI 12-06 criteria. FCS has also developed "desirable" strategies that rely upon resources which may not meet the criteria, but would be preferable resources from manpower and asset protection perspectives. A combination of the required and desirable strategies is being called the optimal strategies, in which the required strategies and desirable strategies are clearly identified. They are described below.

Flooded conditions do not apply to Modes 1-3, as stated above in the assumptions section. Only a Non-flooded condition is assumed.

Phase 1 Core Cooling and Heat Removal, with the installed equipment, is accomplished by:

- Heat removal from the Steam Generators (SGs) by venting the steam through manual operation of safety valve or the atmospheric dump valve, and
- Feeding the SGs with water from the Emergency Feedwater Storage Tank (EFWST) using the Turbine Driven Auxiliary Feedwater Pump (TDAFWP).

The Phase 1 actions and their logical sequence (flow chart) are shown in Figure 1 in this Section. A complete compilation of flow charts is provided in Appendix A. Details of the strategies are provided in the Actions referenced in the flow chart, which are compiled together in Appendix B.

Details:

Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation.* For Phase 1, initial coping strategies are contained within the existing FCS EOP for Station Blackout. A new FLEX support procedure for coping with an ELAP that exceeds the FCS design SBO coping period will be developed based on engineering input provided in Appendix B. OPPD will utilize the industry-developed guidance from the Owners Groups, EPRI and NEI task team to develop these site specific procedures or guidelines to address the criteria in NEI 12-06.
Identify modifications	*List modifications and describe how they support coping time.*

[1] Coping modifications consist of modifications installed to increase initial coping time, i.e. generators to preserve vital instruments or increase operating time on battery powered equipment.

	No modifications are required for this coping strategy.
Key Reactor Parameters	*List instrumentation credited for this coping evaluation phase.* See Table 1 following this Section. Note that only one instrument (Channel A or Channel B) is necessary for each parameter monitored.

Notes:

[Note: Ongoing discussions on source of analysis, adequacy of analysis to provide reasonable assurance, and method of documentation to reach a milestone]

Analyses were performed to determine the length of time EFWST will be able to provide cooling water to the SG, and the batteries will be able to support the instruments.

References:

1. Letter from Westinghouse (C. M. Burton) to OPPD (J. K. Gasper), CFTC-12-67, Omaha Public Power District, Fort Calhoun Station, IER 11-4 180-Day Response – Analysis of the NSSS Response to an Extended Station Blackout, (with Attachment, WEC letter LTR-TDA-12-31), dated August 13, 2012
2. Letter from Westinghouse (C. M. Burton) to OPPD (J. K. Gasper), CFTC-11-201, Omaha Public Power District, Fort Calhoun Station 90-Day Response, (with Attachment LTR-TDA-11-72), dated November 8, 2011
3. PL Letter Report 139-1087-1, Omaha Public Power District/Fort Calhoun Station Response to INPO L1 IER 11-4, *Near-Term Actions to Address the Effects of an Extended Loss of All AC Power in Response to the Fukushima Daiichi Event*, dated January 7, 2012

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Figure 1 Flow Chart of Actions for Phase 1 Coping

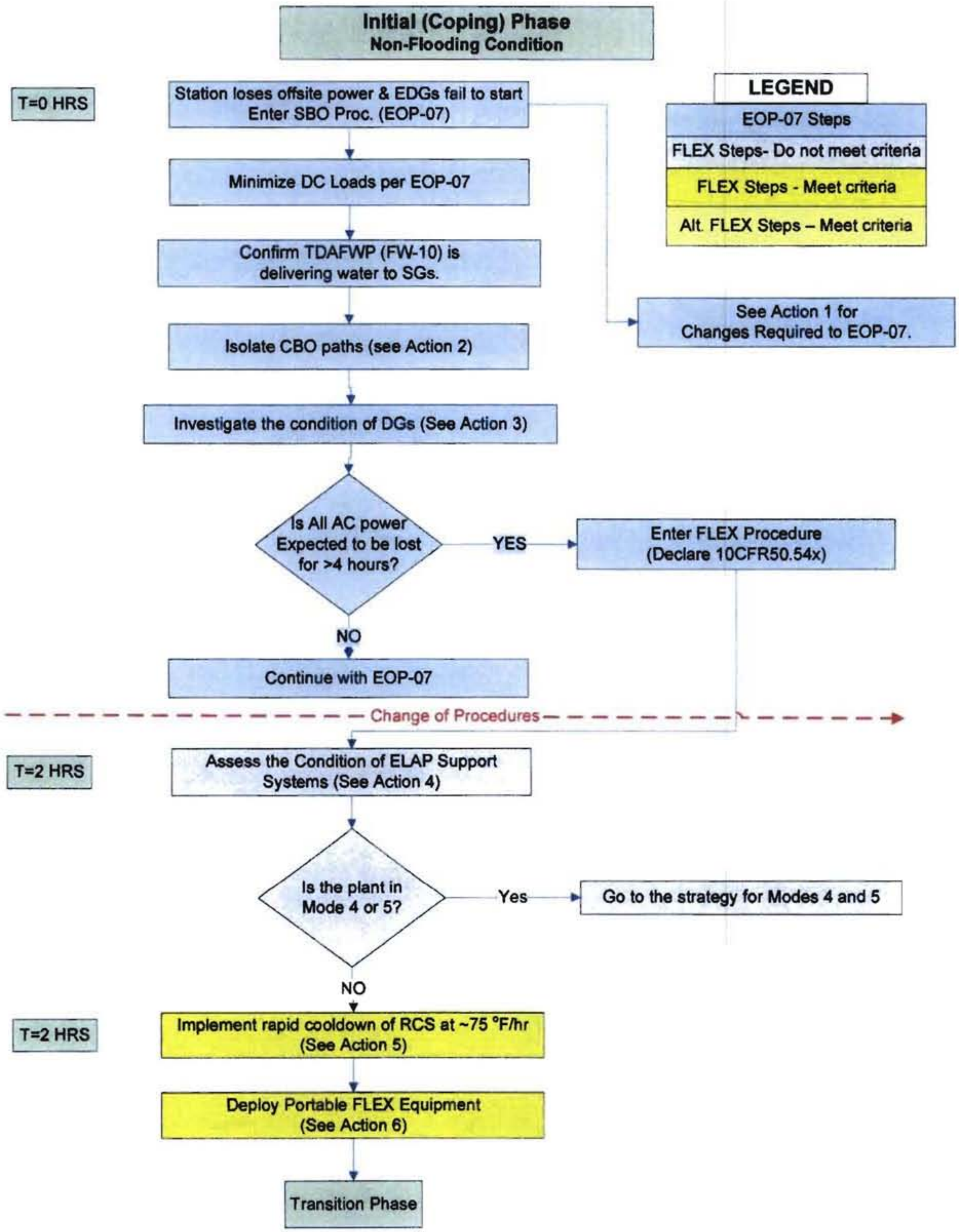

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Table 1 Essential Instruments* for Phase 1 Coping

Instrument Variable and Train	Equip. Tag	Indicator	Indicator Location
Containment Pressure A	PT-783	PI-783	AI-65A (Control Room)
Containment Pressure B	PT-784	PI-784	AI-65B (Control Room)
Steam Generator RC-2A Level A (WR)	A/LT-911	A/LI-911/912	AI-66A (Control Room)
Steam Generator RC-2A Level B (WR)	B/LT-911	B/LI-911/912	AI-66B (Control Room)
Steam Generator RC-2B Level A (WR)	A/LT-912	A/LI-911/912	AI-66A (Control Room)
Steam Generator RC-2B Level B (WR)	B/LT-912	B/LI-911/912	AI-66B (Control Room)
Steam Generator RC-2A Pressure A (WR)	A/PT-913	A/PI-913/914	AI-66A (Control Room)
Steam Generator RC-2A Pressure B (WR)	B/PT-913	B/PI-913/914	AI-66B (Control Room)
Steam Generator RC-2B Pressure A (WR)	A/PT-914	A/PI-913/914	AI-66A (Control Room)
Steam Generator RC-2B Pressure B (WR)	B/PT-914	B/PI-913/914	AI-66B (Control Room)
EFWST Level FW-19 A	Locally, OR LT-1183 (not essential)	Locally, OR LIA-1183 (not essential)	Locally, OR AI-66A (not essential)
EFWST Level FW-19 B	Locally, OR LT-1188 (not essential)	Locally, OR LIA-1188 or LI-1188 (not essential)	Locally, OR AI-66B (not essential)
Pressurizer Pressure A (WR)	PT-115	PI-115A-2	AI-179
Pressurizer Pressure B (WR)	PT-105	UR-105/123	AI-31E
Safety Injection Tank Level (WR) SI-6A**	LT-2904X	LI-2904X	AI-30A
Safety Injection Tank Level (WR) SI-6B**	LT-2924X	LI-2924X	AI-30B
Safety Injection Tank Level (WR) SI-6C**	LT-2944X	LI-2944X	AI-30A
Safety Injection Tank Level (WR) SI-6D**	LT-2964X	LI-2964X	AI-30B
Cold Leg Temperature 1A	A/TE-112C	A/TI-112C	CB-3
Cold Leg Temperature 1B	B/TE-112C	B/TI-112C	CB-3
Hot Leg Temperature 1	A/TE-112H	A/TI-112H	CB-3
Cold Leg Temperature 2A	A/TE-122C	A/TI-122C	CB-3
Cold Leg Temperature 2B	B/TE-122C	B/TI-122C	CB-3
Hot Leg Temperature 2	A/TE-122H	A/TI-122H	CB-3

* Only one channel is required for each monitored parameter.
** Only one SIT level indicator is required to monitor for SIT injection

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Maintain Core Cooling & Heat Removal	
PWR Portable Equipment Phase 2	
Provide a general description of the coping strategies using on-site portable equipment including station modifications that are proposed to maintain core cooling. Identify methods and strategy(ies) utilized to achieve this coping time.	
Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation with a description of the procedure / strategy / guideline.*

The core cooling and heat removal can be continued with the same strategy as described in Phase 1, as long as the SG steam can drive the TDAFWP. When the TDAFWP is not functional for lack of steam or any other reason, then the SG will be fed directly using portable FLEX pumps. Upon recognition that the ELAP event will exceed the design SBO coping duration, plant operators will transition from the existing station blackout procedure to the new FLEX Support Procedure designed to cope with ELAP conditions. Figure 2, provided at the end of this Section, shows the flow chart of actions for this coping strategy.

Core Cooling and Heat Removal Using TDAFWP

TDAFWP actuation and functioning is automatic. It will continue to draw water from the EFWST and feed the SGs. However, the cooling water from the EFWST is expected to be exhausted in 5.2 hours [Refs. 1 and 2]. FCS is evaluating the implementation of Modification 5, as described in Appendix B, which will expand the capacity of EFWST and thus increase the time before this tank is exhausted by approximately 1.2 hours.

Site FLEX equipment will be used to refill the EFWST to continue core cooling. Since refilling of the EFWST is required in a relatively short time (< 5.2 hours), water that is readily available at the site is used. Several sources of clean water may be available at the site. The operator will be directed through the new FLEX procedure to use them, as shown in Figure 3. However, the water tank that meets the NEI 12-06 criteria of availability following a BDBEE is the safety injection and refueling water tank (SIRWT). It is designed to Seismic Category I criteria, contains a minimum of 283,000 gallons, and is protected from external hazards as it is located in the basement of the Auxiliary Building near the SFP. Hereafter, this portion of the Auxiliary Building will be referred to as the Fuel Handling Building (FHB) [Ref. 3]. SIRWT water is, however, borated. FCS is investigating the impact of chemistry of the water being fed into the SGs on corrosion of components in the flow path and heat exchange capacity of the SGs. Based on the results of a similar analysis at another plant, FCS expects that the results of the plant specific analysis to confirm acceptable performance. This is an open item.

To pump water from the SIRWT to the EFWST, FCS will implement Modification 8, which consists of installing a FLEX SIRWT pump (FSP) and its dedicated FLEX diesel generator (FDG). Appendix C provides the conceptual information of this and other FLEX related modifications. The details of the action of transferring water from the SIRWT to the EFWST are described in Actions 8 and 9, included in Appendix B and modifications described in Appendix C are referenced in the actions as necessary.

The primary flow path from the SIRWT to EFWST is shown schematically in Figure 4. The alternative flow path is shown schematically in Figure 5. Figure 5 presents two alternate pumps that can be used. The connections on the SIRWT side are diverse and protected, as they are

Maintain Core Cooling & Heat Removal

PWR Portable Equipment Phase 2

inside the protected FHB. The connection on the EFWST side is the current B.5.b connection, which is also protected within the Auxiliary Building.

Core Cooling and Heat Removal Without TDAFWP

When the TDAFWP is not available, heat removal from the SG is accomplished by feeding it directly from available water sources and venting the steam. Figure 6 shows schematically the flow paths from a well (Appendix C, Modification 18, which is under consideration at FCS) or the UHS (Missouri River). The well water can be substituted for any other clean water, as described in Action 6 (Appendix B). It is noted here and is shown in Figure 6 that only the river (UHS) water can be credited per the NEI 12-06 guidelines. The water chemistry investigation will also look into the impact of chemistry of water from the various other water sources being considered.

References:

1. Letter from Westinghouse (C. M. Burton) to OPPD (J. K. Gasper), CFTC-12-67, Omaha Public Power District, Fort Calhoun Station, IER 11-4 180-Day Response – Analysis of the NSSS Response to an Extended Station Blackout, (with Attachment, WEC letter LTR-TDA-12-31), dated August 13, 2012
2. Letter from Westinghouse (C. M. Burton) to OPPD (J. K. Gasper), CFTC-11-201, Omaha Public Power District, Fort Calhoun Station 90-Day Response, (with Attachment LTR-TDA-11-72), dated November 8, 2011
3. FCS Technical Specifications 2.3(1)a.

Identify modifications	*List modifications necessary for phase 2.* The modifications listed below will be implemented, or are under consideration at FCS, for core cooling in the Phase 2 coping. Conceptual design information of the Modifications is provided in Appendix C. 1. Modification 5 – Increase EFWST Capacity 2. Modification 7 – Flow Paths into Room 81 3. Modification 8 – FLEX SIRWT Pump (FSP) 4. Modification 9 – FLEX Valve Station (FVS) 5. Modification 18 – Well Construction 6. Modification 19 – Pump platform by the river at 995' elevation
Key Reactor Parameters	*List instrumentation credited or recovered for this coping evaluation.* The credited instruments in Phase 2 are the same as those in Phase 1, shown in Table 1. In addition, means will be established of monitoring water flow in the flow paths identified above.

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Maintain Core Cooling & Heat Removal	
PWR Portable Equipment Phase 2	
Storage / Protection of Equipment : **Describe storage / protection plan or schedule to determine storage requirements** FCS will store the FLEX portable equipment either within the safety-related plant structures or in a storage building(s) that will meet the NEI 12-06 protection guidelines. FLEX equipment (including N+1 equipment) that must be deployed in less than 6 hours will be stored in Class 1E structures within the protected area. The design of the storage building(s) is being developed.	
Seismic	*List Protection or schedule to protect* See the statement above.
Flooding Note: if stored below current flood level, then ensure procedures exist to move equipment prior to exceeding flood level.	*List Protection or schedule to protect* See the statement above and the information provided in the "Extreme External Hazard" Section above.
Severe Storms with High Winds	*List Protection or schedule to protect* See the statement above.
Snow, Ice, and Extreme Cold	*List Protection or schedule to protect* See the statement above.
High Temperatures	*List Protection or schedule to protect* See the statement above.

Deployment Conceptual Design
(Attachment 3 contains Conceptual Sketches)

Strategies, actions to implement them and related modifications are listed above and compiled together in Appendices A through C.

Strategy	Modifications	Protection of connections
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications.*	*Identify how the connection is protected.*

Notes:
A complete compilation of Action Flow Charts, Action Descriptions and FLEX-related Modifications is provided in Appendices A, B and C, respectively.

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Figure 2: Flow Chart of Actions for Heat Removal from SGs

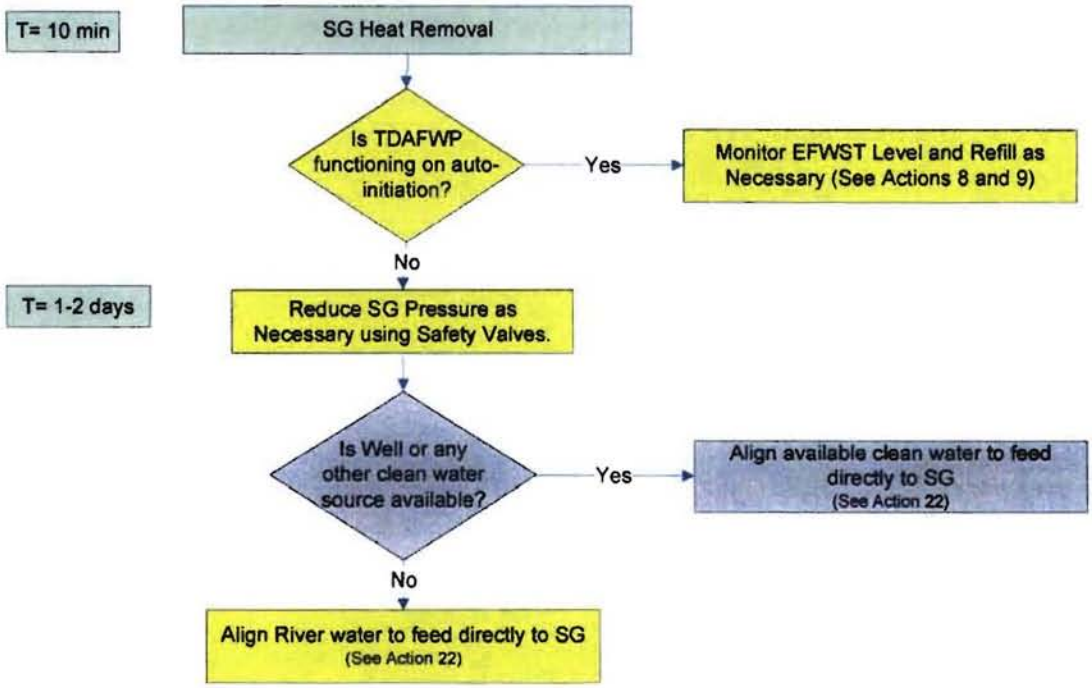

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Figure 3: Flow Chart of Actions for Phase 2 Coping – Refilling EFWST

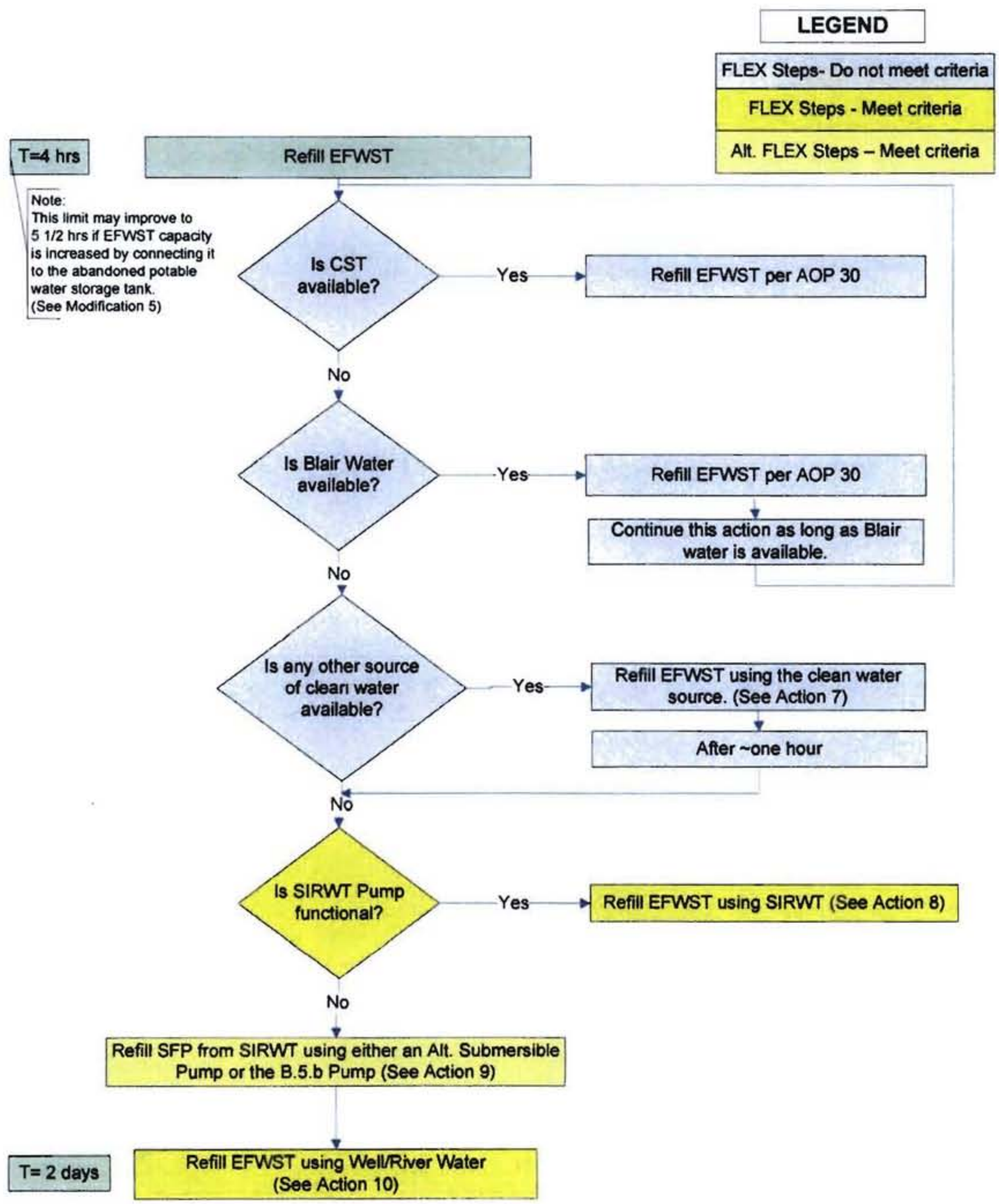

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Fig. 4: Refill EFWST from SIRWT Using FLEX SIRWT Pump

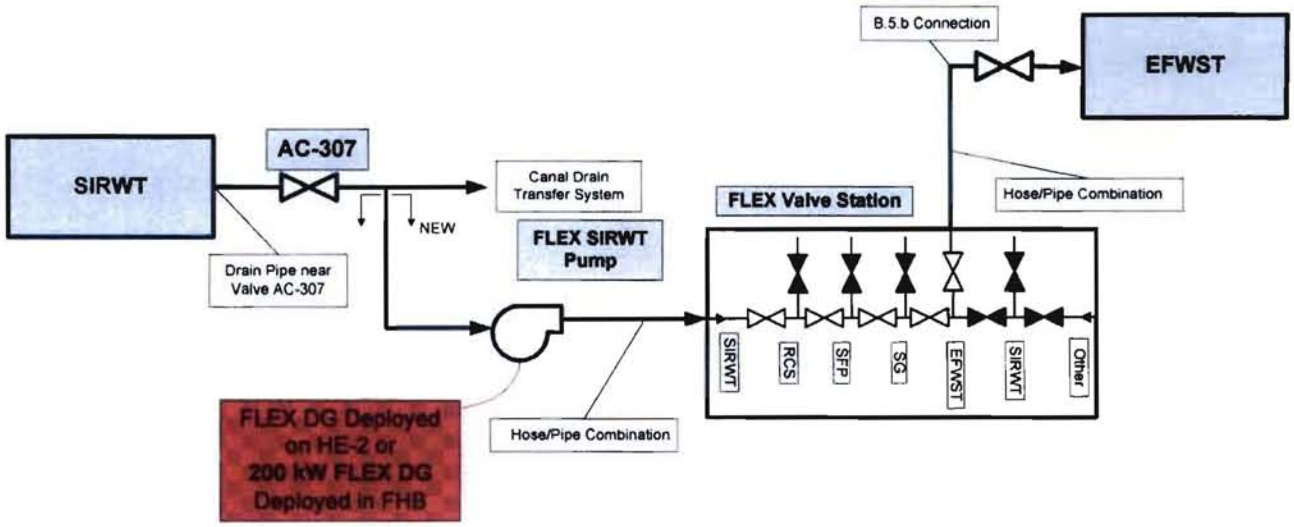
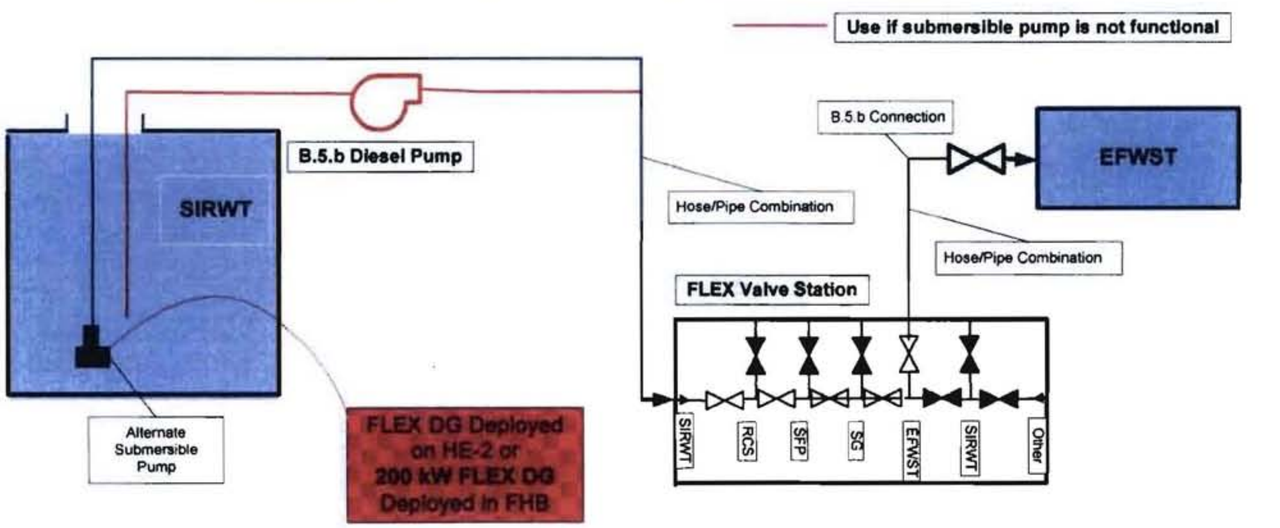
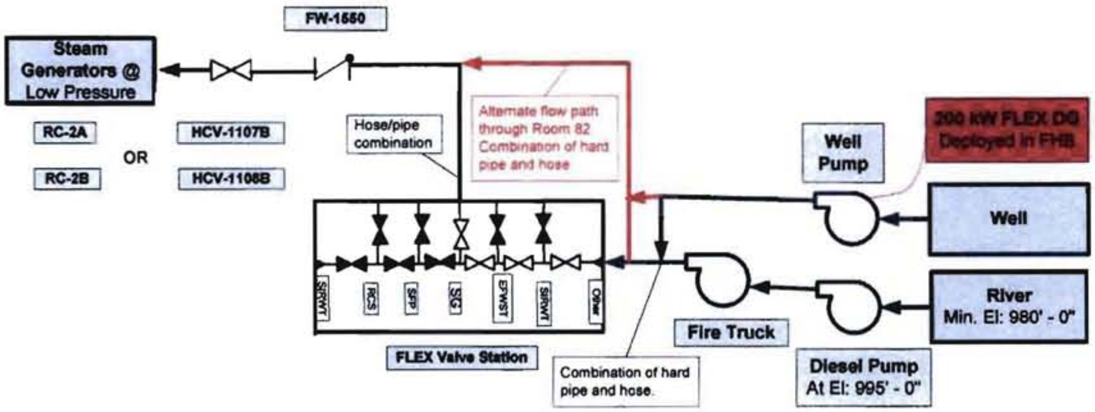


Fig. 5: Refill EFWST Using Alternate Submersible Pump or B.5.b Pump



Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Fig. 6: Cool SG directly with Well or River Water



Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain Core Cooling & Heat Removal		
PWR Portable Equipment Phase 3		
Provide a general description of the coping strategies using phase 3 equipment including modifications that are proposed to maintain core cooling. Identify methods and strategy(ies) utilized to achieve this coping time.		
The FCS Phase 2 strategies for maintaining core cooling & heat removal are intended to function for an indefinite period. Arrangements are being made to obtain additional fuel for FLEX portable equipment from the RRCs. Later in the event, if needed, a 4160 V portable DG will be obtained from the RRC to power the existing switchgear. Depending upon the circumstances, the portable DG power will be supplied to (a) the Motor-Driven Auxiliary Feedwater Pump (MDAFWP) to continue heat removal from the SGs, or (b) the shutdown cooling system (in conjunction with cooling water pumps to supply the shutdown cooling heat exchangers) to establish direct RCS cooling. Further details of Phase 3 coping are provided in Appendix B, Action 25.		
Details:		
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation with a description of the procedure / strategy / guideline.*	
See App. B, Action 25, "Electrical Power" and "Core Cooling & Heat Removal".		
Identify modifications	*List modifications necessary for phase 3*	
See App. B, Action 25, "Electrical Power" and "Core Cooling & Heat Removal".		
Key Reactor Parameters	*List instrumentation credited or recovered for this coping evaluation.*	
Instrument list is provided in Table 1.		
Deployment Conceptual Design (Attachment 3 contains Conceptual Sketches)		
Strategy	**Modifications**	**Protection of connections**
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
See App. B, Action 25, "Electrical Power" and "Core Cooling & Heat Removal".		
Notes: An outline of integrated Phase 3 strategies is provided in Appendix B, Action 25.		

Maintain RCS Inventory Control

Determine Baseline coping capability with installed coping[2] modifications not including FLEX modifications, utilizing methods described in Table 3-2 of NEI 12-06:

- **Low Leak RCP Seals or RCS makeup required**
- **All Plants Provide Means to Provide Borated RCS Makeup**

PWR Installed Equipment Phase 1:

Provide a general description of the coping strategies using installed equipment including modifications that are proposed to maintain core cooling. Identify methods (Low Leak RCP Seals and/or borated high pressure RCS makeup)and strategy(ies) utilized to achieve this coping time.

In Phase 1 for RCS inventory control, the following two actions are taken, as listed in Fig. 1:

1. Isolate Controlled Bleedoff (CBO) (See Appendix B, Action 2), and
2. Initiate rapid cooldown to 350°F (See Appendix B, Action 5)

CBO isolation reduces the loss of RCS inventory by eliminating an estimated 15 gpm/seal leakage. The only loss of RCS inventory remaining will the unidentified leakage of 1 gpm plus 1gpm of leakage per seal, for a total loss of 5 gpm. App. B, Action 2 provides the details of this action. In order to keep the isolation path closed even after air in the actuator accumulator is exhausted, a modification will be required on relief isolation valve (HCV-208) to make it fail in the closed position. See App. C, Modification 1.

The rapid cooldown provides several advantages: reduces the potential for seal failure, reduces the leakage amount should any other leakage develop, allows the Safety Injection Tanks (SITs) to inject borated water thus improving the shutdown margin and lowers the SG pressure sooner thus allowing the use of portable low head pump(s) to supply the feedwater.

Maintaining the shutdown margin with rapid cooldown is a concern that has been addressed. FCS plant-specific studies have found that the advantages of the rapid cooldown strategy investigated for the PWR Owners Group would apply to FCS also. Details and analyses references are provided in App. B, Action 5.

Rapid cooldown is accomplished by releasing steam at a faster rate from the air-assisted SG safety relief valves (SG PORVs, MS-291/292). Analysis has shown, as noted in Appendix B, Action 5, that the existing SG PORVs are capable of supporting rapid cooldown at 75°F/hr to about 400°F. Further cooldown will be at a much slower rate and would require approximately 48 hours to cooldown to 350°F. Two options are available to increase the steam release rate and thus speed up the cooldown, as discussed in Appendix B, Action 5:

1. Manually open the larger safety relief valves. (Tools and procedure for this manual operation exist at FCS.)
2. Modify the SG PORVs to increase their capacity (Appendix C, Mod. 3). This modification was identified as required for the Extended Power Uprate, and a conceptual design was completed. FCS is considering the implementation of this modification, but it is not essential for implementing the FLEX strategies.

[2] Coping modifications consist of modifications installed to increase initial coping time, i.e. generators to preserve vital instruments or increase operating time on battery powered equipment.

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Maintain RCS Inventory Control	
The SG PORVs are air-operated and supported by an accumulator. When the accumulator air runs out, the operators will lose the capacity to open these valves remotely. Although the SG PORVs can be manually operated locally (Tools and procedure for this manual operation exist at FCS), this action could impact the availability of equipment operators to perform other FLEX functions. In order to overcome this challenge, FCS will implement Modification 2, as described in Appendix C. This modification will facilitate recharging of the accumulators using nitrogen bottles. The rapid cooldown requires a higher feedwater flowrate to compensate for the higher steam release rate to remove sensible heat in addition to the decay heat. This is expected to empty the EFWST in about 5.2 hours. Refilling of the EFWST will be required before it empties, as indicated in the Phase 2 strategy for RCS cooling and heat removal. Continuation of rapid cooling will be contingent upon being able to refill the EFWST.	
Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation.* Action to isolate the CBO relief line will be added to the existing SBO procedure. The rapid plant cooldown will not be initiated until it has been determined that the event duration is expected to exceed the SBO coping period. The rapid cooldown strategy will be included in a new FLEX Support procedure, which will be developed based on Actions in Appendix B. OPPD will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop these site specific procedures or guidelines to address the criteria in NEI 12-06.
Identify modifications	*List modifications.* Modifications are quoted above and described in Appendix C.
Key Reactor Parameters	*List instrumentation credited for this coping evaluation.* Instrument list is provided in Table 1.
Notes: A complete compilation of Action Flow Charts, Action descriptions and FLEX-related Modifications is provided in Appendices A, B and C, respectively.	

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain RCS Inventory Control

PWR Portable Equipment Phase 2:

Provide a general description of the coping strategies using on-site portable equipment including modifications that are proposed to maintain core cooling. Identify methods(Low Leak RCP Seals and/or borated high pressure RCS makeup)and strategy(ies) utilized to achieve this coping time.

The objective of RCS inventory control is to compensate for the loss of RCS coolant through seal or unidentified leakage and prevent uncovering of the core. Time before the core is uncovered was determined to be 42 hours with the seal leakage at 15 gpm per seal [Ref. 1]. If the leakage is reduced to 5 gpm the time is expected to be of the order of five days. Once the viability of the modification to assure RCP CBO is confirmed, the time to core uncovery will be recalculated. It is clear, however, that sooner or later in the transition phase, the RCS inventory will have to be replenished.

The RCS can be fed in the following three ways:

1. One of the charging pumps takes water from SIRWT or Boric Acid Storage Tank(s) and delivers to the RCS (Appendix B, Action 19).
2. The FLEX SIRWT Pump (FSP) water from SIRWT and delivers to the RCS (Appendix B, Action 20).
3. Water from a clean water source at the site or the river water can be fed into the RCS using appropriate pumping capacity (This is considered an action of last resort).

Schematic flow diagrams of the above three strategies are shown in Figure 7. Details of the strategies, portable equipment required and the modifications to support them are described in Appendix B, Actions 19 through 20.

SIRWT water is planned to be used for other cooling applications, as noted in the above strategies. If it is used for SG cooling, for example, the SIRWT inventory will be exhausted in approximately 24 hours. Means have been provided to refill the SIRWT through the use of available clean water or the river water as shown schematically in Figure 8 and described in Appendix B, Action 18. Boric acid can be added to the SIRWT in one of two ways: by injecting it from the Boric Acid Storage Tank, if power is available to the associated pump, or by dumping bags of boric acid crystals into the SIRWT.

Details:

Provide a brief description of Procedures/Strategies/ Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation* The actions described above will be included in a new FLEX support procedure, which will be developed based on Actions in Appendix B.
Identify modifications	*List modifications.* Modifications are referenced in the Actions quoted above and described in Appendix C.
Key Reactor Parameters	*List instrumentation credited or recovered for this coping evaluation.* Instrument list is provided in Table 1.

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain RCS Inventory Control

PWR Portable Equipment Phase 2:

Storage / Protection of Equipment:
Describe storage / protection plan or schedule to determine storage requirements

FCS will store the FLEX portable equipment either within the safety-related plant structures or in a storage building(s) that will meet the NEI 12-06 protection guidelines. The design of the storage building(s) is being developed.

Seismic	*List Protection or schedule to protect* See the statement above.
Flooding Note: if stored below current flood level, then ensure procedures exist to move equipment prior to exceeding flood level.	*List Protection or schedule to protect* See the statement above and the information provided in the "Extreme External Hazard" Section above.
Severe Storms with High Winds	*List Protection or schedule to protect* See the statement above.
Snow, Ice, and Extreme Cold	*List Protection or schedule to protect* See the statement above.
High Temperatures	*List Protection or schedule to protect* See the statement above.

Deployment Conceptual Modification
(Attachment 3 contains Conceptual Sketches)

Strategies, actions to implement them and related modifications are listed above and compiled together in Appendices A through C.

Strategy	Modifications	Protection of connections
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*

Notes:
A complete compilation of Action Flow Charts, Action Descriptions and FLEX-related Modifications is provided in Appendices A, B and C, respectively.

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Figure 7: RCS Makeup with Portable Equipment Onsite – Phase 2

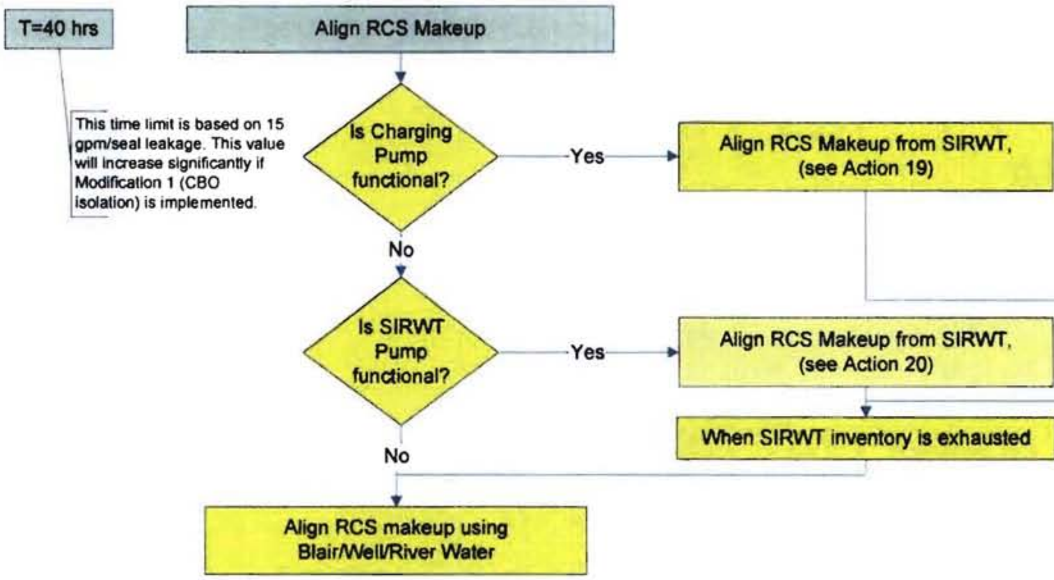
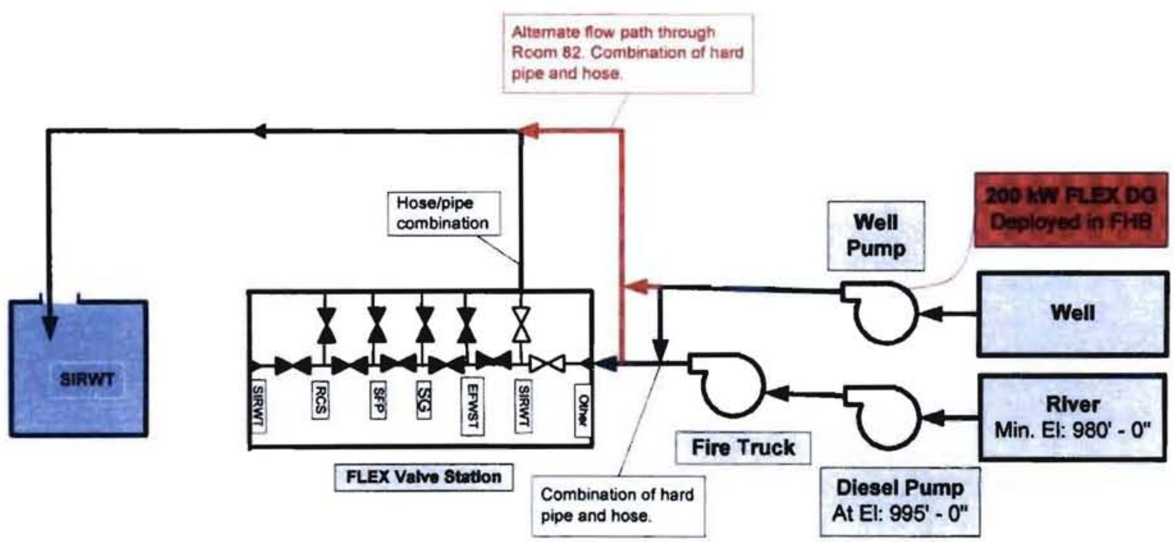


Figure 8: Refilling of SIRWT using Clean Water or River Water



Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain RCS Inventory Control
PWR Portable Equipment Phase 3:
Provide a general description of the coping strategies using Phase 3 equipment including modifications that are proposed to maintain core cooling. Identify methods (Low Leak RCP Seals and/or borated high pressure RCS makeup)and strategy(ies) utilized to achieve this coping time. The FCS Phase 2 strategies for maintaining RCS inventory control are intended to function for an indefinite period. Arrangements are being made to obtain additional fuel for FLEX portable equipment from the Regional Response Centers (RRC). Later in the event, if needed, a 4160 V portable DG will be obtained from the RRC to power the existing switchgear. Depending upon the circumstances, the portable DG power will be supplied to (a) the charging pump to supply water to the RCS, and (b) the shutdown cooling system to establish direct RCS cooling. Further details of coping in Phase 3 are provided in Appendix B, Action 25.

Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation.* See Appendix B, Action 25 "Electrical Power" and "RCS Inventory Control".
Identify modifications	*List modifications.* See Appendix B, Action 25 "Electrical Power" and "RCS Inventory Control".
Key Reactor Parameters	*List instrumentation credited or recovered for this coping evaluation.* The instrument list is provided in Table 1.

Deployment Conceptual Modification
(Attachment 3 contains Conceptual Sketches)

See Appendix B, Action 25 "Electrical Power" and "RCS Inventory Control".

Strategy	Modifications	Protection of connections
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*

Notes: An outline of integrated Phase 3 strategies is provided in Appendix B, Action 25.

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain Containment	
Determine Baseline coping capability with installed coping[3] modifications not including FLEX modifications, utilizing methods described in Table 3-2 of NEI 12-06: • Containment Spray • Hydrogen igniters (ice condenser containments only)	
PWR Installed Equipment Phase 1:	
Provide a general description of the coping strategies using installed equipment including modifications that are proposed to maintain containment. Identify methods (containment spray/Hydrogen igniter) and strategy(ies) utilized to achieve this coping time. An FCS specific analysis shows that the containment design limits will not be challenged until approximately 10 days after the event (see discussion in Phase 2). There are no phase 1 actions required to maintain Containment at this time that need to be addressed.	
Details:	
Provide a brief description of Procedures/Strategies/ Guidelines	*N/A* None required.
Identify modifications	*N/A* None required.
Key Containment Parameters	*List instrumentation credited for this coping evaluation.* Instrument list is provided in Table 1.
Notes:	

[3] Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain Containment
PWR Portable Equipment Phase 2:
Provide a general description of the coping strategies using on-site portable equipment including modifications that are proposed to maintain core cooling. Identify methods (containment spray/hydrogen igniters) and strategy(ies) utilized to achieve this coping time. A FCS specific containment analysis was performed in Reference 1. The analysis assumed a 15 gpm leakage per seal from the Reactor Coolant Pump (RCP) seals, as it is controlled by the flow limiting check valves associated with the pumps. The results showed that a containment pressure of 5.4 psig is reached in 24 hours, while the containment design pressure of 60 psig is reached after 257 hours. However, if the RCP seal leakage is reduced through CBO isolation, as discussed in the RCS Inventory Control Section, the containment pressure would remain below the design pressure for much longer. Containment isolation is not an issue as it would be achieved automatically. Therefore, no Phase 2 actions are required for maintaining containment. References: 1. Letter LTR-OA-11-37, Rev. 0, "Analysis of the Fort Calhoun Station Containment Response to an Extended Station Blackout", November 8, 2011.

Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation.* None required.
Identify modifications	*List modifications* None required.
Key Containment Parameters	*List instrumentation credited or recovered for this coping evaluation.* Instrument list is provided in Table 1.

Storage / Protection of Equipment:	
Describe storage / protection plan or schedule to determine storage requirements Not applicable, as no actions or equipment is required for Phase 2 containment.	
Seismic	*List how equipment is protected or schedule to protect*
Flooding	*List how equipment is protected or schedule to protect*
Severe Storms with High Winds	*List how equipment is protected or schedule to protect*
Snow, Ice, and Extreme Cold	*List how equipment is protected or schedule to protect*
High Temperatures	*List how equipment is protected or schedule to protect*

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain Containment		
Deployment Conceptual Modification **(Attachment 3 contains Conceptual Sketches)** Not applicable.		
Strategy	**Modifications**	**Protection of connections**
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
Notes:		

Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

Maintain Containment
PWR Portable Equipment Phase 3:
Provide a general description of the coping strategies using phase 3 equipment including modifications that are proposed to maintain core cooling. Identify methods (containment spray/hydrogen igniters) and strategy(ies) utilized to achieve this coping time. Containment cooling may be required after ~10 days following the event (or a considerably longer time as determined by a re-analysis of the containment if the CBO is isolated). One way of accomplishing containment cooling is the use containment cooler using ~1200 gpm of river water, and providing power the containment cooler fan by an offsite DG. This is the preferred means of containment heat removal that FCS will pursue. Alternately, Containment Spray may be used to reduce containment temperature and pressure. Higher flow rates will be required to perform this function. Further details on coping in Phase 3 are provided in Appendix B, Action 25.

Details:	
Provide a brief description of Procedures/Strategies/ Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation* See Appendix B, Action 25 "Electrical Power" and "Containment".
Identify modifications	*List modifications* See Appendix B, Action 25 "Electrical Power" and "Containment".
Key Containment Parameters	*List instrumentation credited or recovered for this coping evaluation.* Instrument list is provided in Table 1.

Deployment Conceptual Modification
(Attachment 3 contains Conceptual Sketches)

See Appendix B, Action 25 "Electrical Power" and "Containment".

Strategy	**Modifications**	**Protection of connections**
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*

Notes: An outline of integrated Phase 3 strategies is provided in Appendix B, Action 25.

Maintain Spent Fuel Pool Cooling	
Determine Baseline coping capability with installed coping[4] modifications not including FLEX modifications, utilizing methods described in Table 3-2 of NEI 12-06: • **Makeup with Portable Injection Source**	
PWR Installed Equipment Phase 1:	
Provide a general description of the coping strategies using installed equipment including modifications that are proposed to maintain spent fuel pool cooling. Identify methods (makeup via portable injection source)and strategy(ies) utilized to achieve this coping time. A plant specific evaluation has been performed, showing that minimum time to boil in the Spent Fuel Pool is approximately 19 hours (7 hours for full core offload) and approximately 100 hours for boil-off to reach 8 ft above the active fuel (40 hours for full core offload) [Refs.1 and 2]. See the Phase 2 discussion for further details. There are no Phase 1 actions required at this time that need to be addressed. References: 1. Letter LTR-SEE-II-11-61, Rev 0, Fort Calhoun Station Spent Fuel Pool Time to Boil upon Loss of All AC Power, dated October 27, 2011. 2. FC05988, R4, Thermal Hydraulic Analysis of Fort Calhoun Station Spent Fuel Pool with Maximum Density Storage	
Details:	
Provide a brief description of Procedures / Strategies / Guidelines	The current procedure for Loss of Spent Fuel Pool Cooling provides guidance for monitoring spent fuel pool heatup rate and describes methods for establishing makeup to the SFP in the event that alignment is desired prior to implementation of Phase 2 FLEX strategies.
Identify modifications	N/A
Key SFP Parameter	Per EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012
Notes:	

[4] Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

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Maintain Spent Fuel Pool Cooling	
PWR Portable Equipment Phase 2:	
Provide a general description of the coping strategies using on-site portable equipment including modifications that are proposed to maintain spent fuel pool cooling. Identify methods (makeup via portable injection source)and strategy(ies) utilized to achieve this coping time. A FCS specific Spent Fuel Pool (SFP) analysis was performed [Ref. 1]. Reference 1 evaluated SFP cooling and determined the following: • Following an ELAP it is calculated with conservative assumptions that the SFP water will evaporate due to decay heat from the stored spent fuel bundles and its level will reduce to 8' above the fuel in about 103 hours. • Makeup water is required so as to maintain or increase the water level, so that the radiation levels in the fuel pool area of the Auxiliary Building will be tolerable. • It is calculated that the makeup water will be required at a flow rate of at least 17.6 gpm. It is noted that that the evaporation and/or boiling of the SFP will cause high humidity and steam inside the FHB. Ventilation will have to be provided. It will also be helpful to start SFP makeup early to keep the pool cool, but makeup should not cause excessive SFP overflow to avoid flooding the Auxiliary Building lower levels. Details of this modification to FHB ventilation will be developed and submitted in a six month update. The following options will be used to refill the SFP: • SIRWT water using the FLEX SIRWT Pump (Appendix C, Mod. 8), • SIRWT water using alternate submersible pump or a B.5.b pump, or • River Water using a portable pump (Appendix C, Mod. 19). The above is shown schematically in Figures 9 through 11 at the end of this Section, and the strategies are outlined in Appendix B, Actions 15 through 17. References: 1. Letter LTR-SEE-II-11-61, Rev 0, Fort Calhoun Station Spent Fuel Pool Time to Boil upon Loss of All AC Power, dated October 27, 2011	
Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation* A new FLEX support procedure will be developed that will cover the actions described in Appendix B, Actions 15 through 17. OPPD will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop these site specific procedures or guidelines to address the criteria in NEI 12-06.
Identify modifications	*List modifications* The modifications are quoted in the text above and outlined in Appendix C.

Maintain Spent Fuel Pool Cooling

Key SFP Parameter	FCS will submit SFP instrumentation changes required to comply with NRC Order EA-12-051.

Storage / Protection of Equipment:

Describe storage / protection plan or schedule to determine storage requirements

FCS will store the FLEX portable equipment either within the safety-related plant structures or in a storage building(s) that will meet the NEI 12-06 protection guidelines. The design of the storage building(s) is being developed.

Seismic	*List how equipment is protected or schedule to protect* See the statement above.
Flooding	*List how equipment is protected or schedule to protect* See the statement above and the discussion provided under Extreme Hazards Section.
Severe Storms with High Winds	*List how equipment is protected or schedule to protect* See the statement above.
Snow, Ice, and Extreme Cold	*List how equipment is protected or schedule to protect* See the statement above.
High Temperatures	*List how equipment is protected or schedule to protect* See the statement above.

Deployment Conceptual Design

(Attachment 3 contains Conceptual Sketches)

Strategies, actions to implement them and related modifications are listed above and compiled together in Appendices A through C.

Strategy	**Modifications**	**Protection of connections**
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*

Notes: A complete compilation of Action Flow Charts, Action descriptions and FLEX-related Modifications is provided in Appendices A, B and C, respectively.

Figure 9: Refilling SFP Using SIRWT Water and FLEX SIRWT Pump

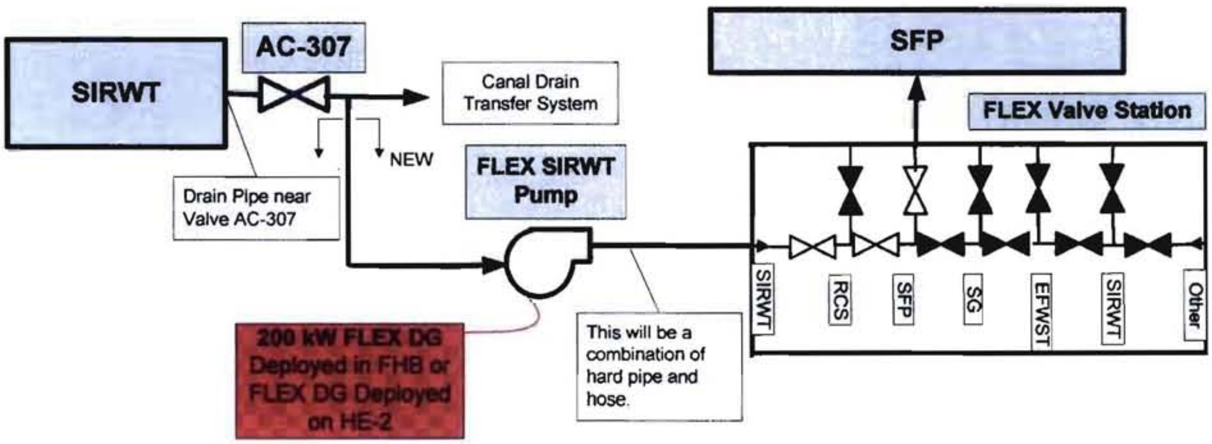

Figure 10: Refilling SFP Using SIRWT Water and Alternate Pumps

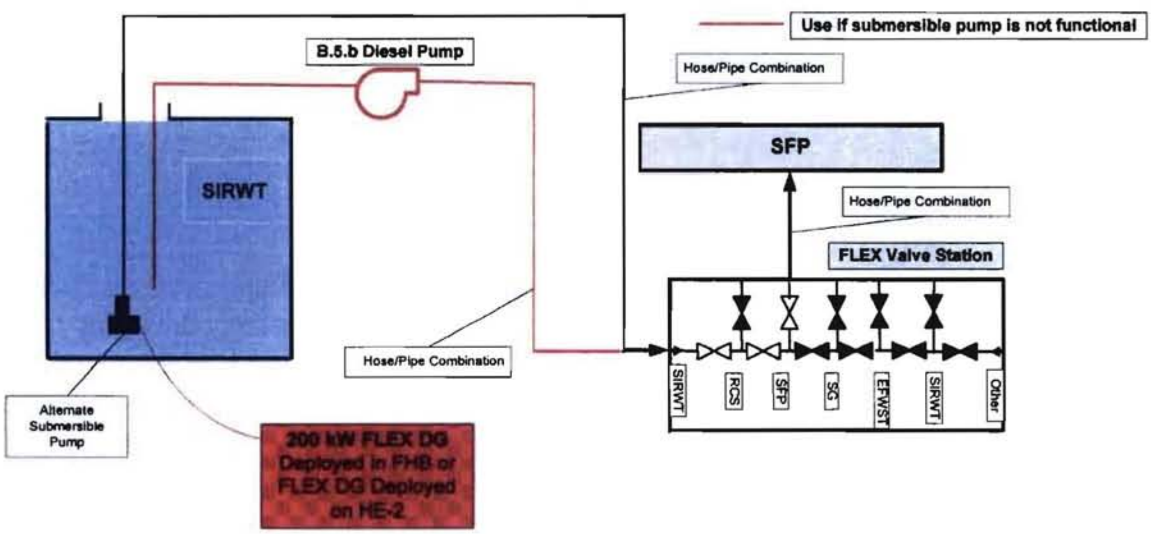

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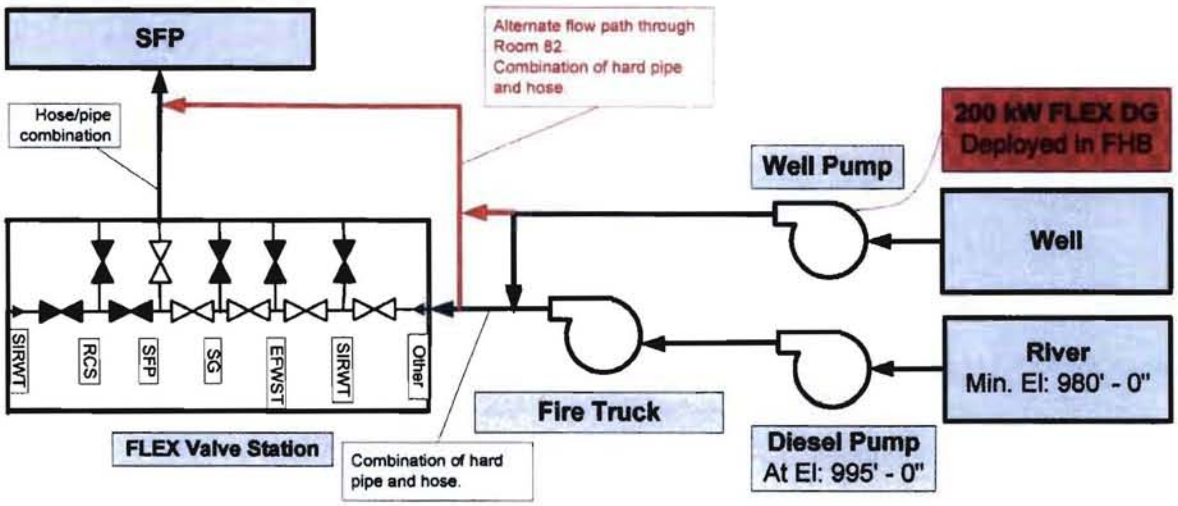
Figure 11: Refilling SFP with Clean Water or River Water



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Maintain Spent Fuel Pool Cooling
PWR Portable Equipment Phase 3:
Provide a general description of the coping strategies using phase 3 equipment including modifications that are proposed to maintain spent fuel pool cooling. Identify methods (makeup via portable injection source)and strategy(ies) utilized to achieve this coping time. Phase 2 strategies can be continued for an indefinite time with extra fuel supplies brought in from offsite. However, for long term cooling of SFP, the concern of steam and vapor in the FHB needs to be addressed. If available, the fuel pool cooling system can be used with power from a portable DG brought in from offsite; otherwise portable heat exchangers and pumps will need to be brought in as well. Further details of coping in Phase 3 are provided in Appendix B, Action 25.
Details:

Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation.* See Appendix B, Action 25, "Electrical Power" and "Spent Fuel Pool Cooling".
Identify modifications	*List modifications* See Appendix B, Action 25, "Electrical Power" and "Spent Fuel Pool Cooling".
Key SFP Parameter	*Per EA 12-051* Per NRC Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012.

Deployment Conceptual Design
(Attachment 3 contains Conceptual Sketches)
See Appendix B, Action 25, "Electrical Power" and "Spent Fuel Pool Cooling".

Strategy	**Modifications**	**Protection of connections**
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*

Notes: An outline of integrated Phase 3 strategies is provided in Appendix B, Action 25.

Safety Functions Support	
Determine Baseline coping capability with installed coping[5] modifications not including FLEX modifications.	
PWR Installed Equipment Phase 1	
Provide a general description of the coping strategies using installed equipment including station modifications that are proposed to maintain and/or support safety functions. Identify methods and strategy(ies) utilized to achieve coping times. Under ELAP conditions the basic support of the safety functions required is that the environment in the required rooms/areas should support the personnel occupancy and/or the equipment functionality. During Phase 1, the areas of concern outside the containment are the TDAFWP room, EFWST room and the Main Control Room (MCR). The environments in these rooms under ELAP conditions vs. the requirements will be analyzed and reported in a subsequent six-month update.	
Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation.* This information will be developed and provided in a six-month update.
Identify modifications	*List modifications and describe how they support coping time.* This information will be developed and provided in a six-month update.
Key Parameters	*List instrumentation credited for this coping evaluation phase.* This information will be developed and provided in a six-month update.
Notes:	

[5] Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

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Safety Functions Support
PWR Portable Equipment Phase 2
Provide a general description of the coping strategies using on-site portable equipment including station modifications that are proposed to maintain and/or support safety functions. Identify methods and strategy(ies) utilized to achieve coping times. In addition to the areas identified in Phase 1 coping, areas in use during Phase 2 will be the FHB (Canal Drain Pump Room, Corridor 26 and the Truck Bay) and Auxiliary Building Room 69. The Environment in these areas will be analyzed and the results and resulting actions will be provided in a subsequent six-month update. <u>MCR Occupancy</u> The objective is to provide the necessary backup power to MCR exhaust fans VA-46A/B and MCR lighting panel LP-8 in an event of an ELAP. The requirements are as follows: • The reactor protective system (RPS) panels and engineered safety feature panels were designed for, and the instrumentation was tested at, 120°F [Ref. 1]. The temperature inside the control cabinets is at most 15°F [Ref. 1] warmer than the temperature of the control room due to heat produced by the electronic circuitry. Therefore, the temperature in the control room during normal operation is limited to a maximum of 105°F [Ref. 1]. Strategies have been devised to support the MCR occupancy. They consist of: a. Powering the MCR HVAC and lighting from the 200 kW FLEX Diesel Generator (FDG) that will be deployed in the FHB Truck Bay, or b. Providing temporary MCR HVAC control using the 10 kW FDG that will be deployed in the Auxiliary Building. The above strategies and their supporting modifications are described in Appendix B, Actions 13 and 14. Reference: 1. FCS Station Technical Specifications Section 2.12, Control Room Ventilation System

Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation with a description of the procedure / strategy / guideline.* FCS will prepare a FLEX Support Procedure that will encompass the actions described in App. B, Actions 13 and 14. OPPD will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop these site specific procedures or guidelines to address the criteria in NEI 12-06.
Identify modifications	*List modifications necessary for phase 2* The required modifications are listed in App. B, Actions 13 and 14, and are outlined in App. C.
Key Parameters	*List instrumentation credited or recovered for this coping evaluation.* FCS will develop the information and provide in the six month update.

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Safety Functions Support		
PWR Portable Equipment Phase 2		
Storage / Protection of Equipment : **Describe storage / protection plan or schedule to determine storage requirements** FCS will store the FLEX portable equipment either within the safety-related plant structures or in a storage building(s) that will meet the NEI 12-06 protection guidelines. The design of the storage building(s) is being developed. See Modification 17.		
Seismic	*List how equipment is protected or schedule to protect*	
Flooding Note: if stored below current flood level, then ensure procedures exist to move equipment prior to exceeding flood level.	*List how equipment is protected or schedule to protect*	
Severe Storms with High Winds	*List how equipment is protected or schedule to protect*	
Snow, Ice, and Extreme Cold	*List how equipment is protected or schedule to protect*	
High Temperatures	*List how equipment is protected or schedule to protect*	
Deployment Conceptual Design **(Attachment 3 contains Conceptual Sketches)** FCS will develop the information and provide in a six-month update.		
Strategy	**Modifications**	**Protection of connections**
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
Notes: A complete compilation of Action Flow Charts, Action descriptions and FLEX-related Modifications is provided in Appendices A, B and C, respectively.		

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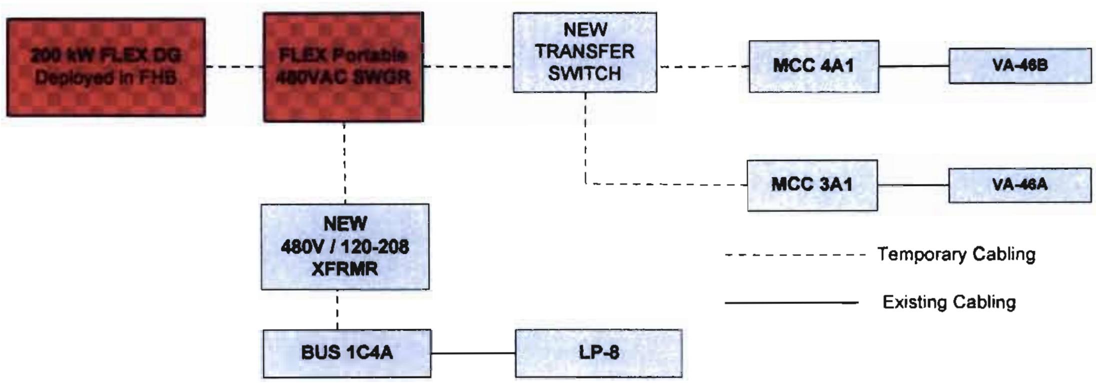
Figure 12: Control Room HVAC and Lighting Alignment



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Safety Functions Support	
PWR Portable Equipment Phase 3	
Provide a general description of the coping strategies using Phase 3 equipment including modifications that are proposed to maintain and/or support safety functions. Identify methods and strategy(ies) utilized to achieve coping times. Phase 2 strategies can be continued for an indefinite time with extra fuel supplies brought in from offsite. See Appendix B, Action 25 for further details of coping in Phase 3.	
Details:	
Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation with a description of the procedure / strategy / guideline.* See App. B, Action 25, "Electrical Power" and "Logistical Support".
Identify modifications	*List modifications necessary for phase 3* See App. B, Action 25, "Electrical Power" and "Logistical Support".
Key Parameters	*List instrumentation credited or recovered for this coping evaluation.* FCS will develop the information and provide in the six month update as necessary.

Deployment Conceptual Design (Attachment 3 contains Conceptual Sketches)		
Strategy	**Modifications**	**Protection of connections**
Identify Strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
Notes:		

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PWR Portable Equipment Phase 2							
Use and (potential / flexibility) diverse uses						*Performance Criteria*	Maintenance
List portable equipment	Core	Containment	SFP	Instrumentation	Accessibility		*Maintenance / PM requirements*
FLEX SIRWT Pump (FSP)	X		X	X	X	[300 gpm, 300 psia], Submersible	*Will follow EPRI template requirements*
FSP Dedicated DG	X		X	X	X	[10 kW, to be confirmed during modification development]	*Will follow EPRI template requirements*
FLEX Valve Station (FVS)	X		X	X	X	Throttle 300 gpm to 30 gpm	*Will follow EPRI template requirements*
FLEX SIRWT Backup Submersible Pump	X		X	X	X	[300 gpm, 300 psia], Submersible	*Will follow EPRI template requirements*
Diesel SIRWT Backup Pump (B.5.b)	X		X	X	X	[300 gpm, 300 psia]	*Will follow EPRI template requirements*
FLEX 200 kW DG	X		X	X	X	[200 kW]	*Will follow EPRI template requirements*
480 V SWGR	X		X	X	X	[480 V]	*Will follow EPRI template requirements*
Well Pump	X		X	X	X	[300 gpm, 50 psia]	*Will follow EPRI template requirements*
River Drafting Pump	X		X	X	X	[300 gpm, 50 psia]	*Will follow EPRI template requirements*
Diesel Pump in a Fire Truck	X		X	X	X	[300 gpm, 70 psia]	*Will follow EPRI template requirements*
FLEX 10 kW DG for Powering a Battery Charger				X		480 V [10 kW]	*Will follow EPRI template requirements*

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PWR Portable Equipment Phase 3							
Use and (potential / flexibility) diverse uses						Performance Criteria	Notes
List portable equipment	Core	Containment	SFP	Instrumentation	Accessibility		
4160 VAC Generator	X	X		X	X	2 MW, 300 Amp	Portable 4160 VAC generator will power one installed vital bus. See Appendix B, Action 25 for further details.
Three (3) High Cap., Low Press. Pumps	X	X	X			1,200 gpm, 120 psi	Self-powered (or provided with necessary generator power). See Appendix B, Action 25 for further details.
Two (2) Med Cap., Low Press. Pumps	X					300 gpm, 300 psi	Self-powered (or provided with necessary generator power). See Appendix B, Action 25 for further details.

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Phase 3 Response Equipment/Commodities	
Item	**Notes**
Radiation Protection Equipment • Radiological survey/counting equipment • Equipment/personnel decontamination equipment and supplies • Radiation/Contamination/Airborne protection supplies and equipment • Respiratory protection equipment	Backup to on-site equipment. See Appendix B, Action 25 for further details
Commodities • Food/Water • Diesel Fuel • Personal Protective Equipment • Radiological protection equipment (PCs, dosimeters)	Commodities will not be required for at least 72 hours. See Appendix B, Action 25 for further details.
Fuel Requirements • Bulk #2 Diesel Fuel • Portable fuel transfer pumps • Fuel Bladders	Fuel will not be required for at least 72 hours. See Appendix B, Action 25 for further details.
Liquid Processing Equipment • Water Purification System • Water Processing/Recycling System	See Appendix B, Action 25 for further details.
Heavy Equipment • Transportation equipment • Debris clearing equipment	Backup to on-site equipment. See Appendix B, Action 25 for further details
Site Recovery Equipment	See Appendix B, Action 25 for further details.

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Attachment 1A
Sequence of Events Timeline

Action Item	Elapsed Time	Action	Time Constraint Y/N [6]	Remarks / Applicability
	0	Event Starts	N	Plant @100% power
1	1 Min.	Rx/Turbine Trip, AFW Initiation	N	Operators enter EOPs, perform Standard Post-Trip Actions, and ensure Safety Function support equipment operating as designed for SBO. See Appendix B, Action 1.
2	10 Min.	Isolate RCP Controlled Bleedoff	N	See Appendix B, Action 2. Although WCAP-16175 (Ref. 2 of App. B, Action2) suggests isolation of CBO within 10 minutes is most desirable, the action will still be effective if done ASAP.
3	15 Min.	Begin DC Bus Load Shed. Actions occur between T+15 min. and T+2 hr.	Y	EOP/AOP Attachment 6. Existing SBO strategy. See Appendix B, Action 1.
4	1 hr.	Survey plant for damage, determine status of DGs	N	See Appendix B, Action 4
5	2 hr.	DC Bus Load Shed complete	Y	This action is delineated in existing SBO EOP.
6	2 hr.	Commence Rapid Cooldown using Air Assisted Main Steam Safety Valves	N	This action provides several advantages in mitigating an ELAP event, but is not required to be performed within a specific time constraint. See Appendix B, Action 5.
8	4 hr.	Transition from Phase 1 to Phase 2 for Core cooling function by Beginning Make up to EFWST.	Y	Initiation time provides margin before EFWST depletion at 5.2 hrs. during rapid cooldown. See Appendix B, Actions 7 – 10.

[6]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

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9	7 hr.	Supply at least one 1E 125VDC bus from portable diesel generator	Y	Initiation time provides margin before battery depletion at 8 hrs. See Appendix B, Actions 11 & 12.
10	9 hr.	Establish CR ventilation and lighting using FLEX portable diesel Generator through station switchgear, or temporary ventilation and lighting using smoke ejector fans and light strings powered by a portable 120V generator.	Y	Initiation time provides margin before CR habitability is assumed challenged at 10 hrs. (This is an open item.) Based on existing design basis analyses, this item is currently considered a time constraint; but further analysis is required to determine the timing and impact of loss of CR ventilation during ELAP. See Appendix B, Actions 13 & 14.
11	16 hr.	Establish SFP Makeup using FLEX SIRWT Pump or backup FLEX pumps taking suction from SIRWT.	Y	Alignment of SFP makeup provides margin before the onset of SFP boiling at 19 hours. Time constraint on this action is considered 100 hours; this is the time available until SFP level reaches 8ft. above the top of the fuel racks. See Appendix B, Actions 15-17.
12	24 hr.	Establish makeup to SIRWT from alternate water source (UHS or dedicated well).	Y	Alignment of SIRWT makeup needed before depletion at 24 hours. See Appendix B, Action 18.
13	40 hr.	Make up to RCS using FLEX SIRWT Pump or backup FLEX pumps taking suction from SIRWT.	Y	Alignment of RCS makeup provides margin before the core uncovery at 42 hours. See Appendix B, Actions 19 and 20.
14	72 hr.	Establish Containment Cooling or Spray using equipment provided by Regional Response Centers.	Y	Alignment provides considerable margin before reaching time constraint associated with challenging containment design limits at 250 hours. See "Maintain Containment – Phase 3" section of this plan.

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Attachment 1B

NSSS Significant Reference Analysis Deviation Table [7]

Item	Parameter of interest	WCAP value (WCAP-17601-P August 2012 Revision 0)	WCAP page	Plant applied value	Gap and discussion
1	Decay heat model	ANS 5.1-1979 + 2 sigma or equivalent	4-13	same	NA
2	Applicable computer code for NSSS analysis	CENTS	4-8	same	NA
3	RCS leakage (non-RCP)	Maximum of 1 gpm unidentified leakage at normal operating pressure	4-14	same	NA
4	RCP leakage	15 gpm per RCP	4-36	same	NA
5	Number of SGs used to establish natural circulation and perform plant cooldown	Two	4-13	same	NA
6	Total TDAFWP flow capability	12.4 lbm/sec/SG	4-29	same	NA
7	Initial RCS Temperature	Full power conditions	4-13	same	NA
8	Initial RCS Pressure	Full power conditions	4-13	same	NA
9	Time initiating cool down	2 hours	4-14	same	NA
10	Rate of RCS cool down	75°F / hr	4-14	same	NA
11	Target cooldown temperature	Steam generator pressure = 120 psia	4-16	same	NA
12	RCS Heat Loss Model	[plant-specific values provided in WCAP-17601-P]	4-28	same	NA
13	RCS Geometry (volume and elevations including initial pressurizer level)	Modeled in CENTS	4-8	same	NA

[7] OPPD has performed various FCS plant specific evaluations to establish applicable time constraints and FLEX equipment capabilities. The input parameters specified in WCAP-17601-P were used as the basis for these evaluations.

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NSSS Significant Reference Analysis Deviation Table [7]

Item	Parameter of interest	WCAP value (WCAP-17601-P August 2012 Revision 0)	WCAP page	Plant applied value	Gap and discussion
14	SIT/ACC Liquid Volume	900.6 ft^3 (for minimum SIT injection parameters) 815.4 ft^3 (for maximum SIT injection parameters)	4-18	same	NA
15	SIT/ACC Total Volume	1306 ft^3	4-18	same	NA
16	SIT/ACC Gas Pressure	255 psia (for minimum SIT injection parameters) 400.7 psia (for maximum SIT injection parameters)	4-18	same	NA
17	Sub-criticality requirements	Keff < 0.99	4-32	same	NA
18	SIT/ACC Boron Concentration	2160 ppm	4-18	same	NA
19	BAST Boron Concentration	Not credited in WCAP-17601 for C-E plants	NA	NA	NA
20	RWST Boron Concentration	Not credited in WCAP-17601 for C-E plants	NA	NA	NA
21	Letdown Capability via Head Vent	Not credited in WCAP-17601 for C-E plants	NA	NA	NA

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Attachment 2
Milestone Schedule

The following milestone schedule is provided. The dates are planning dates subject to change as design and implementation details are developed. Any changes to the following target dates will be reflected in the subsequent 6 month status reports.

Original Target Date	Activity	Status *{Include date changes in this column}*
Oct. 2012	Submit 60-Day Status Report	Complete
Feb. 2013	Submit Overall Integrated Implementation Plan	Complete
Mar. 2013	Develop Conceptual Designs for FLEX/Plant interconnections	
Aug. 2013	Submit 6-Month Status Report	
Nov. 2013	DevelopStrategies (Playbook) with RRC	
Dec. 2013	Develop Conceptual Design for Site Modifications (Storage Building, River Platform, Well, etc.)	
Dec. 2013	Issue 2014 Outage Related Mods	
Feb. 2014	Submit 6-Month Status Report	
May.2014	Develop FSGs	
Jun. 2014	Create Maintenance Procedures	
Jul. 2014	Issue Site Mods	
Aug. 2014	Procure Equipment	
Aug. 2014	Submit 6-Month Status Report	
Sep. 2014	Procedure Changes Training Material Complete	
Oct. 2014	2014 FLEX Mod Implementation Outage	
Nov. 2014	Develop Training Plan	
Feb. 2015	Submit 6-Month Status Report	
May 2015	Issue 2016 Outage Related Mods	
Jun. 2015	Implement Training	
Aug. 2015	Submit 6-Month Status Report	
Sep.2015	Perform Staffing Analysis (Phase 2)	
Feb. 2016	Complete Non-outage Modifications	
Feb. 2016	Submit 6-Month Status Report	
Apr. 2016	2016 FLEX Mod Implementation Outage	
Apr. 2016	Implement FLEX Program	
Sep. 2016	Perform full FLEX Implementation Walkthrough/Drill	
Nov. 2016	Resolve Walkthrough/Drill Deficiencies	
Dec. 2016	Submit Completion Report	

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Attachment 3
Conceptual Sketches

(Conceptual sketches, as necessary to indicate equipment which is installed or equipment hookups necessary for the strategies.)

Section A. Deployment Pathways

Section B. Mechanical Drawings

Section C. Electrical Drawings

Section A

Deployment Paths

FIGURE A-1 : DEPLOYMENT PATHS FROM THE FLEX STORAGE BUILDING TO THE PLANT

PRIMARY DEPLOYMENT PATH
ALTERNATE DEPLOYMENT PATH

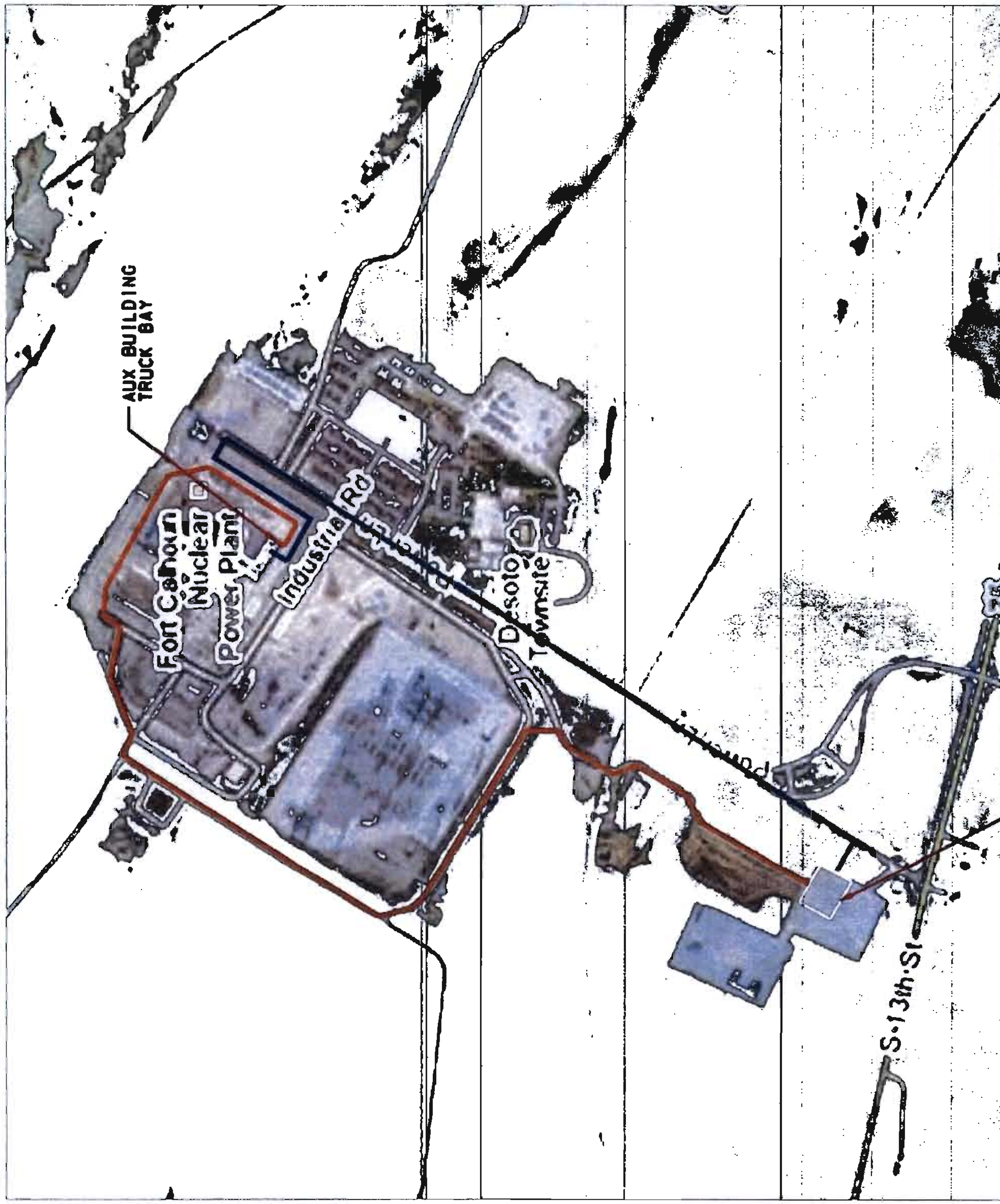

Figure A-2: Deployment Paths, Basement 989' Level

[[Withheld Under 10 CFR 2.390]]

Figure A-3: Deployment Paths, Ground Floor 1007' Level

[[Withheld Under 10 CFR 2.390]]

Figure A-4: Deployment Paths. Intermediate Floor. 1025' Level

[[Withheld Under 10 CFR 2.390]]

Figure A-5: Deployment Paths, Operating Floor, 1036' Level

[[Withheld Under 10 CFR 2.390]]

Section B

Mechanical Drawings

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Fort Calhoun Station EA-12-049 (FLEX) Overall Integrated Implementation Plan

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FIGURE NO. B-4: PIPE/HOSE DEPLOYMENT-OPERATING FLOOR PLAN

[[Withheld Under 10 CFR 2.390]]

FIGURE NO. B-5: PIPE/HOSE DEPLOYMENT-SOUTH ELEVATION

[[Withheld Under 10 CFR 2.390]]

Section C

Electrical Drawings

[[Withheld Under 10 CFR 2.390]]

[[Withheld Under 10 CFR 2.390]]

Figure C-2: FLEX Power Cable Routing

Appendix A

FLEX Optimal Strategies

Flow Charts of Mitigating Actions

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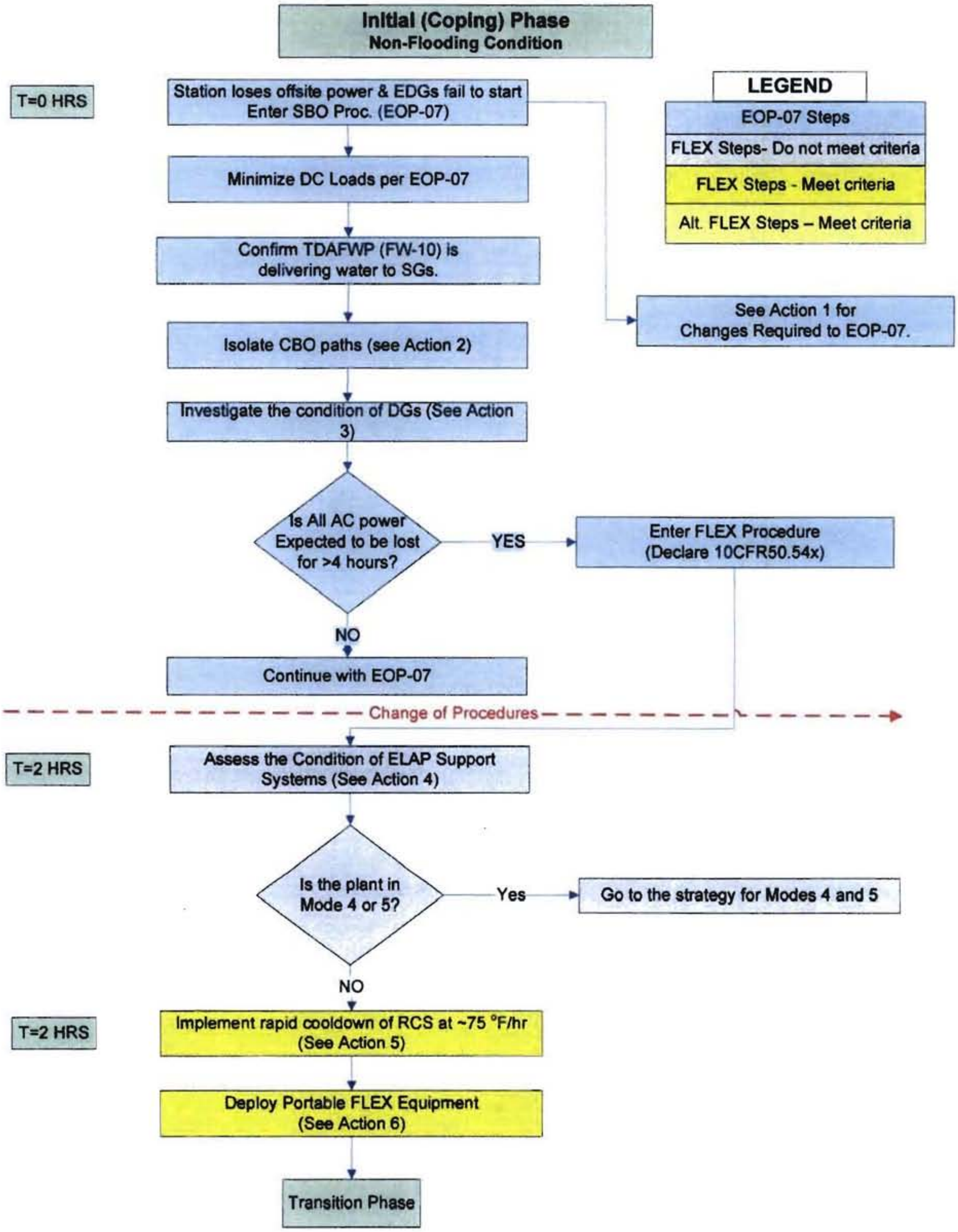

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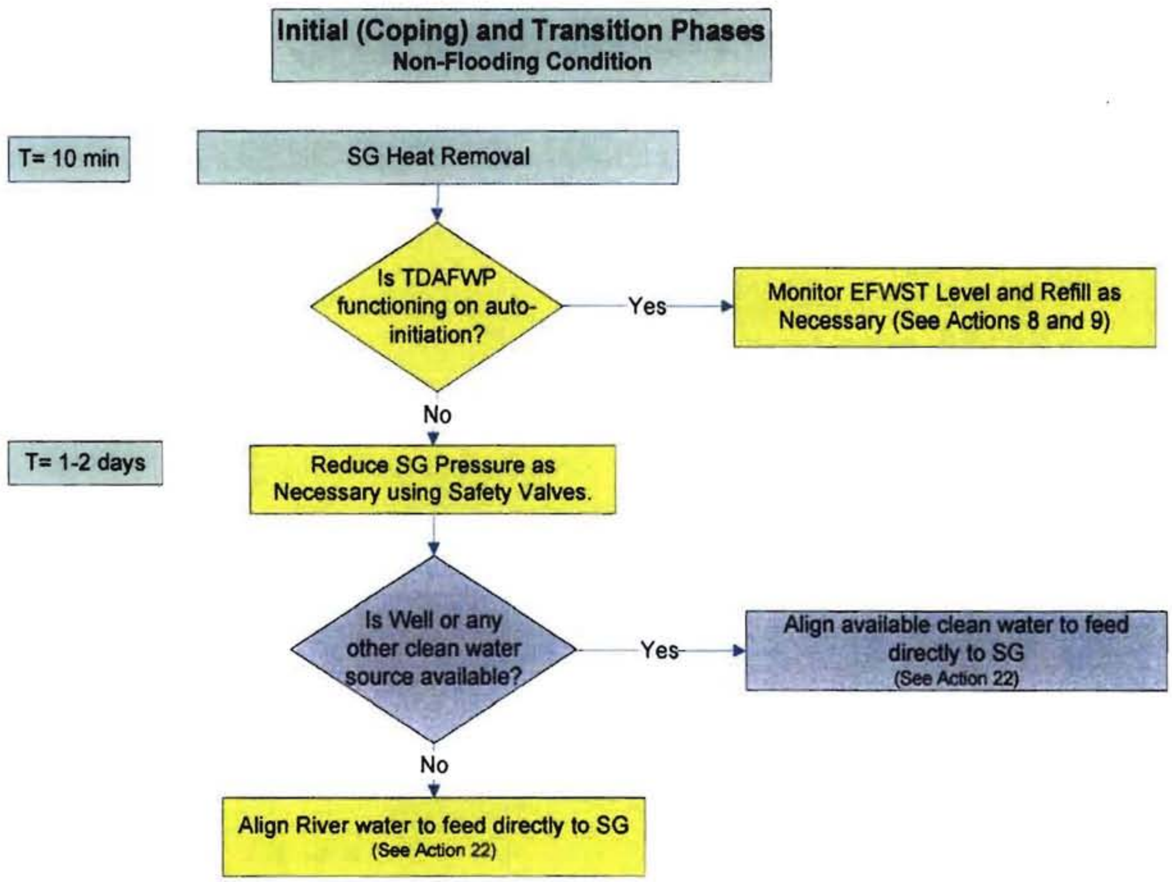

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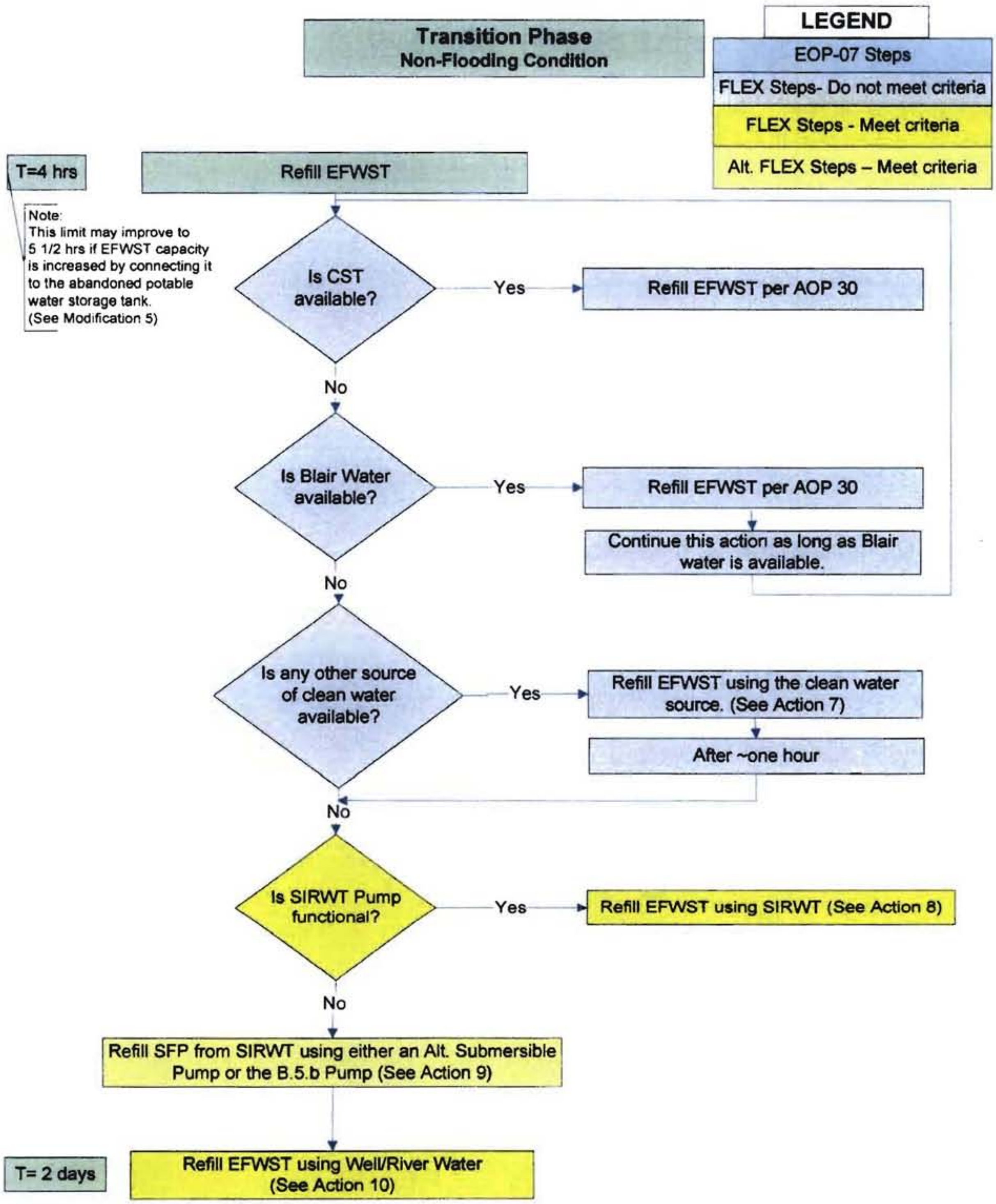

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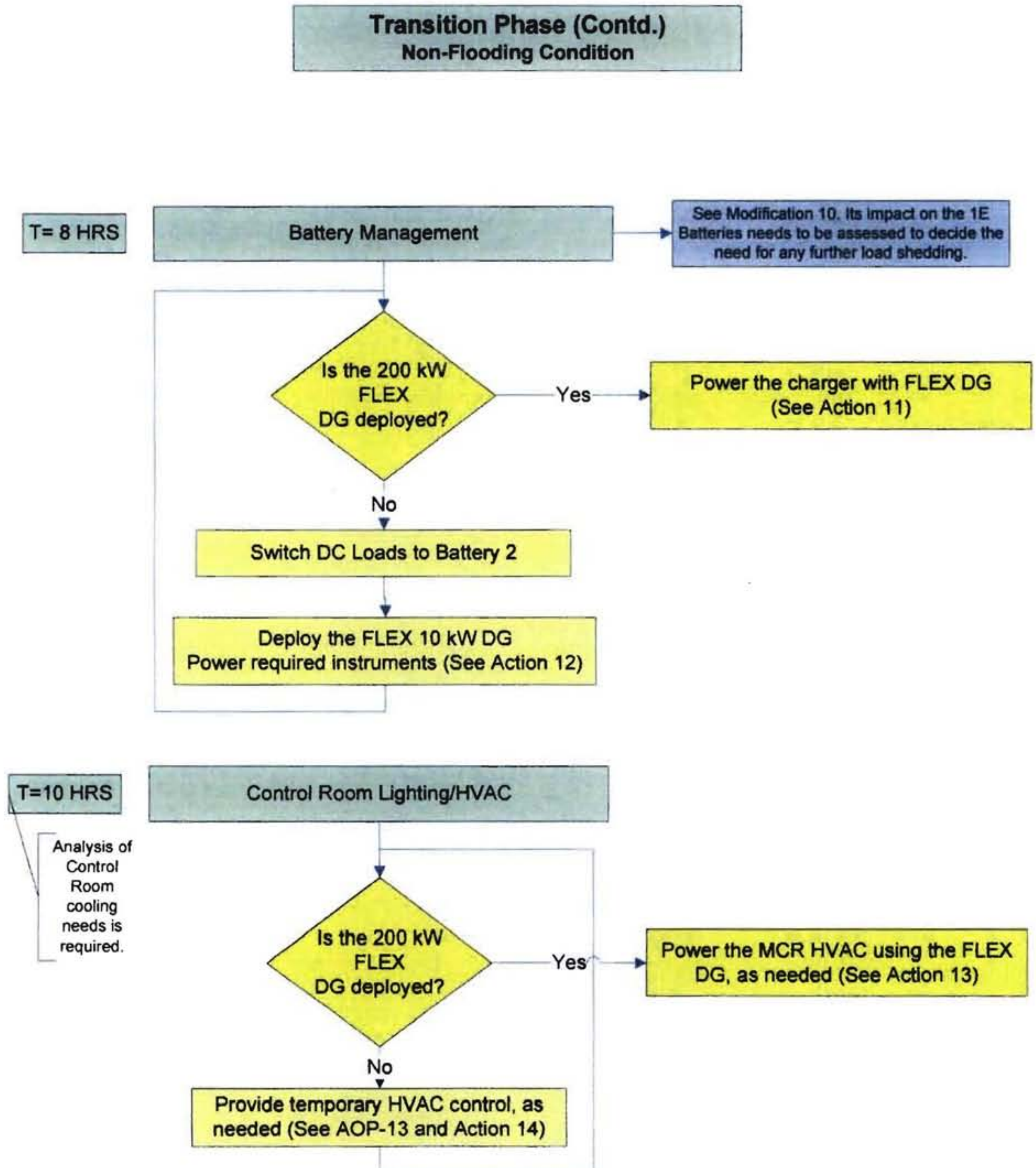

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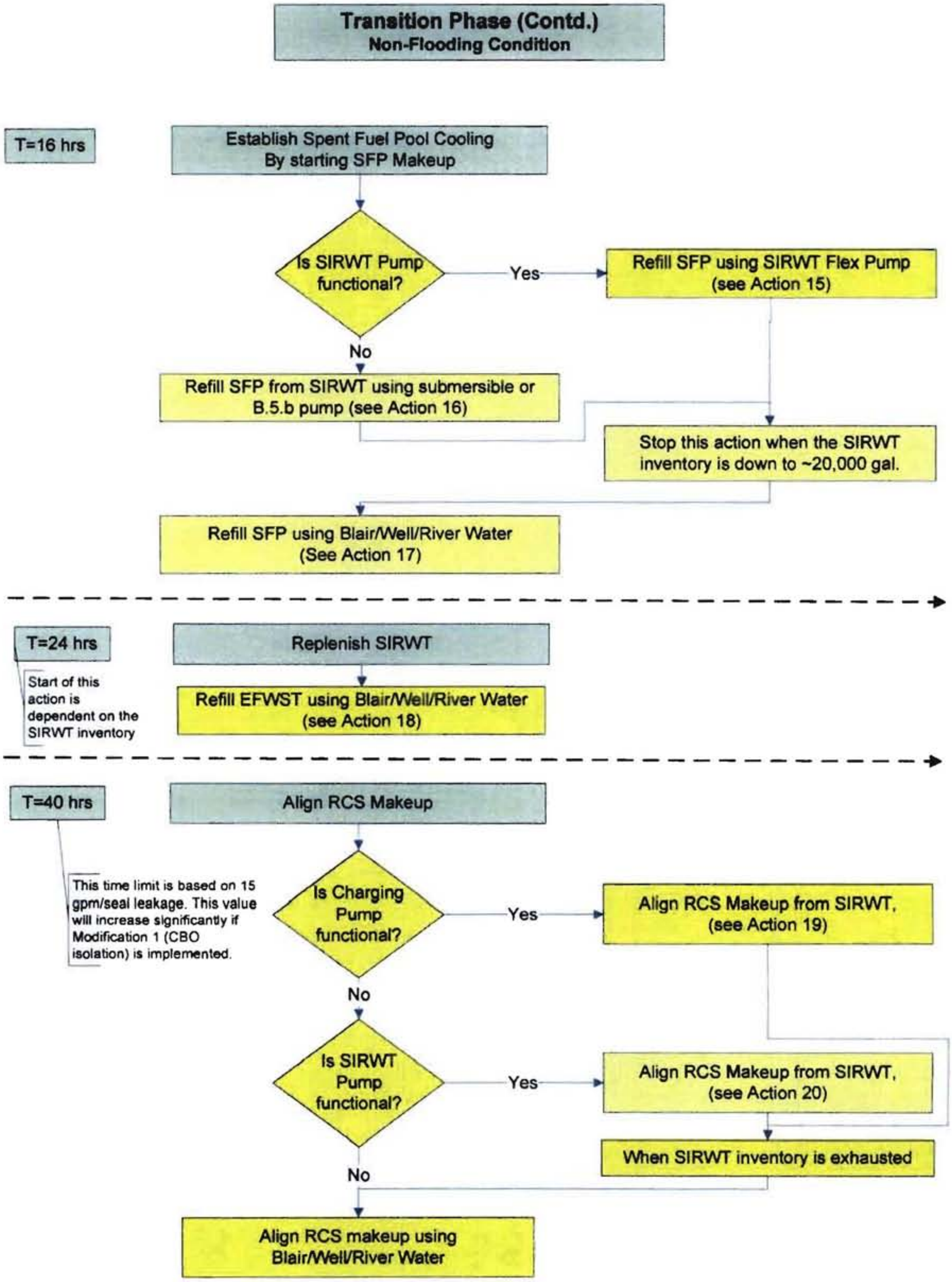

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Final Phase
Non-Flooding Condition

See Appendix B, Action 25

SFP Cooling

See Appendix B, Action 25

Containment Cooling

See Appendix B, Action 25

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Modes 4 and 5 Coping Strategies
Non-Flooding Condition

See Appendix B, Action 23

Modes 4 and 5 Coping Strategies
Flooding Condition

See Appendix B, Action 24

Appendix B

Actions to Implement Optimal Strategies

Appendix B

Actions to Implement Optimal Strategies

Action 1
Changes Required to EOP-07

OBJECTIVE:

The objective of this Action is to provide information for revising the Station Blackout (SBO) Procedure, EOP-07, as required for coping with a Beyond Design Basis External Event (BDBEE) that can cause an Extended Loss of All AC Power (ELAP).

When Fort Calhoun Station (FCS) experiences a Loss of Offsite Power (LOOP) and the Emergency Diesel Generators (EDGs) fail to start automatically, FCS enters the SBO procedure, EOP-07. The SBO coping time for FCS is 4 hours [Ref. 2]. Although the actions taken in this procedure may result in a coping time of up to 8 hours, it is currently not credited to address the potential loss of EDGs for more than 4 hours.

The following changes to the procedure will enhance the station's ability to cope with an SBO of greater than 4 hours and will direct Operations to a new procedure based on the Pressurized Water Reactor Owners' Group (PWROG) FLEX Support Guidelines (FSG):

- Account for the installation of non-1E batteries (Modification 10), if installed.
- Address changes to steam generator (SG) air assisted main steam safety valves MS-291/292 (Modifications 2 & 3)
- Add step to isolate Controlled Bleed-off (CBO) paths (See Action 2 and Modification 1).
- Add a step that directs transition to the Functional Recovery Procedure (EOP-20) and implementation of the Extended Loss of All AC Power (ELAP) guideline if it is determined that the EDGs cannot be recovered within the SBO coping period.

Other supporting procedures may also require changes. These changes will be implemented as part of the modification process for associated FLEX equipment.

MODIFICATIONS REQUIRED:

Modification 1: Controlled Bleed-off Isolation
Modification 2: Nitrogen Backup for Safety Valve Accumulators, or
Modification 3: Modify MS-291 and MS-292
Modification 10: Non-1E Battery Addition (not required, but under consideration)

FLEX EQUIPMENT REQUIRED:

None

REFERENCES:

1. AOP-17, Rev. 14; Loss of Instrument Air
2. Calculation FC06174, Rev. 2; Required Coping Duration for Station Blackout

Action 2
Isolate CBO Paths

OBJECTIVE:

The objective of this action is to isolate the reactor coolant pump (RCP) CBO following an ELAP in order to minimize reactor coolant system (RCS) inventory loss.

Studies have determined that the isolation of CBO following an ELAP or an SBO will limit the potential for damage to the RCP seals and, therefore, will help minimize RCS inventory loss.

> The CBO design is particularly relevant to the ability of a given plant to isolate the CBO flow after the ELAP has commenced. With CBO isolated, the flow of hot water from the RCS through the seal housing is terminated. Thus, heat up of the seals would be limited to conduction of heat in the pump shaft and other metal components. This is a much slower process than heat up by convection due to CBO flow. Therefore, those plants that can isolate seal flow quickly will experience much slower seal material degradation due to high temperature (500 to 600ºF). [Ref. 1]

> Results from [loss of seal cooling] experiments suggest that early isolation of CBO (in less than 5-10 minutes) ensure that seal temperatures at all upper seal stage cavities will be maintained below about 300ºF ... At these temperatures no serious threat exists for seal failure. [Ref. 2]

Therefore, prompt isolation of CBO following an ELAP is considered important in minimizing RCS inventory loss and extending the time by which RCS makeup must be re-established to prevent core uncovery. Currently, an SBO would result in the isolation of CBO to the volume control tank (VCT), which is the normal return path. However, CBO flow would continue via a relief valve, CH-208, to the reactor coolant drain tank (RCDT). To fully isolate CBO flow, valve HCV-208 must be closed to isolate CH-208.

MODIFICATIONS REQUIRED:

HCV-208 currently fails open on a loss of instrument air. To ensure CBO remains isolated following an ELAP, Modification 1 will be implemented to ensure HCV-208 remains closed.

EQUIPMENT REQUIRED:

No FLEX equipment is required for this action.

REFERENCES:

1. WCAP-17601-P, Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs, Rev. 0, dated August 2012 (Section 2.2)

2. WCAP-16175-P-A, Models for Failure of RCP Seals Given Loss of Seal Cooling in CE NSSS Plants, Rev. 0, dated March 2007 (Section 5.3.1)

Action 3
Investigate the Condition of EDGs

OBJECTIVE:

The objective of this Action is to provide information for investigating the condition of the emergency diesel generators.

NEI FLEX implementation guidelines (NEI 12-06) [Ref. 1] require the mitigating strategies to assume, as part of the initial conditions, that all installed sources of emergency on-site AC power and SBO alternate AC power sources are not available and are not imminently recoverable. Actions are required to assess the condition of EDGs. SBO Procedure EOP-07 does instruct operators to use emergency startup procedures to try to start the EDGs. Steps will be added to assess the conditions of EDGs to decide if FLEX strategies need to be implemented and evaluate the potential to restore at least one EDG.

During the FLEX procedure development process, various EDG auxiliary systems and components will evaluated to determine if they should be assessed for damage early in the event. The intent of this assessment is to determine if rapid recovery of an EDG is likely - it is not intended to be used for establishing a detailed recovery plan. Therefore, assessment of inoperable control and protection circuits (i.e. automatic field flashing circuit, output breaker control circuits, remote diesel generator control circuits that can be bypassed and/or operated manually or locally) would be limited in scope. Similarly, assessment of redundant emergency diesel generator components or components used only during EDG standby (i.e., fuel pumps, lube oil pumps) would be limited in scope.

The results of the assessment will be used, along with assessments of offsite power availability, by operations staff to determine whether restoration of an installed power source is likely before the plant exceeds the design coping period for a station blackout. If the operations staff determines that an installed power source will not be available within that period, they will transition to the ELAP guideline as discussed in Action 1.

MODIFICATIONS REQUIRED:

No modifications are required to perform the proposed assessment actions.

EQUIPMENT REQUIRED:

None

REFERENCE:

1. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (Flex) Implementation Guide, dated August 2012

Action 4
ELAP Support Systems Assessment

OBJECTIVE:

The objective of this Action is to provide information for assessing the condition of support systems required/desired for implementing FLEX Strategies.

Nuclear Energy Institute (NEI) FLEX implementation guidelines (NEI 12-06) [Ref. 1] require that the strategies take credit for only that plant equipment which meets the station design basis criteria, including seismic, flooding, tornado, etc., or portable FLEX equipment that is stored in locations that are robust enough to withstand the effects of such events. These strategies have been defined and will be described in subsequent action descriptions. Following a BDBEE, an evaluation of the ability to deploy FLEX equipment would be conducted as part of the implementation of the ELAP guideline discussed in Action 1 to ensure that resources are used effectively if and when FLEX strategies must be implemented.

It is also considered very desirable from convenience, equipment and manpower needs perspectives to utilize certain equipment and systems that may be available, even though they may not meet the station design basis or FLEX criteria. Thus, an assessment of those systems will be performed to support implementation of certain optimal coping strategies.

MODIFICATIONS REQUIRED:

FLEX Credited Equipment

No modifications are required to perform the proposed action; all modifications mentioned are associated with proposed actions outlined in other Actions.

FLEX EQUIPMENT REQUIRED:

FLEX Credited Equipment

No specific FLEX credited equipment is required to perform the proposed action; all equipment mentioned is associated with proposed actions outlined in other actions.

REFERENCE:

1. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (Flex) Implementation Guide, dated August 2012

Action 5
Rapid Cooldown of RCS

OBJECTIVE:

The objective of this action is to complete a rapid cooldown of the reactor coolant system (RCS) cooldown from the hot shutdown condition to less than 350°F and a corresponding steam generator pressure of 120 psia following an extended loss of AC power (ELAP).

Studies performed for the PWROG [Refs. 1 and 7] have determined that a rapid RCS cooldown and depressurization following an ELAP provides several advantages. First, the potential for reactor coolant pump (RCP) seal failure, and the resultant increase in RCS inventory losses, is reduced by lowering both the temperature and the pressure. Should seal leakage or any other RCS leakage develop, the reduced pressure extends the time to core uncovery significantly. Second, the reduction in pressure allows the safety injection tanks to inject borated water, thereby helping to maintain shutdown margin. The reactivity management situation is improved in the early cooldown situation because the combined negative reactivity from the safety injection tank injection and the xenon buildup offset the positive reactivity increase resulting from the RCS temperature decrease. Finally, a rapid cooldown produces lower steam generator pressures sooner, which allows for the use of portable/temporary pumps to supply auxiliary feedwater (AFW) should a problem with the turbine-driven auxiliary feedwater pump develop.

FCS plant-specific studies, discussed in the next section, have found that the advantages of the rapid cooldown strategy investigated for the PWROG would apply to FCS also [Refs. 2 and 3].

STRATEGY:

The rapid cooldown strategy for FCS would include the following:

- A period of holding at the hot shutdown condition while the situation is assessed;
- Initiation of actions to prepare for the deployment of portable (FLEX) equipment during Phase 2 of the coping period;
- Initiation of a cooldown from the hot shutdown condition using the turbine driven auxiliary feedwater pump and the air assisted main steam safety valves, MS-291 and MS-292.

If steam cannot be relieved from both main steam lines, the cooldown rate may be reduced or other actions taken to avoid the consequences of an asymmetrical cooldown as discussed in Reference 1.

The emergency feedwater storage tank (EFWST) has sufficient capacity to maintain Hot Shutdown for 8 hours [Ref. 8]. The EFWST has sufficient capacity to support a rapid cooldown (assumed 75°F/hr.) for approximately 5 hours (two hours at hot shutdown followed by approximately 3 hours of cooldown [Ref. 5]), by which point an additional source for auxiliary feedwater must be aligned.

It is desirable to continue rapid cooldown to a steam generator pressure of 120 psia which corresponds to an RCS hot leg temperature of approximately 350°F and an RCS pressure of approximately 150 psia. A plant-specific analysis has determined that, at these conditions, the safety injection tanks (SITs) have injected sufficient borated water to maintain adequate shutdown margin after the xenon has decayed away [Ref. 1, Section 5.8.2.1]. Additional analyses will be performed to assure adequate shutdown margin future core physics parameters and to address issues associated with an asymmetric cooldown using only one steam generator. A plant-specific analysis has also determined that the SITs will not inject nitrogen into the RCS until RCS pressure falls below 100 psia [Ref. 1, Table 5.6.2-1]. Thus, the target pressure at the completion of the cooldown at FCS is 100 – 150 psia. Actions would then be taken to either vent or isolate the SITs to prevent Nitrogen injection, which could affect natural circulation in the RCS.

MODIFICATIONS REQUIRED:

1. Modification 3 - A modification to replace air assisted main steam safety valves MS-291 and MS-292 with larger capacity valves would allow for a rapid RCS cooldown using power-operated valves. A second option would be local manual operation (hydraulic jacking) of the larger capacity MSSVs (MS-275 through MS-282) which would alleviate the need for this modification. Which of these options is chosen will be discussed in a 6-month update.
2. In order to isolate the safety injection tanks after they have injected sufficient inventory, but prior to injecting any significant amount of nitrogen, a modification may be required. FCS is evaluating several options for isolating the SITs, including:
    a. Evaluating whether containment conditions would allow entry for manual valve operation
    b. Providing temporary motive power to the SIT isolation valves
    c. Providing a means of venting the SITs.

EQUIPMENT REQUIRED:

The ability to continue supplying auxiliary feedwater to the steam generators as the EFWST inventory is approaching exhaustion will required that modifications to re-supply the EFWST be completed.

- FLEX SIRWT Pump (FSP) and its associated FLEX DG
- FLEX Backup Submersible Pump and its associated DG
- Backup Portable Self-Powered Pump
- FLEX Valve Station (FVS)

REFERENCES:

1. WCAP-17601-P, Section 5.5.2
2. Westinghouse LTR-TDA-11-72, Rev. 0, dated October 27, 2011
3. Westinghouse LTR-TDA-12-31, Rev. 0, dated August 7, 2012
4. USAR Table 14.9-6
5. Summary of Key Results from ELAP Cases for FCS (supplemental data from ELAP case runs reported in Ref. 3 above)
6. OCAG-1, Rev. 22, Operational Contingency Action Guideline
7. PA-PSC-0965, Rev. 0, PWROG Core Cooling Position Paper
8. USAR Section 9.4.1

Action 6
Deploy Portable FLEX Equipment

OBJECTIVE:

The objective of this Action is to discuss the sequence in which the portable FLEX equipment should be deployed. The guidelines on the methods of deployment are provided in the Modifications associated with the portable equipment.

NEI FLEX implementation guidelines [Ref. 1] require that to cope with a BDBEE that could cause an ELAP and Loss of Normal Access to the Ultimate Heat Sink (LUHS), FCS must have portable equipment available at the site and deploy it to be able to cope until equipment from offsite sources can be brought in. FCS has identified FLEX portable equipment that will be available and deployable for use, and has performed a conceptual walk down to validate that the actions can be performed within the necessary time constraints. For actions beyond one day, adequate resources will be available to ensure additional FLEX deployment actions can be accomplished within the necessary time constraints. The time constraints described here include adequate margin for uncertainty in the conceptual validation process.

ACTION:

The following portable FLEX equipment will be deployed, at the action completion times indicated:

- At T= 4 hours or earlier, deploy FLEX SIRWT pump (FSP) and its associated FLEX diesel generator (FDG).
  - o If the FSP is not available, deploy the backup submersible pump and power it from the FSP's dedicated FDG.
  - o If the backup submersible pump or the FSP's dedicated FDG is not available, deploy the B.5.b Diesel Pump.
- At T= 4 hours, deploy the FLEX Valve Station (FVS).
- At T= 7 hours, deploy the 200 kW (nominal) FDG.
  - o If the 200 kW FDG is not deployed, deploy the 10 kW (nominal) FDG.
- At T= 9 hours, establish CR ventilation using VA-46A or B powered from the 200 KW FDG
  - o If the 200 kW FDG is not deployed, establish temporary CR ventilation in accordance with AOP-13 [Ref. 1]
- At T= 16 hours, deploy portable pump to inject water from the SIRWT into the SFP
- At T= 1 day, if the river level is less than 995', deploy the river pump on the platform at EL. 995' and deploy the fire truck to convey the river water to the SIRWT or FVS.

MODIFICATIONS REQUIRED:

No modifications are required to perform the proposed action; all modifications mentioned are associated with proposed actions outlined in other Actions.

FLEX EQUIPMENT REQUIRED:

All flex equipment discussed in this action is associated with proposed actions outlined in other actions.

REFERENCES:

1. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide
2. AOP-13, Rev. 9, Loss of Control Room Air Conditioning

Action 7
Use of Clean Water Sources at the Site

NOTE: This action is not considered part of the credited FLEX response strategy. It is presented as INFORMATION ONLY to describe other water sources that, if available, may be used rather than the FLEX credited water sources.

OBJECTIVE:

The objective of this Action is to list the water sources that are available at the site, with water that is much cleaner than the river or the Ultimate Heat Sink (UHS) water. These cleaner water sources do not meet the criteria of NEI 12-06 [Ref. 1] and hence cannot be credited in the mitigation strategies. However, if any of these sources survive the BDBEE, their use will be less harmful to the plant equipment than the use of river water [Ref. 7] and, hence, preferable.

The possible water sources, capacities and the required supporting equipment and procedures, where available, are listed below. It should be noted that the strategies for the use of these sources are not fully developed yet, but are expected to be developed along with the development of other credited strategies.

Water Source	**Capacity, gal**	**Supporting Equipment**	**Applicable Procedures**
Condensate Storage Tank (CST)	150,000 [Ref. 9]	Diesel AFWP FW-54	EOP-07 [Ref. 5], AOP-30 [Ref. 6]
Primary Water Storage Tank, DW-46	23,500 [Ref. 2]	Portable B.5.b Pump in Room 69	None yet.
Demineralized Water Storage Tank, DW-39	13,000 [Ref. 3]	Portable B.5.b pump in 6-bay	None yet.
R.O. Unit Water Storage Tank, DW-68	180,000 (estimated)	B.5.b pump (Fire Truck or Trailer)	None yet.
Blair City Water	Not Limited		AOP-30
Potable Water Tank, PW-1	13,000 [Ref. 8]	Hose	Modification 6
Fire Water	Not Limited		AOP-30
T.C./Admin Building Fire Water Head Tank	135,000 [Ref. 4]	Hose	None yet.

REFERENCES:

1. NEI 12-06, Rev. 0, Diverse and Flexible Coping Strategies (Flex) Implementation Guide, dated August 2012
2. System Training Manual (STM) 27, Rev. 17; Miscellaneous Water Systems (Information Only)
3. STM 13, Rev. 23, Demineralized Water (Information Only)
4. EA-FC-04-010, Rev. 2, Recommendations for Implementing of Compensatory Actions in Response to NRC Bulletin 2003-01
5. EOP-07, Rev. 14; Station Blackout
6. AOP-30, Rev. 11; Emergency Fill of the Emergency Feedwater Storage Tank
7. Water Chemistry Study (under development)
8. Engineering Change EC 43219, PW-1 Relocation
9. STM 20, Rev. 48; Feedwater and Condensate System (Information Only)

Action 8
Refill EFWST from SIRWT Using New FLEX SIRWT Pump

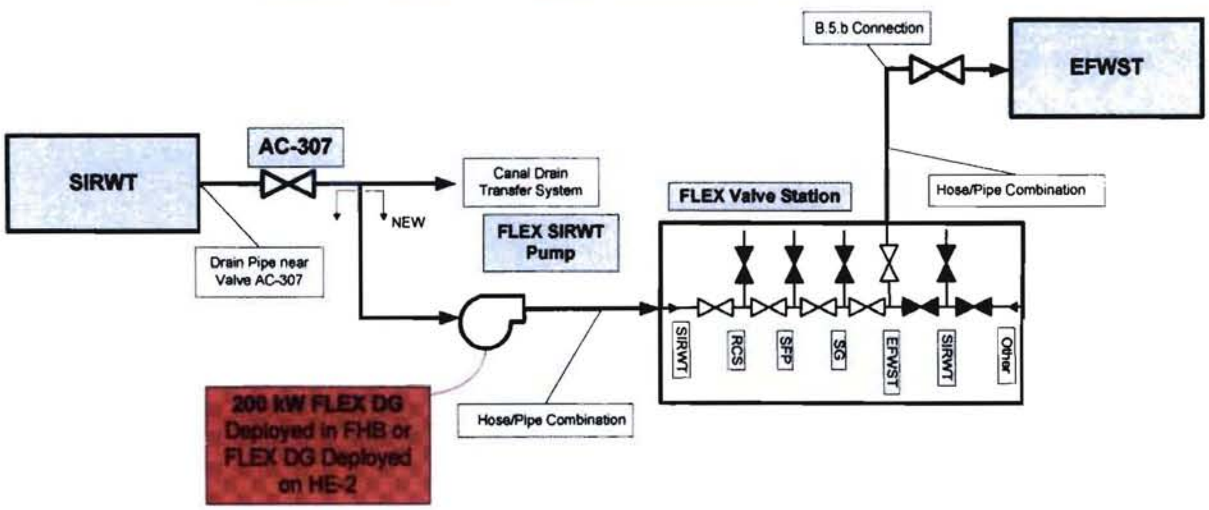
OBJECTIVE:

The objective of this action is to transfer water from the SIRWT and supply it to the EFWST FW-19 located in the Auxiliary Building, Room 81.

- The EFWST has capacity sufficient to cool the SGs for 8 hours [Ref. 1] while the RCS is maintained at hot standby.
- It is desirable to cool down the RCS rapidly, as described in Action 5 and Section 5.5.2 of Ref. 2. This will consume water from the EFWST at a faster rate.
- It is determined that in its current configuration, the EFWST will be emptied in about 5.2 hours [Ref. 3].
- A Modification that was required and designed for the potential extended power uprate (EPU) would expand the EFWST capacity by connecting it to the abandoned potable water tank [Ref. 4]. Although it is desirable to install this modification, since it will increase the EFWST emptying time by about 1.2 hours, installation of this modification is not required to accomplish this action.
- The fastest creditable way to refill the EFWST is by use of the SIRWT water. Three different pumps will be available for this function:
    - FSP will be installed/deployed in the transfer canal drain pump room. Its dedicated DG will be installed on the Fuel Building crane HE-2.
    - A backup submersible pump will be staged in the vicinity. This pump can be lowered into the SIRWT through its hatch. It can be powered from the same DG as the FSP.
    - A portable diesel pump [Ref. 5] can be deployed in the vicinity, and can be used as the third backup (see item 4 in the Modifications Required section below).

Any one of the above pumps will be lined up to take water from the SIRWT and supply it to FVS that will be deployed in Room 69. The FVS can be aligned to feed the EFWST through the B.5.b connection. This is one of the pathways to refill the EFWST with clean borated water soon after the ELAP.

Fig. 8-1: Refill EFWST from SIRWT Using FLEX SIRWT Pump



STRATEGY:

See schematic Figure 8-1 showing the method to refill EFWST from the SIRWT using the FSP.

MODIFICATIONS REQUIRED:

1. Modification 8: New FLEX SIRWT Pump
2. Modification 9: FLEX Valve Station
3. Modification 7: EFWST Fill Connection Pipe

FLEX EQUIPMENT REQUIRED:

- Flexible Hoses
- FLEX SIRWT Pump
- FLEX DG Installed on HE-2
- 200 kW FLEX DG Installed in the FHB Truck Bay

REFERENCES:

1. Fort Calhoun Station Updated Safety Analysis Report (USAR), Section 9.4.1
2. WCAP-17601-P, Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs, Rev. 0
3. Westinghouse letter (C. E. Burton) to OPPD (J. K. Gasper), CFTC-12-67, with attachment WEC Letter LTR-TDA-12-31, Analysis of the Fort Calhoun Station NSSS Response to an Extended Station Blackout, dated November 20, 2012, and CFTC-11-201, IER 11-4 90-Day Response, with attachment LTR-TDA-11-72, dated November 8, 2011
4. EC 43209, FW-19 EFWST Expansion, Rev. 0
5. OCAG-1, Operational Contingency Action Guideline, Rev. 22

Action 9
Refill EFWST Using New Alternate Submersible Pump or B.5.b Pump

OBJECTIVE:

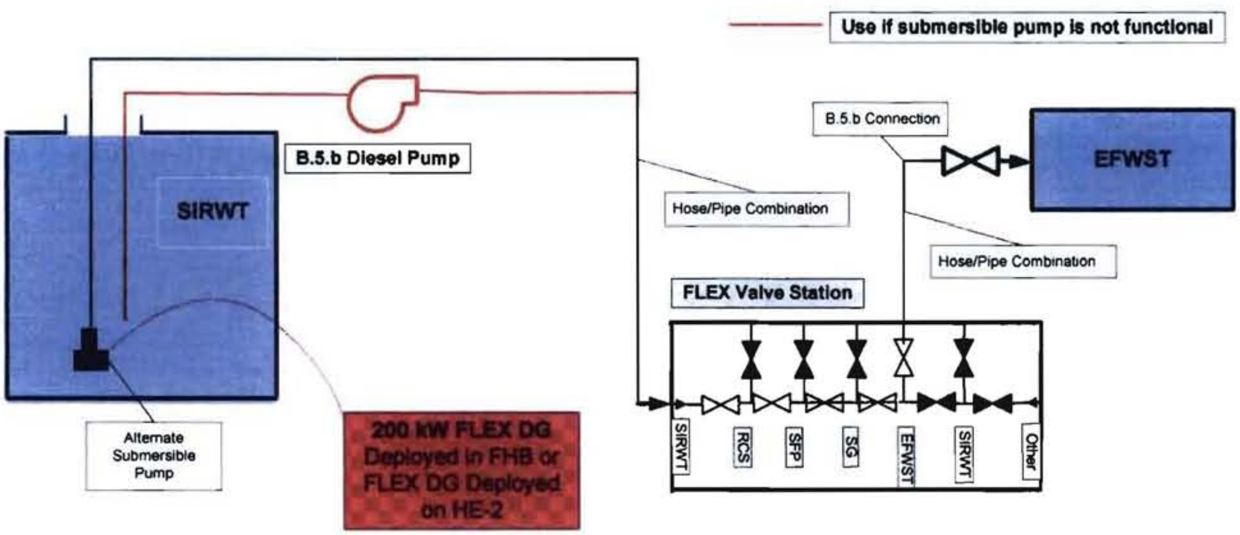
If Action 8 is found to be not feasible, this action should be used to transfer water from the SIRWT and supply it to EFWST, FW-19, using either an alternate submersible pump or B.5.b diesel pump.

See the objectives of this function in Action 8.

Water from the SIRWT is supplied to the FLEX Valve Station (FVS) that will be deployed in Room 69. The FVS can be aligned to feed the EFWST through the B.5.b connection discussed in Action 8.

This is one of the pathways to refill EFWST with clean, but borated, water soon after the ELAP.

Fig. 9-1: Refill EFWST Using Alternate Submersible Pump or B.5.b Pump



STRATEGY:

See schematic Fig. 9-1 showing the method to refill EFWST using alternate submersible pump or B.5.b pump.

MODIFICATIONS REQUIRED:

1. Modification 8: FLEX SIRWT Pump
2. Modification 9: FLEX Valve Station
3. Modification 7: EFWST Fill Connection

FLEX EQUIPMENT REQUIRED:

1. FLEX Valve Station
2. Portable self-powered pump

Note: The portable pump will be stored near the B.5.b box in corridor 26.

3. Submersible pump

Note: The submersible pump will be stored near the B.5.b box in corridor 26.

4. FLEX hoses
5. FLEX DG Installed on HE-2
6. 200 kW FLEX DG Installed in the FHB Truck Bay

REFERENCES:

None

Action 10
Refill EFWST with Well/River Water

OBJECTIVE:

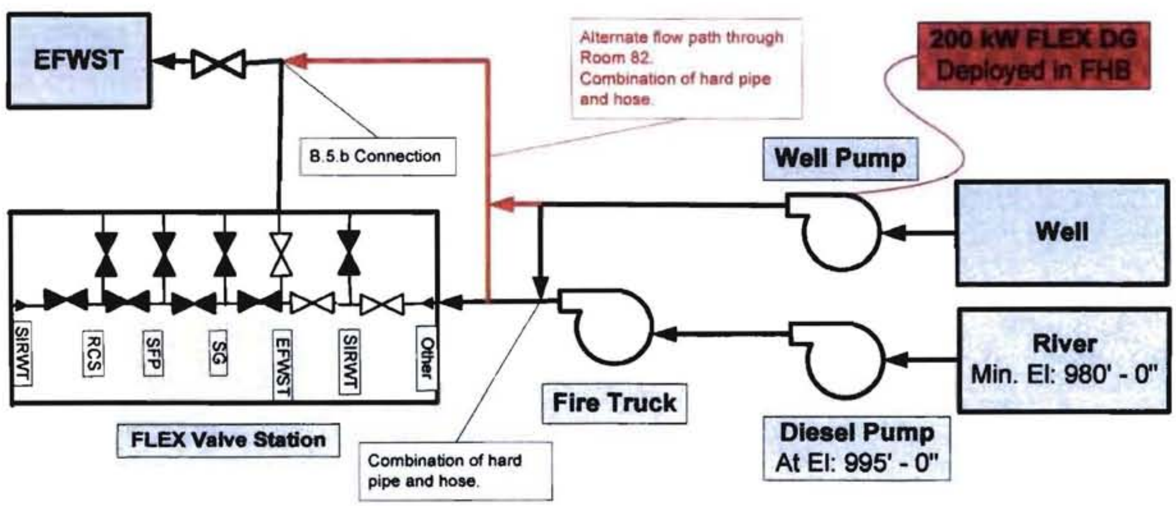
The objective of this action is to supply well or river water to refill the EFWST (FW-19) located in the Auxiliary Building, Room 81.

- Initial refilling of the EFWST is done per Actions 7, 8 or 9. However, these actions depend upon sources of water with limited volumes.
- If the above sources of water were not available or feasible while the SGs are still at high temperature and pressure conditions, use well water* (if available) or the river water to refill the EFWST.
- The well pump, if available, it can be powered with the 200 kW FDG deployed in the FHB Truck Bay.
- If well is not available, a fire truck alone or in combination with a river diesel pump, depending upon the river level, can be used to supply river water to the FVS.
  - * Additional sources of clean water at the site have been identified in Action 7.

Any one of the above water sources will be lined up to supply water to FVS that will be deployed in Room 69. FVS can be aligned to feed the EFWST through the B.5.b connection.

In the event that Room 69 / Room 81 pipe cannot be used, the alternative flow path through Room 82, as described in Modification 7, can be used to supply water directly to the EFWST, bypassing the FVS.

Fig. 10-1 Refill EFWST with Well or River Water



STRATEGY:

See schematic Fig. 10-1 showing the method to refill EFWST with well or river.

MODIFICATIONS REQUIRED:

1. Modification 7: EFWST Fill Connection
2. Modification 9: FLEX Valve Station.
3. Modification 18: Well Construction
4. Modification 19: Pump Platform by the River at EL. 995'

FLEX EQUIPMENT REQUIRED:

- FLEX Valve Station
- Well and Pump
- 200 kW FDG
- Diesel Drafting Pump at the River
- Fire Truck

REFERENCES:

None

Action 11
Power Battery Charger with 200 kW FLEX DG

OBJECTIVE:

The objective of this action is to power one of the two 1E battery chargers with power from a (nominal) 200 kW FLEX Diesel Generator (FDG) that will be deployed in the Fuel Handling Building Truck Bay (Modification 4 and Action 6).

- DC Power is essential in the FLEX mitigation strategies for powering the essential instruments, which are listed in Action 12.
- FCS is currently equipped with two sets of 1E batteries. Each will last about 8 hours with the existing loads on them [Refs. 1 and 3]. It is desirable to have DC power available for 24 hours before chargers are powered with an alternate power source.
- Batteries need to be charged before they run out completely to avoid damage to them as described in PL Letter Report 139-1087-1, Attachment C [Ref. 1].
- A modification that would install a non-1E battery set and permanently move to it large non-essential DC loads from the 1E batteries is being considered (Modification 10). Some additional minor load shedding may or may not be required to achieve the desired 24 hour battery capacity.
- 200 kW FDG being deployed in the FHB Truck Bay is capable of powering the 1E charger. Potential cable routing paths are being analyzed to ensure feasibility. Time constraint for deployment of the 200kW diesel is based on the current 8 hour battery capacity.
- If the 200 kW FDG cannot be deployed within 8 hours, the DC bus can be supplied with power using a backup 10 kW FDG, as described in Action 12.

MODIFICATIONS REQUIRED:

1. Modification 4: Deployment of 200 kW FDG
2. Modification 13: Power Cables Routing

FLEX EQUIPMENT REQUIRED:

1. 200 kW FLEX DG
2. 480V Portable Switchgear
3. 480V / 120 – 208V 3 phase 60 Hz Transformer
4. Disconnect Switch

REFERENCES:

1. PL Letter Report 139-1087-1, Omaha Public Power District/Fort Calhoun Station Response to INPO L1 IER 11-4, *Near Term Actions to Address the Effects of an Extended Loss of All AC Power in Response to the Fukushima Daiichi Event*, dated January 7, 2012
2. Letter CFTC-12-5, IER 11-4 90/10 Day Response – Instrumentation Review, dated January 11, 2012
3. USAR Section 8.4.2

Action 12

Power for the DC Bus with 10 kW FLEX DG

OBJECTIVE:

The objective of this action is to power one of the two 1E DC Buses with power from the 10 kW FLEX Diesel Generator (FDG) (Modification 11). The 10 kW FDG output will be run through either its own dedicated rectifier or the rectifier of one of the 1E chargers. This action is a backup to the powering of the charger with the 200 kW FDG (Action 11), if that option is not available.

See Action 11 for the need and objectives of DC power. The size of the FDG described in this action will be determined by the minimum load expected on a DC bus. This is mainly a function of the instrumentation that must remain powered. The minimum essential instruments required to mitigate an ELAP event are listed below (only one instrument per variable is required; EFWST level can be obtained locally; remote indication is desirable, but not essential):

Essential Instrumentation Equipment and Indicator Locations

Instrument Variable and Train	Equipment Tag	Indicator	Indicator Location
Containment Pressure A	PT-783	PI-783	AI-65A (Control Room)
Containment Pressure B	PT-784	PI-784	AI-65B (Control Room)
Steam Generator RC-2A Level A	A/LT-911	A/LI-911/912	AI-66A (Control Room)
Steam Generator RC-2A Level B	B/LT-911	B/LI-911/912	AI-66B (Control Room)
Steam Generator RC-2B Level A	A/LT-912	A/LI-911/912	AI-66A (Control Room)
Steam Generator RC-2B Level B	B/LT-912	B/LI-911/912	AI-66B (Control Room)
Steam Generator RC-2A Pressure A	A/PT-913	A/PI-913/914	AI-66A (Control Room)
Steam Generator RC-2A Pressure B	B/PT-913	B/PI-913/914	AI-66B (Control Room)
Steam Generator RC-2B Pressure A	A/PT-914	A/PI-913/914	AI-66A (Control Room)
Steam Generator RC-2B Pressure B	B/PT-914	B/PI-913/914	AI-66B (Control Room)
EFWST Level FW-19 A	Locally, OR LT-1183 (not essential)	Locally, OR LIA-1183 (not essential)	Locally, OR AI-66A (not essential)

Essential Instrumentation Equipment and Indicator Locations

Instrument Variable and Train	Equipment Tag	Indicator	Indicator Location
EFWST Level FW-19 B	Locally, OR LT-1188 (not essential)	Locally, OR LIA-1188 or LI-1188 (not essential)	Locally, OR AI-66B (not essential)
AFW Flow A	FT-1109	FI-1109-1 or FI-1109	AI-66A or CB-10 (Control Room)
AFW Flow B	FT-1110	FI-1110-1 or FI-1110	AI-66B or CB-10 (Control Room)
Wide Range Pressurizer Pressure A	PT-115	PI-115A-2	AI-179
Wide Range Pressurizer Pressure B	PT-105	UR-105/123	AI-31E

NOTE: Instrumentation for Spent Fuel Pool Level monitoring would be inoperable during an SBO event. The Spent Fuel Pool Level instrumentation requires modification to meet the requirements of NRC Order EA 12-051 [Ref. 2]. This modification is being carried out under the response to NRC Order EA 12-051.

Staging Location for the 10 kW FDG: The potential location(s) for the staging area for the 10 kW FDG are marked on the plan drawing for Elevation 1007'-0", as shown below:

Figure 12-1: Potential Staging Location(s) for the 10kW FDG

[[Withheld Under 10 CFR 2.390]]

MODIFICATIONS REQUIRED:

Modification 11: Deployment of 10 kW FDG

FLEX EQUIPMENT REQUIRED:

- FLEX 10 kW Diesel Generator
- Power Cabling.

REFERENCES:

1. DWG 11405-A-6 (File No. 12163), Rev. 87, entitled *Primary Plant Ground Floor plan P&ID*
2. NRC Order EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012

Action 13
Control Room Lighting / Ventilation

OBJECTIVE:

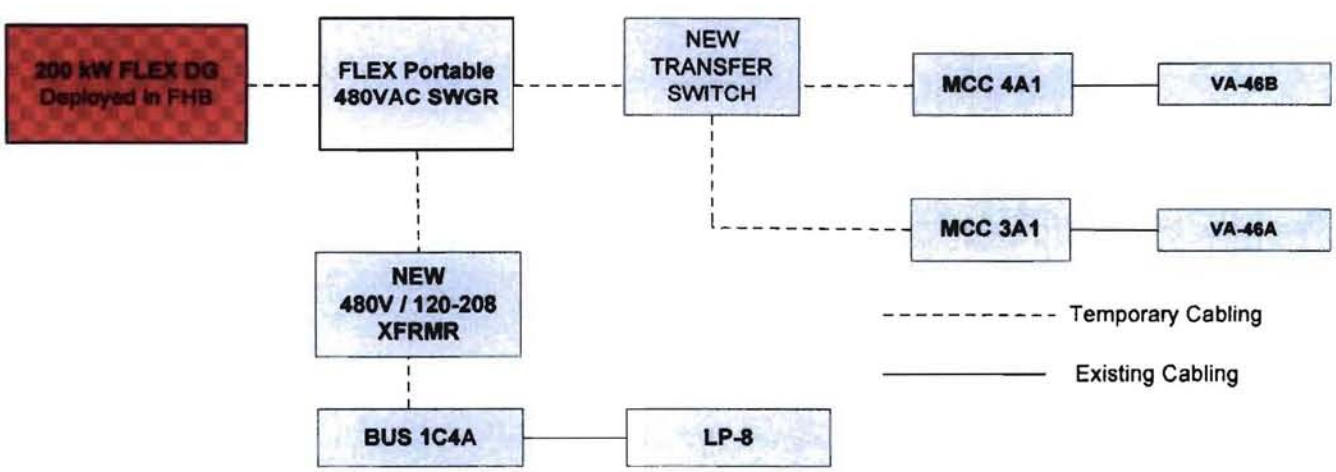
The objective of this action is to provide the necessary backup power to Main Control Room exhaust fans VA-46A/B and Main Control Room lighting panel LP-8 in an event of an ELAP.

- The reactor protective system (RPS) panels and engineered safety feature panels were designed for, and the instrumentation was tested at, 120°F [Ref. 1]. The temperature inside the control cabinets is at most 15°F [Ref. 1] warmer than the temperature of the control room due to heat produced by the electronic circuitry. Therefore, the temperature in the control room during normal operation is limited to a maximum of 105°F [Ref. 1].

  However, the RPS is not needed during an ELAP because the reactor would have already tripped as a result of the blackout or would have been previously shut down. As stated in NEI 12-06 (Section 3.2.1.3, Item 9), no additional events or failures are assumed to occur immediately prior to or during the event. As a result, it is not expected that the engineered safety features actuation system (ESFAS) will be needed during an ELAP.

  In addition, the ELAP itself will cause a loss of certain power supplies located in the control room, which will reduce the heat input to the control room. The control room heat inputs and temperatures during an ELAP will be investigated in detail and the control room cooling requirements will be analyzed to determine requirements for control room ventilation for this action and Action 14. For this action the assumption is made that providing power to the control room exhaust fans VA-46A/B is required.
- Control Room lighting is required for the Operators to perform their actions.
- Since normal power for the exhaust fans VA-46A/B and Main Control Room lighting panel LP-8 will not be available in ELAP conditions, the 200 kW FLEX DG will be used to power these loads. Temporary cables will have to be installed for this purpose (Modification 13).

Fig. 13-1: Control Room Lighting / HVAC Alignment



STRATEGY:

See schematic Figure 13-1 above for powering exhaust fan VA-46A or VA-46B and Main Control Room lighting panel LP-8:

MODIFICATIONS REQUIRED:

1. Modification 4: FLEX DG Deployment in FHB Truck Bay
2. Modification 13: Power cables Routing

FLEX EQUIPMENT REQUIRED:

1. 200 kW FLEX DG
2. 480V Portable Switchgear
3. 480V / 120 – 208V 3 phase 60 Hz Transformer
4. Disconnect Switch

REFERENCE:

1. Fort Calhoun Station Technical Specifications, Section 2.12, Control Room Ventilation System

Action 14
Provide Temporary Main Control Room Ventilation

OBJECTIVE:

The objective of this action is to provide the necessary temporary ventilation to the Main Control Room (MCR) in the event of a loss of control room air conditioning.

This Action is to be taken if Action 13 is not feasible. See the objectives of the MCR HVAC Control in Action 13.

STRATEGY:

FCS Procedure AOP-13 [Ref. 1] provides instructions for establishing temporary ventilation in the MCR under various conditions. These actions will work in an ELAP scenario if power is provided by a FLEX power source. FCS plans to provide a portable generator to support this action.

MODIFICATIONS REQUIRED:

None

FLEX EQUIPMENT REQUIRED:

10 kW FLEX DG

REFERENCE:

1. AOP-13, Rev. 09, Loss of Control Room Air Conditioning

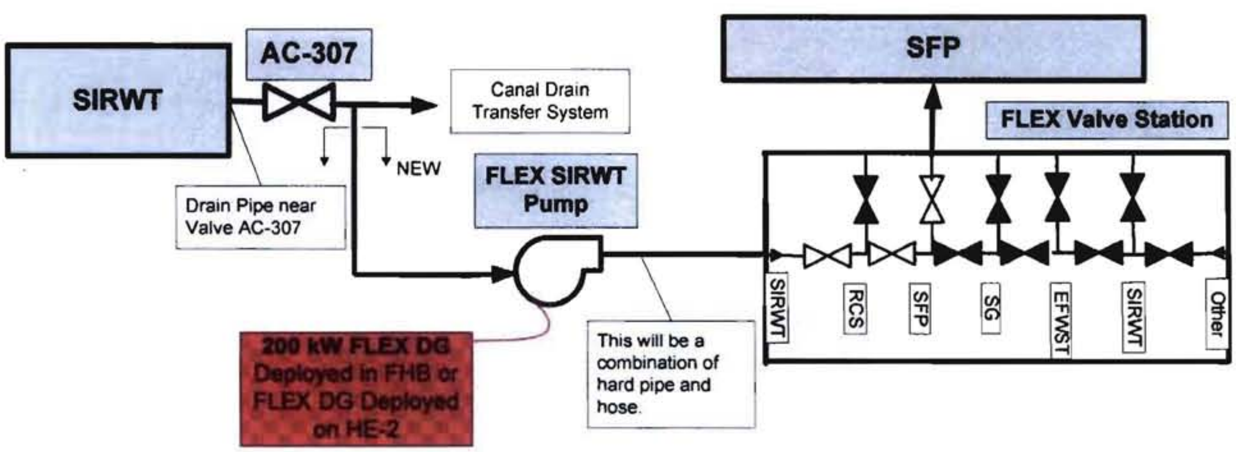
Action 15
Refill SFP Using SIRWT Pump

OBJECTIVE:

The objective of this action is to transfer water from the SIRWT to the Spent Fuel Pool (SFP). This is one of the pathways to supply clean borated water to SFP after the ELAP. Reference 1 evaluated SFP cooling and determined the following:

- Following an ELAP it is calculated with conservative assumptions that boiling will begin at approximately 19 hours; and the SFP water will evaporate due to decay heat from the stored spent fuel bundles and its level will reduce to 8' above the fuel in about 103 hours [Ref. 1].
- Makeup water is required so as to maintain or increase the water level, so that the radiation levels in the Fuel Handling Building (FHB) will be tolerable.
- It is calculated that the makeup water will be required at a flow rate of at least 17.6 gpm [Ref. 1].
- It is noted that that the evaporation and/or boiling of the SFP will cause high humidity and steam inside the FHB. Ventilation will have to be provided. It will also be helpful to start SFP makeup early to keep the pool cool, but makeup should not cause excessive SFP overflow to avoid flooding the Auxiliary Building lower levels.

Fig. 15-1: Refill SFP Using SIRWT



STRATEGY:

See schematic Figure 15-1 for method to refill SFP.

MODIFICATIONS REQUIRED:

1. Modification 8: New FLEX SIRWT Pump.
2. Modification 9: FLEX Valve Station.
3. Modification 12: SFP Fill Pipe

FLEX EQUIPMENT REQUIRED:

1. FLEX SIRWT Pump (FSP)
2. FLEX Valve Station (FVS)

REFERENCES:

1. Letter LTR-SEE-II-11-61, Rev. 0, Fort Calhoun Station Spent Fuel Pool Time to Boil upon Loss of All AC Power, dated October 27, 2011

Action 16
Refill SFP Using New Alternate Submersible Pump or B.5.b Pump

OBJECTIVE:

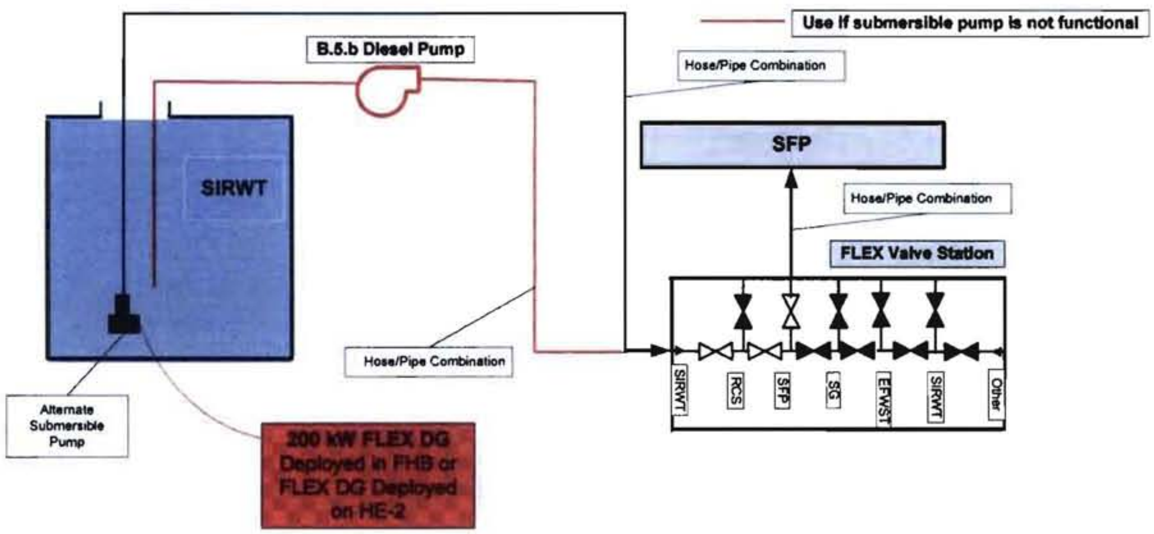
If Action 15 is found to be not feasible, this action should be used to transfer water from the Safety Injection and Refueling Water Tank (SIRWT) and supply it to Spent Fuel Pool (SFP), using either an alternate submersible pump or portable, self-powered pump.

See the objectives of this function in Action 15.

Water from the SIRWT is supplied to FLEX Valve Station (FVS) that will be deployed in Room 69. FVS can be aligned to feed the SFP.

This is one of the pathways to supply clean borated water to SFP after the ELAP.

Fig. 16-1: Refill SFP Using Alternate Submersible Pump or B.5.b Pump



ACTION:

See schematic Figure 16-1 for method to refill SFP.

MODIFICATIONS REQUIRED:

1. Modification 8: FLEX SIRWT Pump.
2. Modification 9: FLEX Valve Station.
3. Modification 12: SFP Fill Pipe.

FLEX EQUIPMENT REQUIRED:

1. FLEX Valve Station
2. Portable, self-powered pump

   Note: The portable pump will be stored near the B.5.b box in corridor 26.
3. Submersible pump

   Note: The submersible pump will be stored near the B.5.b box in corridor 26.
4. FLEX hoses
5. FLEX DG Installed on HE-2
6. 200 kW FDG Installed in the FHB Truck Bay

REFERENCE:

None

Action 17
Refill SFP with Well/River Water

OBJECTIVE:

The objective of this action is to supply well or river water to refill the spent fuel pool (SFP). It is noted here that other clean water storage tanks, listed in Action 7, can be used.

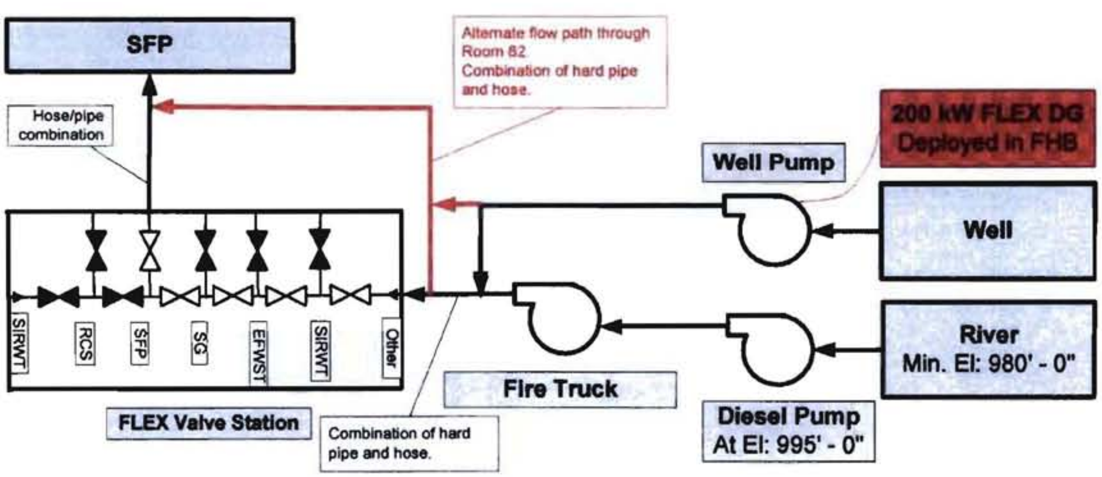
- Refill SFP primarily by taking water from the Safety Injection and Refueling Water Tank (SIRWT), per Actions 15 or 16. When SIRWT is close to being empty, refill per Action 18, and continue refilling of the SFP.
- If the above source of water were not available or feasible for any reason, use well water, or the river water to refill the SFP.
- The well pump, if available, can be powered with the 200 kW FDG deployed in the FHB Truck Bay.
- If the well or other sources of clean water are not available, river water can be supplied to the FLEX Valve Station (FVS) using a Fire Truck alone or in combination with a river diesel pump, depending upon the river level.

Any one of the above water sources will be lined up to supply water to FLEX Valve Station (FVS) that will be deployed in Room 69 in one of two ways:

- A flexible hose run through the Fuel Handling Building truck bay, or
- A hose/pipe combination through Room 82, Room 81 and to Room 69

FVS can be aligned to feed the SFP through the fill pipe.

Fig. 17-1 Refilling SFP with Well or River Water



STRATEGY:

See schematic Fig. 17-1 for method to refill SFP.

MODIFICATIONS REQUIRED:

1. Modification 9: FLEX Valve Station.
2. Modification 18: Well Construction
3. Modification 19: Pump Platform by the River at EL. 995'
4. Modification 7: Hard Pipe to Fill EFWST at Room 82.

FLEX EQUIPMENT REQUIRED:

- FLEX Valve Station
- Well and Pump
- 200 kW FDG
- Diesel Drafting Pump at the River
- Fire Truck

REFERENCES:

None

Action 18
Refill SIRWT with Well/River Water

OBJECTIVE:

The objective of this action is to supply well or river water to refill the SIRWT. It is noted here that other clean water storage tanks, listed in Actions 4 and 7, can also be used if they are available.

- The SIRWT is a large capacity safety-related tank that is kept full with borated water. Under ELAP conditions, water from SIRWT is planned to be used for various functions such as steam generators cooling, spent fuel pool refilling and the RCS refilling. It is desirable to refill the SIRWT, maintain its boron concentration and continue to use it for the above functions.
- The well pump, if available, can be powered with the 200 kW FDG deployed in the FHB truck bay.
- If the well or other sources of clean water are not available, river water can be supplied using a fire truck alone or in combination with a river diesel pump, depending upon the river level.
- Boric acid can be added to the SIRWT in one of two ways:
    - By injecting it from the Boric Acid Storage Tank, if power is available to the associated pump.
    - By dumping bags of boric acid crystals into the SIRWT.

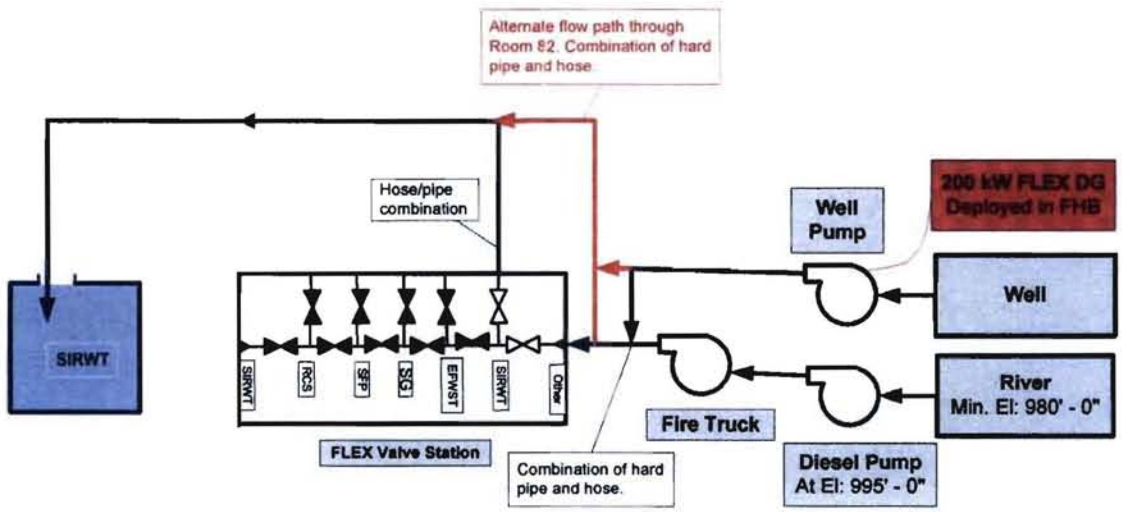
  Details of boric acid addition have not been developed yet.

Any one of the above water sources will be lined up to supply water to the FLEX Valve Station (FVS) that will be deployed in Room 69 in one of two ways:

- A flexible hose run through the Fuel Handling Building truck bay, or
- A hose/pipe combination through Room 82, Room 81 and to Room 69

The FVS can be aligned to feed the SIRWT through its hatch.

Fig. 18-1 Refilling SIRWT with Well or River Water



STRATEGY:

See schematic Figure 18-1 for method to refill SIRWT.

MODIFICATIONS REQUIRED:

1. Modification 7: Hard Pipe to Fill EFWST at Room 82.
2. Modification 9: FLEX Valve Station.
3. Modification 18: Well Construction
4. Modification 19: Pump Platform by the River at EL. 995'

FLEX EQUIPMENT REQUIRED:

- FLEX Valve Station
- Well and Pump
- 200 kW FDG
- Diesel Drafting Pump at the River
- Fire Truck

REFERENCES:

None

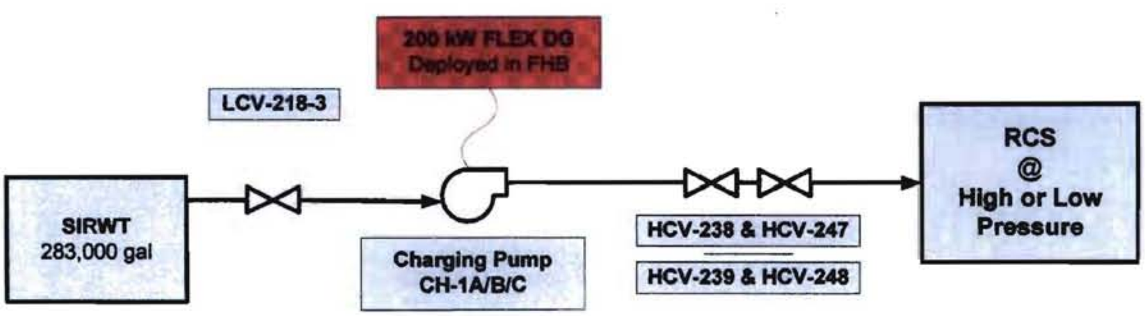
Action 19
Align RCS Makeup from SIRWT using Charging Pump

OBJECTIVE:

The objective of this action is to provide the necessary RCS makeup to compensate for the loss of RCS coolant through seal or unidentified leakage and prevent uncovering of the core.

- Seal leakage will be reduced to approximately 1 gpm/seal through the isolation of controlled bleed-off, if Modification 2 – CBO Isolation is installed. (See Action 2)
- The loss of RCS coolant will then be reduced to 1 gpm of unidentified leakage + 4 gpm seal leakage (1 gpm/pump).
- Time before the core is uncovered was determined to be 42 hours with the seal leakage at 15 gpm per seal [Ref. 4]. If the leakage is reduced to 5 gpm the time is expected to be of the order of five days. This time will be recalculated when Modification 1 is confirmed.
- The charging pump (any one of the three) provides an existing pathway for RCS makeup from SIRWT. Since normal power for this pump will not be available in ELAP conditions, the 200 kW FLEX DG will be used to power the charging pump through either of the following two connections:
    - Switchgear 1B3A for CH-1A, 1B4C for CH-1B or 1B3B-4B for CH-1C, if available
    - Local at the charging pump.
- Although use of the charging pump is not required for reactivity control [Ref. 3], use of the charging pump, especially when it is aligned to the Boric Acid Storage Tank (BAST) provides the defense in depth.

Fig. 19-1: Align RCS Makeup from SIRWT Using Charging Pump



STRATEGY:

See schematic Fig. 19-1 to align RCS makeup from SIRWT using charging pump using References 1 and 2.

MODIFICATIONS REQUIRED:

1. Modification 10: FLEX DG Deployment in FHB Truck Bay
2. Modification 13: Power Cable Routing

REFERENCES:

1. AOP-17, Rev. 14; Loss of Instrument Air
2. AOP-16, Rev. 18a; Loss of Instrument Bus Power
3. Westinghouse Report LTR-TDA-12-31, Rev. 0, *Analysis of the Fort Calhoun Station NSSS Response to an Extended Station Blackout per Contract 83453, Release 00121,* Amend. 2, dated August 7, 2012
4. Westinghouse Report LTR-TDA-11-72, Rev. 0, *Analysis of Fort Calhoun Station NSSS Response to an Extended Blackout*, dated October 27, 2011

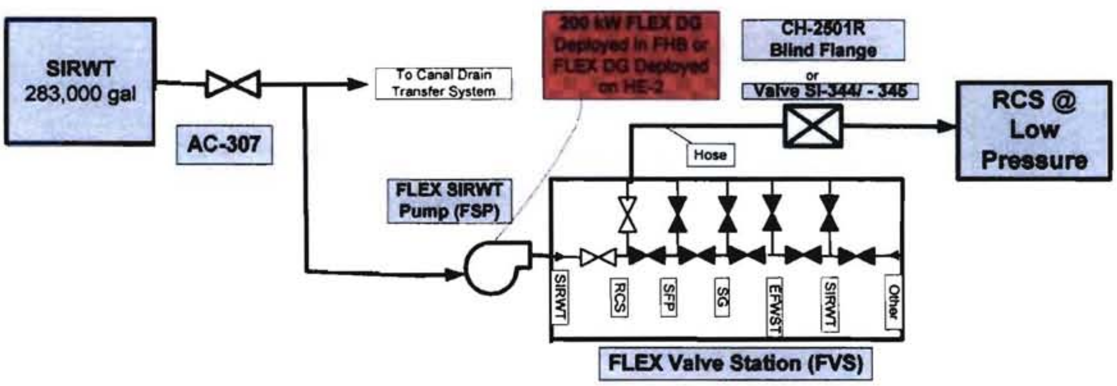
Action 20
Align RCS Makeup from SIRWT using FLEX SIRWT Pump

OBJECTIVE:

The objective of this action is to provide the necessary RCS makeup to compensate for the loss of RCS coolant through seal or unidentified leakage and prevent uncovering of the core.

The primary method of supplying makeup to the RCS is through the use of one of the Charging Pumps, as described in Action 19. The objectives and requirements of RCS makeup described in Action 19 apply to this Action as well.

Fig. 20-1: Align RCS Makeup from SIRWT Using FLEX SIRWT Pump



STRATEGY:

See schematic Figure 20-1 above to align RCS makeup from SIRWT using FLEX SIRWT pump.

MODIFICATIONS REQUIRED:

1. Modification 10: FLEX DG Deployment in FHB Truck Bay
2. Modification 7: Hard Pipes for EFWST Fill Connection and Room 82
3. Modification 14: FVS to CH2501R Blind Flange Connection
4. Modification 15: FVS to Valve SI-344 Connection

REFERENCES:

None

Action 21

Not Used at This Time

Action 22
Cool SG directly with Well/River Water

OBJECTIVE:

The objective of this action is to supply well or river water directly to either of the two steam generators (SGs) for cooldown. It is noted here that other clean water storage tanks, listed in Action 7, can be used.

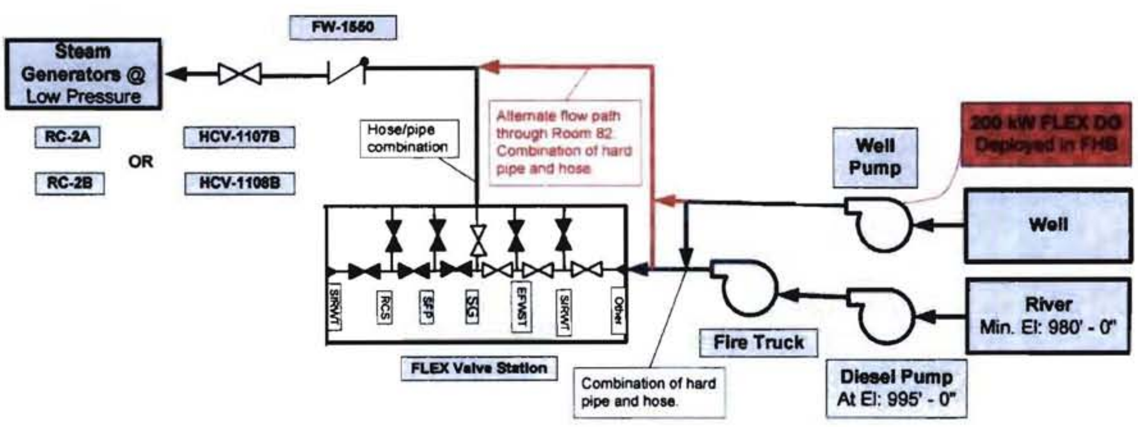
- Initial cooldown of the SGs is through the Auxiliary Feedwater System (AFW) which is supplied from the EFWST. If the above source of water were not available or feasible for any reason, use well water, or the river water for SG cooldown.
- The well pump, if available, can be powered with the 200 kW FDG deployed in the FHB truck bay.
- If well is not available, the Fire Truck in combination with a river diesel pump, depending upon the river level, can be used to supply river water to the FLEX Valve Station (FVS).

Any one of the above water sources will be lined up to supply water to FLEX Valve Station (FVS) that will be deployed in Room 69 in one of the two ways.

- A flexible hose run through the Fuel Handling Building truck bay, or
- A hose/pipe combination through Room 82, into Room 81

The direct water source can be aligned to feed the SG through valve FW-1550 via an already installed hose connection. Engine powered pumps are currently located in Room 81 to boost pressure if the head from the Well or River pumps is not adequate

Fig. 22-1 Cool SG Directly with Well or River Water



STRATEGY:

See schematic Fig. 22-1 for the alignment to cool SG directly with well or river water.

MODIFICATIONS REQUIRED:

1. Modification 9: FLEX Valve Station.
2. Modification 18: Well Construction
3. Modification 19: Pump Platform by the River at EL. 995'
4. Modification 7: Hard Pipe to Fill EFWST and at Room 82.

FLEX EQUIPMENT REQUIRED:

- FLEX Valve Station
- Well and Pump
- 200 kW FDG
- FLEX hoses
- Diesel Drafting Pump at the River
- Fire truck

REFERENCES:

None

Action 23
Lower Mode FLEX Strategies

OBJECTIVE:

The objective of this action is to establish the FLEX strategies that will be implemented to ensure the ELAP/LUHS mitigation objectives of NRC Order EA 12-49 [Ref 1] and NEI 12-06 [Ref. 2] can be achieved in lower modes of operation. In Modes 2 and 3, the plant is still in a condition to maintain the decay heat removal safety function in the same manner as if the BDBEE/ELAP/LUHS occurred in Mode 1 and no special consideration is required. However, once a cooldown of the RCS begins, certain aspects of the at-power strategies (especially with respect to system alignments and use of the TDAFW pump, FW-10) can no longer be implemented. To identify effective FLEX strategies for lower operating modes, three non-power plant conditions are evaluated:

- Transitioning from Mode 3 (RCS temperature of 515°F to 210°F) thru Mode 4 with RCS intact.
- Mode 4 with RCS vented thru Mode 5. This condition is further divided between:
  - RV head on (RCS overflow to Containment Sump)
  - RV head off (RCS overflow to refueling cavity)
- De-Fueled (all fuel in Spent Fuel Pool).

In general, certain FLEX strategies developed to achieve FLEX objectives for an event initiated in Modes 1 or 2 can be used to address Modes 3 – 5 and de-fueled as well. One exception is that additional actions may be necessary to address the containment function when fuel is in the reactor and the RCS is vented. In this case the anticipated energy release to containment may be greater than that assumed for an event occurring when the RCS is intact and additional actions may be necessary to ensure temperature and pressure limits are not approached.

STRATEGY:

Actions to address ELAP/LUHS are discussed for each of the three plant conditions described above.

Transitioning from Mode 3 (RCS Temperature 515°F to 210°F) thru Mode 4 with RCS Intact

<u>General Discussion</u>:

If the RCS is still intact, the basic strategy will be to use the S/Gs for decay heat removal. However, at some point during the mode transition, steam pressure will no longer be adequate to operate the TDAFW pump FW-10 (nominally around 300°F). To ensure adequate cooling is maintained, at least one S/G will be maintained at or above normal water level. This should provide a reasonable period of time in a passive cooling mode until FLEX equipment can be deployed to provide active cooling.

<u>RCS Heat Removal</u>:

Initially, the contained volume of the S/G will be used to absorb heat from the RCS. MS-291/292 will be opened remotely or locally (or, in certain low temperature circumstances, removed) to provide an outlet flowpath for steam/water from the S/G(s). If S/G pressure is not adequate to run FW-10, S/Gs would be fed using the strategy outlined in Action 22. Ideally, S/G flow rate would exceed steam production flow rate, allowing single phase heat removal. A concern for single phase flow thru S/G is assuring that water exiting MS-291/292 flows out of room 81 into the turbine building and does not cause flooding in the auxiliary building. Internal flooding analyses for Room 81 will need to be reviewed to ensure floor penetrations are adequate to protect against water intrusion into Rooms 56, 57 and 71.

RCS Makeup:

If the RCS temperature is > 350°F, rapid cooldown would be initiated to bring the RCS down to that temperature. Boration should not be an issue because the RCS would have been borated to shutdown boron concentration during transition through Mode 2 to Mode 3. Once at temperature ≤ 350°F, RCS makeup will be accomplished using one or more of the strategies outlined in Actions 19 and 20.

Containment:

Due to lower temperatures and pressures in this condition, containment response would be less severe than in Modes 1-3, so no additional actions (beyond those assumed for BDBEE during power operation) will be required.

SFP:

Unchanged from BDBEE/ELAP/LUHS during power operation.

Mode 4 (RCS Vented) – Mode 5

General Discussion:

Once the RCS is vented, the basic strategy will be to use RCS makeup for decay heat removal. If filling of the refueling cavity has begun, makeup flow rate will be maximized until the refueling cavity is full (i.e., single-phase once-through-cooling will be used). Prior to filling of the refueling cavity, flooding of the containment (and subsequent removal of water from the containment sump) is a concern; therefore, RCS makeup flow rate is adjusted to restore maximum water level that will not result in spillage, and then throttled to achieve equilibrium with boil-off.

RCS Heat Removal:

Time to core uncovery is shortest on loss of RCS cooling when the RCS is at reduced inventory conditions. Rapid response would be necessary to ensure that a makeup water source is deployed before core uncovery occurs. While it is not feasible during outage situations to pre-deploy all FLEX equipment necessary to immediately implement RCS makeup strategies, pre-staging of the 200KW FDG and maintaining clear access paths to rapidly connect temporary power to a charging pump should be achievable. Although AOP-19 (Loss of Shutdown Cooling) [Ref. 3] shows that a 55 gpm flow rate may be necessary to make up for boil-off shortly after shutdown, the 40 gpm provided by a charging pump using the strategy described in Action 19 would increase the time to core uncovery, allowing the deployment of low pressure RCS makeup as outlined in Action 20. An evaluation will be conducted to confirm that this strategy will provide at least 4 hours before core uncovery to allow for deployment of FLEX equipment.

Once the reactor cavity has been filled to above the RV flange, the water in the cavity will provide an adequately large heat sink to allow deployment of low pressure RCS makeup as outlined in Action 20 without the need for pre-staging of equipment.

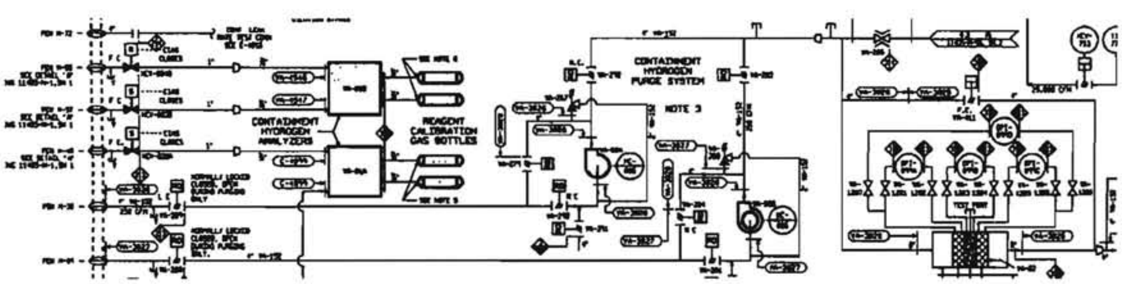
RCS Makeup:

RCS makeup flowpaths are discussed above as the means of RCS heat removal in these modes of operation. Of concern when using RCS makeup as a means of heat removal is the collection and removal of spillage from the RCS into the containment sump such that excessive flooding of the containment is avoided. While a very large volume of water could be collected in the containment building before flooding presents a real concern (See EA-FC-04-010) [Ref. 4], inflow cannot be accommodated indefinitely. Thus, RCS makeup will be throttled to maintain equilibrium with boil-off, to maximize the time before removal of water from the containment sump will be necessary. To remove water from containment, it will be necessary to open ECCS recirculation isolation valve(s) HCV-383-3 and/or HCV-383-4. This will require the removal of the manway cover from the "guard pipe" which encloses the valves. Water would then be removed via 1 inch test lines isolated by valves SI-161 and SI-162 and sent to a collection tank for processing. If the reactor cavity has been isolated for refueling operations, single-phase flow can be allowed until the cavity is full. Water can then be removed from the reactor cavity via the fuel transfer tube to the fuel transfer canal in the Fuel Handling Building. Water removal efforts would be undertaken in Phase 3, after offsite assistance and equipment is obtained to collect and process the discharged water.

Containment:

The RCS heat removal strategy for these plant conditions places a larger challenge on the containment than operating modes where the S/Gs are available to remove decay heat, since the containment must now accommodate the heat rejected from the RCS, instead of just RCS leakage. To ensure that the containment building is not overpressurized and to provide a path for decay heat to be released to the atmosphere, a containment purge flowpath via HCV-746A/B, PCV-742A/B, HCV-882/VA-289 or HCV-881/VA-280 will be established. All purge valves inside containment are air operated, so a containment entry may be required to manually open them, unless some type of blocking device can be applied during outages to ensure that the inside containment valves stay open. The hydrogen purge system (HCV-881 and 882 flowpaths) may be a good candidate for this process, since the valves outside containment are all manual and the vent path is via a HEPA filter. However, an analysis will be required to determine whether this flowpath would be adequate for heat removal/pressure control, as it is a relatively small pipe diameter (4"). Figure 23-1, below shows potential containment vent flowpaths via containment hydrogen purge.

Fig. 23-1, Portion of Drawing 11405-M-1, Sh. 2 [Ref. 5]



In the longer term, heat removal would be established using containment fan coolers supported by equipment provided from RRCs in Phase 3.

SFP:

Unchanged from BDBEE/ELAP/LUHS during power operation.

Defueled

General Discussion

When the RCS is defueled, all heat removal is focused on the SFP. Actions to maintain the RCS Heat Removal and Containment functions will not be necessary. FLEX equipment deployment will only be necessary to provide makeup to the SFP.

SFP

The current SFP FLEX deployment/capacity calculation, LTR-SEE-II-11-61 [Ref. 1] assumes a decay heat load in the SFP equivalent to that seen immediately after a refueling outage. The decay heat load during a full core offload would be significantly higher. Although a specific analysis of the time to fuel uncovery was not performed to support FLEX, calculation FC05988 [Ref. 7] was performed to determine time to boil and time to 8 feet above the fuel assemblies using design basis considerations for full core offload. FC05988 shows a minimum requirement of approximately 47 gpm to make up for boil-off, which is well within the capacity of the FLEX SIRWT Pump when no other water supply paths are being used. Per FC05988, with a complete core offload and 72 hours since shutdown, time to boil will be approximately 7 hours [Ref. 7, Table 1.2]. Time for SFP level to fall to 8 ft. above the fuel assemblies [21.9 ft, consistent with Ref. 1] is approximately 40 hours [Ref. 7, Figure 1.7]. Given that no other FLEX deployment activities are necessary during a full core offload, the SFP makeup strategies described in Attachments 15-17 can be accomplished prior to boiling in the SFP.

MODIFICATIONS REQUIRED:

Modifications designed to achieve FLEX objectives for BDBEE/ELAP/LUHS during power operation will support the actions needed to achieve FLEX objective for lower mode operations. No modifications specific to lower mode FLEX strategies are required.

FLEX EQUIPMENT REQUIRED:

Equipment designed to achieve FLEX objectives for BDBEE/ELAP/LUHS during power operation will support the actions needed to achieve FLEX objective for lower mode operations. No equipment specific to lower mode FLEX strategies is required.

REFERENCES:

1. NRC Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012
2. NEI 12-06, R0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide
3. AOP-19, R17, Loss of Shutdown Cooling
4. EA-FC-04-010, R2, Recommendations for Implementing of Compensatory Actions in Response to NRC Bulletin 2003-01
5. FCS Drawing 11405-M-1 Sh. 2, R32, Containment Heating, Cooling & Ventilating Flow Diagram P & ID
6. Letter LTR-SEE-II-11-61, R0, Fort Calhoun Station Spent Fuel Pool Time to Boil upon Loss of All AC Power, dated October 27, 2011
7. FC05988, R4, Thermal Hydraulic Analysis of Fort Calhoun Station Spent Fuel Pool with Maximum Density Storage

Action 24
External Flooding FLEX Strategies

OBJECTIVE:

The objective of this action is to identify the FLEX strategies that will be implemented to ensure the ELAP/LUHS mitigation objectives of NRC Order EA 12-49 [Ref 1] and NEI 12-06 [Ref. 2] can be achieved during large external floods.

Fort Calhoun Station is designed to accommodate floods up to EL. 1014' (approximately 10-11 ft. above grade) [Ref. 4]. However, the current plant design does not consider an ELAP/LUHS concurrent with the design basis flood. Further, the potential exists for floods of greater than EL. 1014'.

Further flooding analyses will be conducted in the upcoming 12-18 months in response to Near Term Task Force (NTTF) recommendation 2.1. However, based on historical evidence, it can be assumed there will be at least two (2) days' warning of an impending flood that could significantly impact the operational capabilities of the plant. Given this advance warning, the 2 day time period can be used to place the plant in a condition that would be most conducive to maintaining the ELAP/LUHS mitigation objectives for the period of inundation until the flood waters recede and system restoration can begin.

To identify effective FLEX strategies for external flooding, two flood conditions must be evaluated:

- A flood up to, but not exceeding the FCS design basis.
- A flood that exceeds the FCS design basis.

In the former case, the installed equipment, systems and instrumentation specified in NEI 12-06 [Ref. 2] (i.e., electrical distribution system and TDAFW pump, etc.) would remain available for mitigation of an ELAP/LUHS, and FLEX equipment can be deployed and protected such that the strategies established for other BDBEEs would be available for flooding as well. The only significant challenge for this scenario is the ability to replenish consumable supplies to ensure that the FLEX equipment continues to work as designed for the duration of the flood.

In the latter case, a beyond design basis flood must be assumed to affect installed and FLEX equipment that is located below the flood elevation (or could be damaged by the effects of the flood). While the exact elevation of a worst case flood is not known at this time, the design and location of FLEX equipment is being developed considering the potential for a beyond design basis flood event.

STRATEGY:

Actions to address ELAP/LUHS are discussed for each of the flood conditions described above. For either of these conditions, the initial response to a notification of impending flood will be similar. Per existing procedures [Ref. 4], the plant will be placed in cold shutdown if river level is expected to exceed EL. 1004'. This action provides a number of beneficial effects, including establishment adequate shutdown margin to account for Xenon decay, increasing margin to thermal limits, reducing potential RCS leakage rate (protect RCP seals) and reducing system pressures so that low pressure makeup water sources can be used.

The FLEX Storage Building proposed for FCS will be located near the current Owner Controlled Area access point at approximately EL. 1090'. This location is anticipated to be adequate to protect it from hypothetical floods. FLEX and logistical support equipment that cannot be located in creditable areas inside the plant will be located in this structure. Logistical support equipment will include provisions for transporting equipment and supplies over water to the plant.

External Flood within the FCS Design Basis (≤ EL. 1014')

General Discussion:

For this scenario, all FLEX equipment and strategies are available. Since the plant will be in Mode 4 or 5, the strategies described in Action 23 will be used to achieve the ELAP/LUHS mitigation objectives. The strategies described below will be incorporated into the existing AOP for flooding [Ref. 4], with a reference to the FLEX support guidelines in the event of an ELAP/LUHS.

FLEX Equipment Deployment:

If the river level is predicted to remain below EL. 1014' (with enough margin to provide confidence that the design basis level will not be exceeded), procedural direction will be provided in Ref. 4 to pre-stage FLEX equipment stored in the FLEX storage building to appropriately flood protected areas within the plant. FLEX Systems will be deployed in a manner that will allow rapid response in the event of an ELAP, but will remain disconnected until the ELAP is experienced to avoid potential failures due to interaction with installed safety equipment. FLEX equipment will be fueled and operationally tested prior to the arrival of the flood to minimize the potential for unexpected failures in the early stages of the flood.

FLEX Logistical Support:

Initially, fuel for portable equipment will be provided from the DG Fuel Oil Storage Tank (FO-1) or the Diesel Generator day tanks, using portable fuel transfer pumps and tanks as currently credited for other ELAP/LUHS scenarios. Although the exact fuel usage rate cannot be calculated until FLEX equipment design is completed, FO-1 contains a minimum of 16,000 gallons fuel oil [Ref. 5]. (See Modification 20) Additionally, several hundred gallons of fuel are available in the Diesel Generator Day Tanks and Base Tanks. Given that the minimum volume of fuel in FO-1 provides at least 4 days' operational capability for the EDGs under design basis accident conditions, it is clear that this capacity will be adequate for several days' supply of fuel until replenishments can be provided from offsite sources. Current procedural guidance is provided for replenishment of diesel fuel from tank trucks at the Owner Controlled Area access point.

The FLEX storage building will contain tools and other consumable supplies, such as food, sanitary materials, flashlight batteries and other staples necessary to maintain plant operations. Shallow draft skiffs and/or pontoon boats will be located in the FLEX storage building to transport personnel, equipment and supplies to the plant in the event that dry access cannot be established prior to the onset of flooding.

External Flood Greater Than the FCS Design Basis (> EL. 1014')

General Discussion:

This section is conceptual at this point, because the flood analyses needed to establish maximum water levels for FLEX system design are not complete. For this scenario, only FLEX equipment that is submersible or located above the anticipated flood level will be available. Since the plant will be in Mode 4 or 5, the strategies described in Action 23 form the basis for achieving the ELAP/LUHS mitigation objectives. The primary components available for SG feeding, RCS and SFP makeup will be the FLEX SIRWT Pump (FSP) and associated dedicated diesel generator. As described in Modification 8 the FSP will be submersible. The dedicated

DG for the FSP will be located at an elevation higher than the maximum hypothetical flood. A portable FLEX valve station (similar to the one described in Modification 9, but stored in the FLEX storage building to be deployed for floods) will be located above the maximum expected flood level. Although some hose connection points may be below the level of the flood waters, they are expected to remain intact, as they are all located inside robust structures.

MODIFICATIONS REQUIRED:

Modifications designed to achieve FLEX objectives for BDBEE/ELAP/LUHS during power operation will support the actions needed to achieve FLEX objectives for flooding scenarios. No modifications specific to flooding FLEX strategies are required.

FLEX EQUIPMENT REQUIRED:

Equipment designed to achieve FLEX objectives for BDBEE/ELAP/LUHS during power operation will support the actions needed to achieve FLEX objectives for flooding scenarios. No equipment specific to flooding FLEX strategies is required.

REFERENCES:

1. NRC Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, March 12, 2012
2. NEI 12-06, R0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide
3. Letter from OPPD (W.G. Gates) to NRC (Document Control Desk) dated December 29, 1993 (LIC-93-0301)
4. AOP-01, R33, Acts of Nature
5. Technical Specification 2.7, Electrical Systems

Action 25
Phase 3 FLEX Strategies

OBJECTIVE:

The objective of this action is to establish the long term FLEX strategies that will utilize equipment and resources provided by the SAFER Regional Response Centers to ensure the ELAP/LUHS mitigation objectives of NRC Order EA 12-49 [Ref 1] and NEI 12-06 [Ref. 2] can be achieved.

The Fort Calhoun Station Phase 2 FLEX implementation strategies are intended to allow for indefinite operation, with the exception of maintaining the containment function and logistical support for consumable supplies, especially fuel and water. However, an eventual transition to a long term cooling strategy is necessary to achieve a stable cold shutdown condition and minimize liquid and gaseous releases to the environment. It is anticipated that the first piece of equipment provided by the RRC will be delivered within 24 hours of notification of the RRC and that full deployment will be achieved in 72 hours. However, it is anticipated that only logistical support for consumables such as fuel and other supplies will be needed in the 72 hour timeframe. The current FCS Phase 2 FLEX equipment and interconnections are designed maintain all key parameters for at least 7 days, which will provide adequate time to complete the connection of the RRC supplied equipment.

The transition to Phase 3 involves establishing long term strategies for supporting the following functions:

- Electrical Power
- Reactor Core Heat Removal
- Spent Fuel Pool Heat Removal
- Containment Heat Removal
- Logistical Support (fuel and other consumable supplies, water purification, water processing)

Fort Calhoun has provided feedback to the SAFER organization as to the specific needs of the station; but presently, the equipment and services that will be provided by the Regional Response Centers have not been formalized. Thus, the strategies described in this section are conceptual in nature. They will be adjusted as necessary to accommodate the final equipment selections made by SAFER to be provided as part of the Phase 3 response.

ACTION:

Actions to implement Phase 3 ELAP/LUHS mitigation strategies are discussed for each of the functions described above.

Electrical Power:

The electrical generation capabilities of the on-site FLEX portable generators deployed in Phase 2 will provide adequate power to operate FLEX transitional equipment and achieve the FLEX objectives indefinitely. The goal of the Phase 3 electrical generator(s) will be to:

1. Re-energize the FCS installed electrical distribution system at the 4160 VAC level.
2. Power Phase 3 FLEX equipment deployed to support long term coping strategies

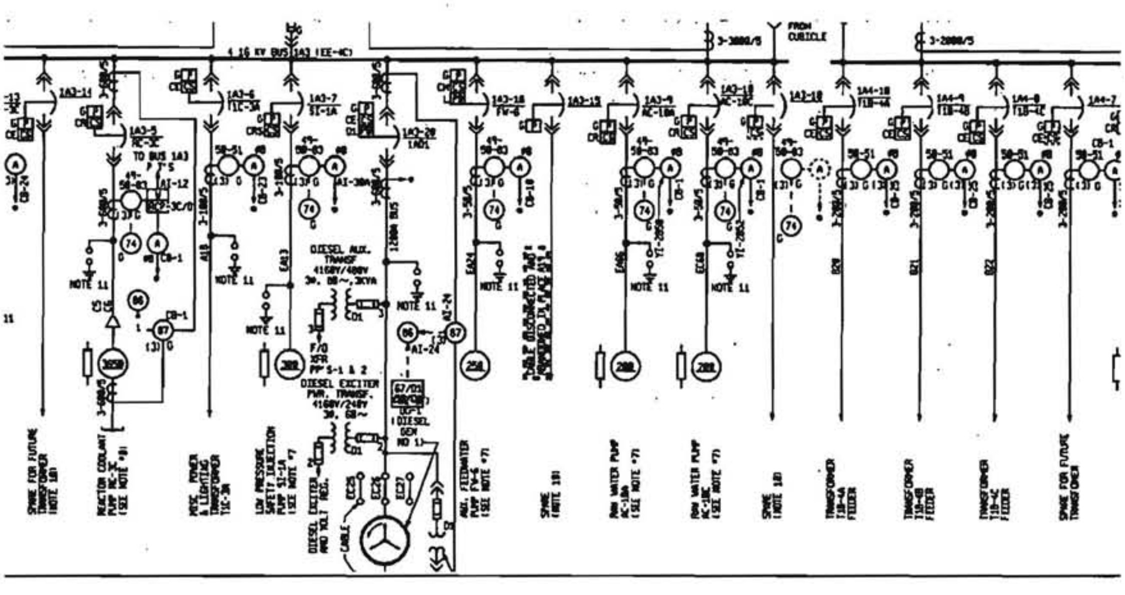
FCS has specified a 4160 VAC generator, rated at 2000kVA and 300 amps to supply one train of vital AC electrical equipment. This is approximately ½ of the installed EDG capacity of 4000 KW, and would accommodate the following major loads [Ref. 3]:

- LPSI or CS pump (for SDC Operation) – 300 HP
- HPSI pump (for recirculation from Containment sump to RCS; alternate to SDC operation) – 300 HP
- Motor Driven Auxiliary Feedwater Pump – 250 HP
- Containment Cooling Fan – 125 HP
- Charging Pump (for RCS Makeup) – 75 HP (Intermittent)
- SFP Cooling Pump – 40 HP
- Demineralized Water Transfer Pump – 40 HP (Intermittent)
- Control Room HVAC Fan – 15 HP
- Battery Charger – 79kVA
- Station Lighting (T1C-3A/4A) – 300kVA

A second Diesel Generator to power the redundant electrical train is desirable, but not a necessity.

Connection of the DG to the station electrical distribution system would be via spare transformer breaker cubicles 1A3-14 (1A3-15, 17 and 18 may also be used) and/or 1A4-7 (1A4-13 may also be used). Figure 25-1 below, shows the intended tie-in locations.

Figure 25-1, Portion of Drawing 11405-E-3 [Ref. 4



Several smaller Diesel Generators are anticipated to be provided by the RRC; these will act as backups to the Phase 2 FLEX DGs (10 – 200 KW) located at FCS.

Diesel Generators to supply FLEX equipment provided by the RRC are assumed to be of the proper rating and voltage to support the operation of that equipment.

Core Cooling & Heat Removal:

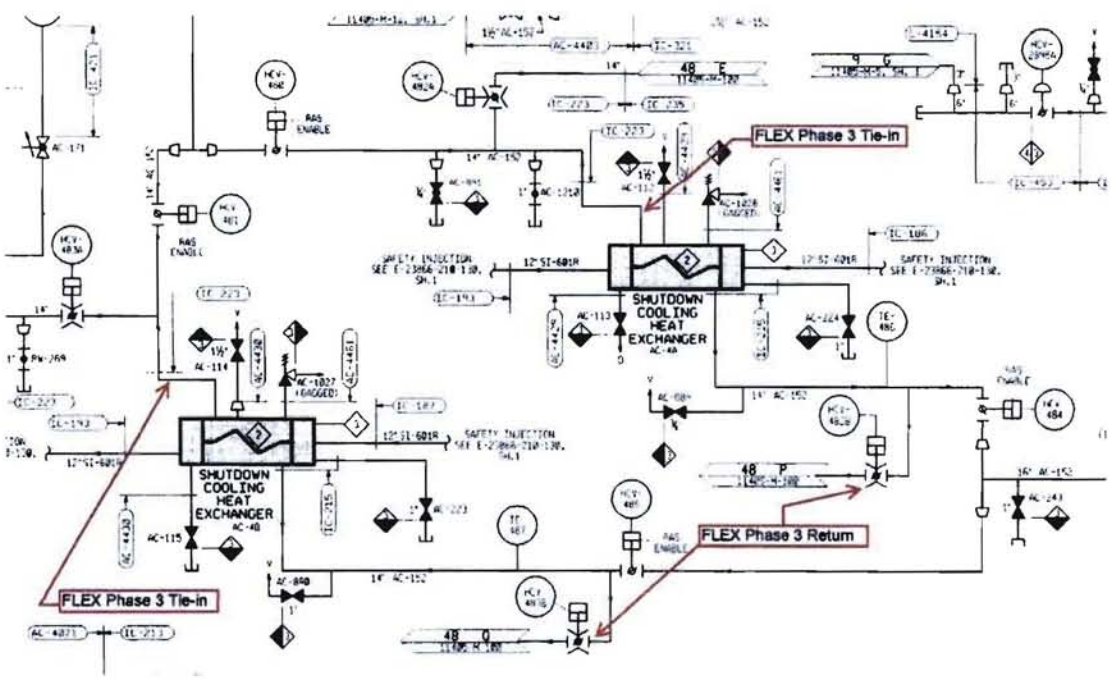
The Phase 2 FLEX strategy is to use the SGs to remove heat from the RCS, unless the RCS is vented, in which case RCS makeup at a flow rate adequate to remove decay heat will be used. These strategies have been preliminarily evaluated to be effective for an extended period of time to accommodate flooding. RCS Heat Removal strategy addresses both continued feedwater addition to the SGs and transition to the Shutdown Cooling System for operation.

Both these strategies rely upon the restoration of power to a vital 4160 VAC electrical bus. Until power is restored to the bus, the Phase 2 strategies will be retained.

If the SGs are used for heat removal, the initial motive force for feedwater will be the TDAFW pump. Once SG pressure is reduced, a low pressure water source, such as the FSP or the pre-staged engine driven pumps located in Room 81 may be used to supply water to the SGs (see Actions 8, 9 and 22). FCS has specified that the RRC supply self-powered, low pressure makeup pumps rated at 300 gpm/300 psi that would be used as a backup to on-site Phase 2 FLEX equipment. For transition to Phase 3, water would continue to be supplied to the EFWST using Action 8 or 9. Upon restoration of power to Bus 1A3, Auxiliary Feedwater Pump FW-6 would be started and AFW flow established using remote or local control in accordance with the existing procedure for restoration of AFW [Ref. 6].

If it is desired to remove heat directly from the RCS, the Low Pressure Safety Injection/Containment Spray system can be aligned to recirculate water via the Shutdown Cooling system. Upon restoration of power to 4160VAC Bus 1A3 or 1A4, a LPSI or CS pump can be started to initiate SDC flow. This will require alignment of motor operated valve HCV-348 inside containment. If power is restored to only 4160VAC Bus 1A4, HCV-348 will have to be manually opened (containment entry would be required) or a temporary power supply will have to be provided to the MCC cubicle. A portable SCiB MOV Power Pack is currently under development by Westinghouse Corporation to address this issue. Cooling water would be provided by high capacity pumps supplied by the RRC. FCS has specified that the RRC supply self-powered, low pressure high capacity pumps rated at 1,200 gpm/120 psi, drafting from the UHS (Missouri River), that would be used to provide cooling water to the Shutdown Cooling Heat Exchanger (SDCHX). The water will be introduced to the CCW piping downstream of the inlet CCW/RW interface valves. The outlet CCW/RW interface valves would be opened to provide a cooling water return path to the river. Figure 25-2 below, shows the intended tie-in locations.

Figure 25-2, Portion of Drawing 11405-M-10, Sh. 3 [Ref.7]



If the RCS is vented and RCS makeup was used for core cooling, the water will collect in either the Containment Sump or the Refueling Cavity. Although a method may be developed to provide a recirculation path from the refueling cavity through the fuel transfer tube to the fuel transfer canal, the default means of recirculating the water from the Refueling Cavity would be to overflow the cavity to the ECCS Recirculation sump. If the reactor vessel head is not removed, RCS spillage would go directly to the ECCS Recirculation sump. The ECCS recirculation method would be via the design post-accident recirculation flowpath. Upon restoration of power to Bus 1A3 or 1A4, a HPSI pump would be started and recirculation flow would be directed through a SDCHX. Cooling water to the SDCHX would be provided in the same manner as described above for normal SDC.

RCS Inventory Control:

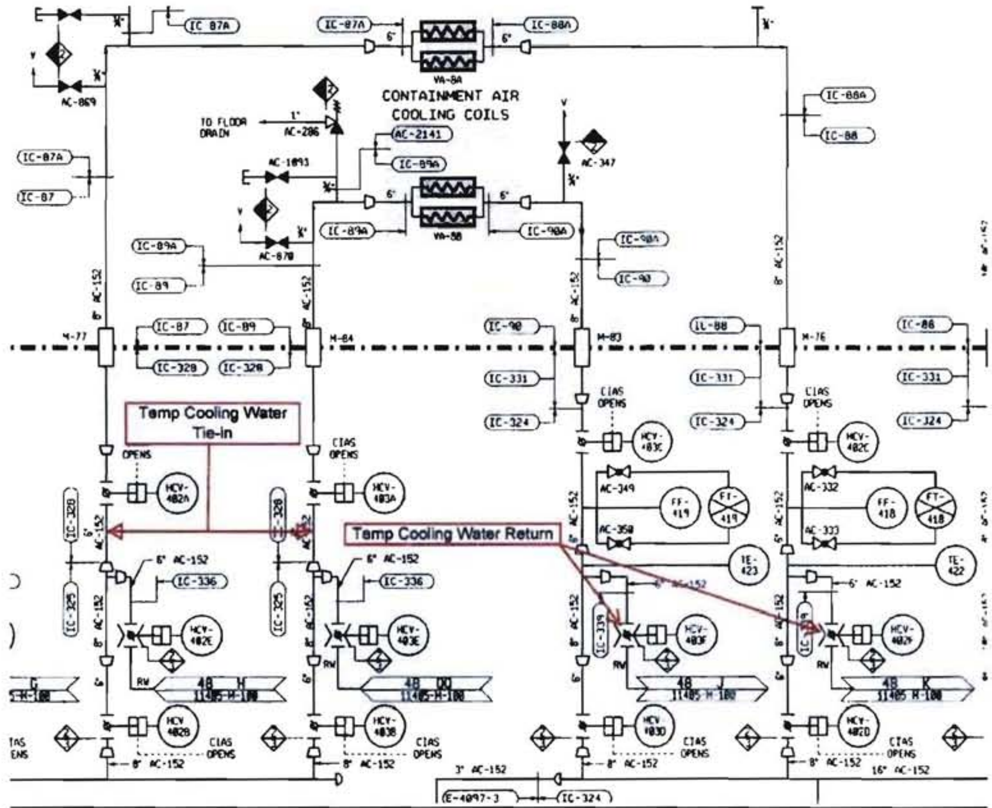
Upon restoration of power to Bus 1A3 or 1A4, a Charging Pump or HPSI pump would be used to make up water as necessary to the RCS. The Phase 2 flowpaths identified in Action 18 would be used to replenish the SIRWT. FCS has specified that the RRC supply self-powered, low pressure makeup pumps rated at 300 gpm/300 psi that would be used as a backup to the Phase 2 equipment. These pumps would be capable of taking suction from a clean water source, such as tanked water, treated water or recycled water provided by the RRC. See the section on logistical support for further information on clean water sources.

Containment:

An FCS specific analysis [Ref. 8] shows that during scenarios where the SGs are used for heat removal, RCS leakage into the containment building could be accommodated for up to 10 days without actions to depressurize or remove heat. Following implementation of Action 2, this period is expected to increase significantly because RCS leakage will be reduced to less than 5 gpm. During lower modes, if the RCS is vented and RCS makeup was used for core cooling, the containment may have been vented to prevent pressure buildup. In either case, the long term means of containment pressure/temperature control will be to restore a containment heat removal system with the assistance of RRC supplied equipment.

The preferred means of establishing containment heat removal is to restore a Containment Fan Cooling unit to service. Upon restoration of power to Bus 1A3 or 1A4, a Containment Cooling fan can be started to establish air flow within containment. FCS has specified that the RRC supply self-powered, low pressure high capacity pumps rated at 1,200 gpm/120 psi that would be used to supply cooling water to the operational containment cooling unit. This flow rate is adequate to remove the heat load from a Design Basis accident [Ref. 11, Attachment 27]. The water will be introduced to the CCW piping downstream of the inlet CCW/RW interface valves. The outlet CCW/RW interface valves would be opened to provide a cooling water return path to the river. Figure 25-3 below, shows the intended tie-in locations.

Figure 25-3, Portion of Drawing 11405-M-40, Sh. 1 [Ref.7]



One potential concern with the preferred method of containment heat removal is that if temperatures in containment are sufficiently high, flashing of the cooling water in the containment cooling coils could lead to damage of the cooler tubes. If it is determined that the containment cooling units cannot be used for heat removal, a containment spray pump can be used to reduce containment pressure and temperature using the normal CS flowpath once power is restored to 4160VAC Bus 1A3 or 1A4. In this scenario, initiation of CS must be coordinated with alignment of SDC, as the SI and CS systems are interconnected when on SDC.

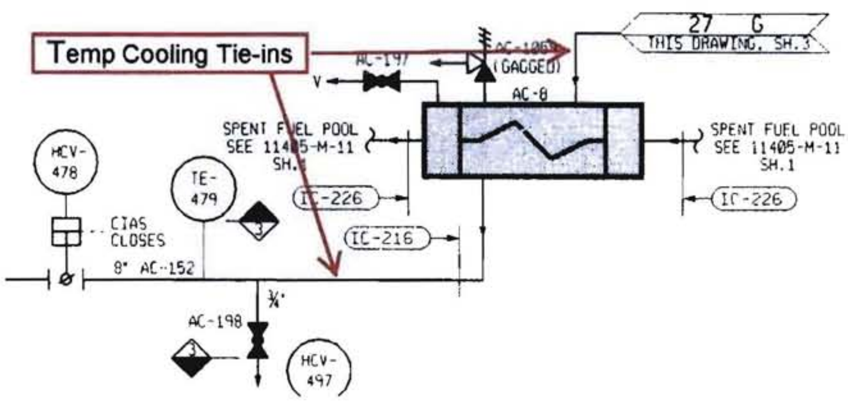
<u>Spent Fuel Pool Cooling</u>:

The Phase 2 FLEX strategy provides cooling for the SFP by making up for boil-off from the SFP. Ventilation openings in the FHB will allow stem to escape the FHB, maintaining habitability, but providing a release path for potentially contaminated vapor to the environment. To return the SFP to a subcooled state and establish a recirculation cooling flowpath, two separate Phase 3 strategies are provided:

1. Establish Cooling water to the SFP Heat Exchanger
2. Utilize a portable SFP Heat Exchanger.

The preferred means of establishing SFP recirculation cooling is to use the installed SFP cooling system and provide cooling water to the SFP Heat Exchanger. Once power is restored to 4160VAC Bus 1A3 or 1A4, a SFP cooling pump can be started. FCS has specified that the RRC supply self-powered, low pressure high capacity pumps rated at 1,200 gpm/120 psi that would be used to supply cooling water to the SFPHX by drafting from the UHS. Phase 3 tie-in points will be established as shown in Figure 25-4, below. If resources and equipment are available and the SFP Cooling system is intact, this strategy may be implemented in Phase 2 in lieu of relying on SFP makeup for cooling, using the Phase 2 FLEX 200 KW Diesel Generator and B.5.b equipment for cooling water.

Figure 25-4, Excerpt of Portion of Drawing 11405-M-10, Sh. 3 [Ref. 7]



While the SFP cooling strategy described above is the preferred strategy, it does not meet the NEI 12-06 criteria for robustness. As a backup to use of the installed SFPC system, FCS has specified that the RRC supply a portable cooling system that would take suction from the SFP, cool the water and return via hoses, or use a plate-style heat exchanger immersed in the SFP. The design of this approach will be finalized when the RRC equipment is defined by the SAFER organization.

Logistical Support:

In addition to the Phase 3 equipment needed to support the Phase 3 strategies described above, FCS has specified to the SAFER group that two major pieces of process equipment will be needed to support Phase 3 operations:

1. A water purification system that will remove impurities from makeup water being supplied to the SGs, RCS and SFP.
2. A water treatment/recycling system that will reduce the concentration of radioactive material and/or undesirable chemical impurities from the water discharged from the SGs, RCS and SFP before being released or re-used.

Additionally, FCS has specified that additional tow vehicles, roadway clearance/repair equipment and boats/barges be provided to improve access to the station following a BDBEE. Other site recovery equipment includes:

- De-watering pumps
- Mechanical connections (hoses/couplings)
- Electrical connections (cables/splices/connectors)
- Lifting/moving equipment (slings/cables/harnesses)
- Air Compressors
- Portable lighting
- Diagnostic tools

Refueling equipment includes:

- Portable fuel transfer pumps
- Fuel Bladders

Radiological control equipment includes:

- Radiological survey/counting equipment
- Equipment/personnel decontamination equipment and supplies
- Radiation/Contamination/Airborne protection supplies and equipment
- Respiratory protection equipment

OPPD will maintain adequate consumable supplies for 72 hours of operation without external support. At that time, FCS has specified that the following consumables will be needed:

- Food/Water
- Diesel Fuel
- Personal Protective Equipment
- Radiological protection equipment (PCs, dosimeters)

MODIFICATIONS REQUIRED:

Modification feasibility packages have not been developed for Phase 3 yet, because the exact nature of the equipment to be supplied by the RRC has not yet been established. However, in general, modifications will be required to the following systems to allow for tie-in of Phase 3 FLEX equipment:

- 4160 VAC connections to Vital AC Buses 1A3 and 1A4
- Cooling water connections to the SDCHXs
- Cooling water connections to the Containment Fan Coolers
- Cooling water connections to the SFP Heat Exchanger

FLEX EQUIPMENT REQUIRED:

Equipment designed to achieve FLEX objectives for BDBEE/ELAP/LUHS in Phase 3 include:

- At least one (1) 4160 VAC generator, rated at 2000kVA and 300 amps.
- At least three (3) self-powered, low pressure high capacity pumps rated at 1,200 gpm/120 psi
- At least two (2) self-powered, low pressure makeup pumps rated at 300 gpm/300 psi
- A water purification system that will remove impurities from makeup water being supplied to the SGs, RCS and SFP.
- A water treatment/recycling system that will reduce the concentration of radioactive material and/or undesirable chemical impurities from the water discharged from the SGs, RCS and SFP before being released or re-used.
- Other Logistical equipment as described in the Logistics section of this strategy report.

REFERENCES:

1. NRC Order EA-12-049, Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, dated March 12, 2012
2. NEI 12-06, R0, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide
3. EA99-005, R6, EDSA Design Base 3.0 – FCS Electrical System Database Documentation (EDS-DB3-L1)
4. Drawing 11405-E-3, R23, 4.16 KV Auxiliary Power One Line Diagram P & ID
5. Letter DAR-SEE-II-11-9, R0,Engineering Report in Support of Response Planning for Catastrophic Flooding Scenarios at Fort Calhoun Station, dated May, 2012
6. AOP-28, R16, Auxiliary Feedwater System Malfunctions
7. 11405-M-10, Sh. 3, R24, Auxiliary Coolant Component Cooling System Flow Diagram P& ID
8. Letter LTR-OA-11-37, Rev. 0, Analysis of the Fort Calhoun Station Containment Response to an Extended Station Blackout, dated November 8, 2011
9. STM-10, R35, Containment Structure & Ventilation System
10. 11405-M-40, Sh. 1, R36, Auxiliary Coolant Component Cooling System Flow Diagram P& ID
11. System Design Basis Document VA-CON-139, Rev. 35, Containment HVAC

Appendix C

Modifications to Support Optimal Strategies

Fort Calhoun Station
Modifications to Support Optimal Strategies

FCS FLE Modification No. 1
Control Bleed Off Isolation

Modification Purpose

The purpose of this modification is to ensure that HCV-208, the isolation valve for reactor coolant pump controlled bleed-off relief valve CH-208, remains closed to minimize the loss of reactor coolant inventory following a beyond-design-basis external event.

Strategy Impact

During an extended loss of AC power, controlled bleed-off represents a continuous loss of reactor coolant system inventory. The isolation of controlled bleed-off – which would be accomplished by closing controlled bleed-off containment isolation valves HCV-241 and HCV-206 and the controlled bleed-off relief isolation valve HCV-208 – reduces the rate at which RCS inventory is lost and allows more time to complete FLEX transition activities before core uncovery. The reduction in RCS inventory loss through HCV-208 and CH-208 also reduces the rate at which energy is released to containment.

Modification Description

The proposed modification consists of converting HCV-208 from fail-open to fail-closed.

The following provides a brief description of the proposed modification.

- The valve actuator would be converted/replaced from a spring-to-open to a spring-to-close configuration.
- The solenoids and accumulator would be configured to ensure the valve will continue to fail-as-is in the short term.
- The accumulator capacity would be verified to ensure the valve would be capable of remaining open long enough to prevent premature shutting down of the RCPs. However, the valve would ultimately fail closed once the accumulator air supply could no longer provide sufficient pressure to overcome the actuator spring force.
- The existing two-position control switch would be retained to allow for positioning of the valve from the main control board.

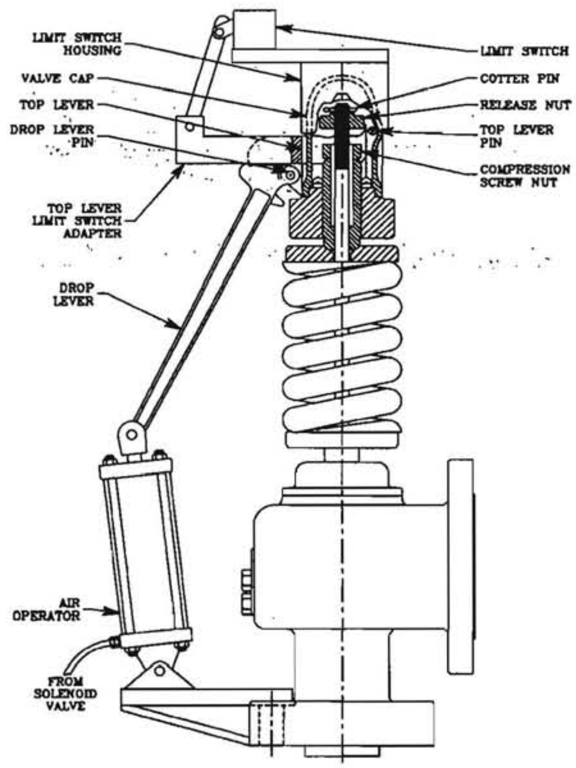
Modification Purpose

The purpose of the modification is to install a backup nitrogen supply to the main steam safety valves MS-291 and -292 accumulators for the purpose of being able to feed them with nitrogen bottles in the event that instrument air (IA) is lost.

Strategy Impact

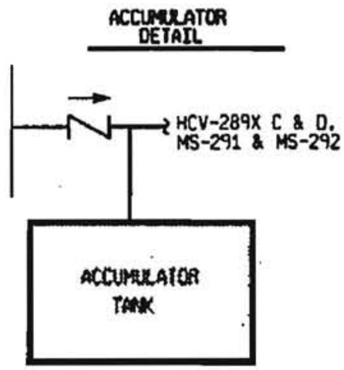
This modification will support extended operation of these safety valves to allow rapid cooldown of the RCS following a beyond design basis external event (BDBEE) that results in an extended loss of AC power (ELAP).

Normally, the safety valves function automatically as a typical spring-style safety valve, opening upon overpressure. However, the valves can also be controlled from the control room by remotely operating their pneumatic actuators. The safety valve configuration is shown in the Figure below:



Safety Valve with Pneumatic Cylinder [Ref. 1]

When remotely operated using the pneumatic cylinder, the safety valves fail shut once their respective local accumulator has been exhausted. The local accumulators are shown in the Figure below:



Piping Configuration

The modification will utilize the existing check valve in the IA system piping upstream of the existing accumulators to isolate the IA feed to the respective safety valve. The total installed bottle capacity will be sized in a new calculation to provide the necessary volume required to support the expected valve operational flow and time period requirements as well as sufficient leakage margin. The time period will be determined to cover the phase 1 FLEX response such that additional bottles are not needed until phase 2 to provide sufficient time to perform the initial bottle replacements. The basis for sizing the nitrogen capacity will be dependent on the final phase 1 FLEX methodology that utilizes these valves for rapid cooldown.

The bottle pressure regulator will be set at a pressure below the normal IA operating pressure, but above the minimum required safety valve actuator supply pressure requirement to ensure that the bottles do not normally feed the valves while IA is available, yet still ensuring that sufficient pressure will be supplied to operate the valves from the bottles. It is envisioned that two separate installations of bottles will be provided, one for MS-291 and a separate one for MS-292. A cross-tie is included to allow one manifold to supply both valves as a backup considering the close proximity of the two valves.

Modification Description

The modification is expected to consist of the following changes:

- Install high pressure bottles, seismic storage rack, and bottle manifold consisting of a pressure regulator, high pressure bottle safety relief valve, and low pressure safety relief valve (downstream of the pressure regulator) on both safety valves (similar to nitrogen backup for valve HCV-385 [Ref. 4]).
- Install tee in safety valve IA supply lines for connection to bottles.
- Install tubing from bottle manifold to IA connection tee.
- Install cross-connect tubing and isolation valve between the MS-291 and MS-292 manifolds.
- Revise plant procedures to implement periodic surveillance to ensure bottles are maintained at an acceptable level of fill.

FCS FLEX Modification No. 3
Modify MS-291 and MS-292

Modification Purpose

The purpose of the modification is to replace one Main Steam Safety Valve (MSSV) on each main steam line (MS-291 and MS-292) with a hydraulically actuated modulating atmospheric dump valve (ADV) (HCV-291 and HCV-292) together with their associated control circuits.

Strategy Impact

The steam dump valves will be sized to prevent the main steam safety valves from opening following a turbine trip at full load. These valves along with the turbine driven auxiliary feedwater pump are included in the rapid RCS cooldown strategy from hot shutdown conditions. The replacement of the existing power-operated valves, MS-291 and MS-292, with larger capacity valves will allow cooldown to continue to 350°F without the need for local manual operation of larger capacity MSSVs (MS-275 through MS-282).

Modification Description

A similar modification was determined to be required for Extended Power Uprate (EPU). Draft EPU modification, EC 43218, was initiated; however, it was neither finalized nor implemented. Portions of that EC can be utilized as input to this recommended facility change.

This modification (Modification 3) consists of the following changes:

- Replace the existing MSSVs MS-291 and MS-292 with hydraulically actuated 6" Masoneilan Angle Pattern, cage guided control valves, (Atmospheric Dump Valves HCV-291 and HCV-292) on Main Steam Headers 28" MS-1000.
- Install hydraulic actuation skids with reserve thrust accumulators.
- Install new manual block valve upstream of each ADV.
- Modify main steam header piping to increase the ADV vent branch inlet line form 2.5" diameter to 6" diameter.
- Modify/re-route the vent stack piping to install two new silencers on the ADV vent stack tail pipe and provide clearance to adjacent 14" diameter stacks.
- Adjust setpoints on the remaining MSSVs (MS-275 through MS-282).
- Install new pressure transmitters, limit switches, digital controllers, and control switches associated with the new ADVs.
- Install new supports for the new ADVs, vent stacks and vent stack silencers.

FCS FLEX Modification No. 4
200 kW FLEX DG and Switchgear Deployment in the Fuel Building Truck Bay

Modification Purpose

Purpose of the modification is to enable deployment of one 200 kW FLEX Diesel Generator (FDG) and its associated equipment (Switchgear and Transfer Switch) in the Fuel Handling Building (FHB) Truck Bay to help mitigate an ELAP.

Strategy Impact

The 200 kW FDG is required under ELAP conditions to power the Charging Pump, Control Room HVAC, Battery Chargers and other required equipment.

Modification Description

The modification will consist of the following:

- Establish the deployment locations – an examination of potential physical locations for the deployment of one (1) 200 kW diesel generator and its associated Switchgear and Transfer Switch.
- Provide Flood Protection for one (1) 200 kW diesel generator and its associated Switchgear and Transfer Switch to the design basis flood level of 1014'.
- Provide exhaust pipe from FDG exhaust to outside via an opening in the wall.

FCS FLEX Modification No. 5
Increase EFWST Capacity

Modification Purpose

The purpose of the modification is to expand the capacity of the Emergency Feedwater Storage Tank (EFWST) by upgrading the adjacent abandoned Potable Water Tank (PWT) to seismic category I and connecting the two (2) tanks together.

Strategy Impact

An expanded capacity of the EFWST (FW-19) will extend the time duration to supply water to critical Plant areas from the BDBEE initiation event when refilling of the EFWT tank will be required. Thus, the initial coping phase will be extended and operations will have more time to deploy the FLEX equipment that may be used to refill the EFWST.

Modification Description

A similar modification was determined to be required for Extended Power Uprate (EPU). A draft EPU modification was prepared; however, it was neither finalized nor implemented. Portions of that draft EPU modification can be utilized as input to this recommended facility change.

This modification (Modification 5) consists of the following changes:

- The abandoned Potable Water Tank will be dedicated as a seismic category I tank.
- An 8" hard pipe will be installed to connect the FW-19A and FW-19. The EC designates the Potable Water Tank as FW-19A.
- A nitrogen supply line will be routed to FW-19A to provide cover gas; the line would tie into the existing nitrogen supply line for Emergency Feedwater Tank FW-19. Installation of the nitrogen supply line will also ensure that the existing vacuum breaker will serve both tanks.
- New level set points are defined to account for the additional volume in FW-19A.

FW-19A is adequate for the FW-19 design conditions. Both tanks are made from ASTM A285 Gr. C, Carbon Steel. Both tanks are also coated by the same material that is approved for station use.

FCS FLEX Modification No. 6
New Potable Water Tank Connection to EFWST

Modification Purpose

The purpose of the modification is to provide the ability to transfer water from the new Potable Water Tank PW-1 in the Turbine Building to the Emergency Feedwater Storage Tank (EFWST) FW-19 in the Auxiliary Building.

Strategy Impact

In case of an ELAP, the modification is expected to allow for an additional 13,000 gallons of clean water (from PW-1) to be available for use to remove decay heat from the Steam Generators. PW-1 is not qualified to the seismic requirements and as such it cannot be credited in the FLEX strategy. However, it may be used when it is available and has the advantage of a favorable elevation, allowing makeup to the EFWST by gravity feed. It may also be used to provide water directly to one or both portable low pressure S/G makeup pumps stored in Room 81.

Modification Description

The modification is expected to consist of the following plant changes:

- Install a vacuum breaker at PW-1. The vacuum breaker will allow for drawdown of water from PW-1 without creating a vacuum.
- Install hose connection hardware at drain valve PW-639.
- If there is no spare penetration available between the Turbine Building and the Auxiliary Building at the 1036' floor elevation, then the operator would route a 2-½" or 4" hose between the pipe connection at drain valve PW-639 (near the New Potable Water Tank) and the B.5.b pipe connection at valve FW-1563 (near the EFWST). The hose would be routed along the 1036' floor elevation from the Turbine Building to the Auxiliary Building via the door at column C-6. This is considered Option A.
- If a spare penetration exists between the Turbine Building and the Auxiliary Building in the vicinity of the tanks, then a hard pipe will be installed in the penetration. The penetration will be sealed and the penetration pipe will be capped at either end for future fit-up with hoses as needed. Hoses would be routed to the pipe connections described in Option A above. This is considered Option B.

FCS FLEX Modification No. 7
Water Flow Paths into Room 81

Modification Purpose

The purpose of the modification is to facilitate getting water from various in-plant and outside sources into Room 81 where the Emergency Feedwater Storage Tank (EFWST) FW-19 is located. Water is expected to be received from the FLEX Valve Station (FVS) in Room 69, or alternatively from B.5.b equipment positioned outside the south end of the plant. This modification will ensure that water can be supplied via two separate flow paths into Room 81, assuming the Turbine Building does not survive the Beyond Design Basis External Event (BDBEE).

Strategy Impact

Water from the Safety Injection and Refueling Water Storage Tank (SIRWT), well, river, Blair City and other water sources will be routed through the FLEX valve station deployed in Room 69. This modification will provide the piping connections to supply water from any of these sources to Room 81 where the EFWST (FW-19) is located. Refilling of EFWST is essential to continued removal of heat from the Steam Generators (SGs). Using these flow paths, water could also be supplied directly to the SGs or via portable pumps currently stored in Room 81 to the SGs if the TDAFW pump (FW-10) is not available. Additionally, hose connections in Room 81 can combine the flow paths afforded by this modification to receive water from outside and feed back to the FVS for use in several other required cooling applications.

Modification Description

The piping connection can be a combination of flexible hose where possible and hard pipe where installation of hose would be time consuming.

From Room 69 to Room 81:
This modification will consist of transitioning a hard pipe through a spare penetration in the west wall of room 81 and down the wall in Room 69, terminating near the floor at EL. 1025'. The modification will consist of the following changes.

- A 4" (to be confirmed later) hard pipe will be routed between Room 69 and Room 81 through a spare penetration (see Figure 1).
- The hard pipe will have flanges on either end and will be equipped so as to facilitate quick connection with a hose.
- Flexible pipe (hose) can be routed from the FLEX Valve Station to the hard pipe end in Room 69, and another hose can be routed from the hard pipe end in Room 81 to the EFWST (FW-19) fill connection. Two options are considered:
  - Fill connection to EFWST (FW-19) through B.5.b connection.
  - Fill connection to EFWST (FW-19) through abandoned Potable Water Tank (FW-19A). In this case it is assumed that FW-19A will be connected to FW-19 as in FLEX Modification No. 5 and that FW-19A will be qualified as a seismic category 1 tank.
- The hard pipe will be routed to withstand Seismic accelerations.

From Outside to Room 81:

This modification provides an alternate water supply path (in the event that the Room 69/Room 81 pipe cannot be used). Install pipe on south end of Auxiliary Building (AB) that runs up the wall into room 82 through ventilation louver, then via hose thru two doors on west end of room into Room 81.

FCS FLEX Modification No. 7
Water Flow Paths into Room 81

For making hose connections in the event that Room 81 is not accessible from the Turbine Building, access to Room 81 would be via hatch from Room 69 to AB roof, then over to hatch in Room 82 roof and down into the room.

[[Withheld Under 10 CFR 2.390]]

Figure 1: Potential Connect Points on FW-19 and FW-19A and Penetration Location in Room 81
(Selected Portion from Drawing 11405-A-8 (12165))

[[Withheld Under 10 CFR 2.390]]

Figure 2: Valve Station Location, Storage Location and Penetration Location in Room 69
(Selected Portion from Drawing 11405-A-7 [Ref. 3])

FCS FLEX Modification No. 8
FLEX SIRWT Pump and Its Dedicated DG

Modification Purpose

The purpose of the modification is to install a FLEX SIRWT Pump (FSP) and piping in the Fuel Handling Building (FHB). The pump will take water from the Safety Injection and Refueling Water Tank (SIWRT) and supply it for various cooling needs following an Extended Loss of AC Power (ELAP). The pump will be powered by either a dedicated FLEX Diesel Generator (FDG) or the 200 kW FDG (refer to Mod. 4). The pump will be capable of discharging to the FLEX Valve Station in Room 69 (refer to Mod. 9), the B.5.b pipe connection(s) at Containment Spray Valves HCV-344 and HCV-345, the SFP fill connection at the 1025' floor elevation (refer to Mod. 12), or other available Steam Generator (SG) and Reactor Coolant System (RCS) make-up connections (TBD).

The FSP will have its own dedicated FDG to allow rapid deployment of the FSP. This FDG will be located in the FHB. For the consideration of a beyond design basis (BDB) flood (>1014'), when the FHB area where the FSP will be located (Room 24) will be flooded, the FDG will be located high in the FHB. The preferred location is on the FHB crane HE-2, but an alternate location may be identified if the HE-2 location proves not to be feasible.

Strategy Impact

In case of an ELAP, the modification is expected to allow the approximately 283,000 gallons of clean, borated water (from the SIRWT) to be available for use for cooling the Steam Generators and Spent Fuel Pool, and for Reactor Coolant System (RCS) makeup. The new FSP and its dedicated FDG will be seismically mounted so that they can be credited in the FLEX strategy.

Modification Description

The modification is expected to consist of the following plant changes:

- Install a pump at the 989' floor level of the Fuel Handling Building in Room 24 (Canal Drain Pump room). The pump will be seismically mounted to the floor, and will remain functional while submerged in water.
- Install a dedicated FDG on the FHB crane HE-2 (EL. 1066') to power the FSP. Alternatively, make provisions to power the FSP from the 200 kW FDG when it is installed in the FHB Truck Bay.
- For primary pump suction, route hard pipe from the fuel transfer canal drain piping (just downstream of Valve AC-307) to the SIRWT Pump. A test connection will be installed on the suction piping to allow for operability testing. Seismically support the piping. Alternatively, in lieu of permanent piping, a suction hose could be fabricated for installation between a tee provided downstream of AC-307 and the pump suction.
- The alternatives to this pump are:
    - A submersible pump that will be staged in Corridor 26 at EL. 1007' and be lowered into the SIRWT through its hatch and powered from the same sources as the primary FSP.
    - A Diesel Pump that is to be staged in the B.5.b box in corridor 26 will be deployed at EL. 1007' and a suction hose will be lowered into the SIRWT through its hatch.

- Route hard pipe from the discharge of the SIRWT Pump through the opening at floor elevation 1007' in New Fuel Storage Room 25a. Seismically support the piping. Alternatively, in lieu of permanent piping, hose could be routed from the pump discharge through the opening at floor elevation 1007' (or up the stairwell at 989'). In this case, the grating over the opening would need to be modified to allow for rapid deployment of the discharge hose.
- When required, the operator would route hoses from the pump discharge pipe (or hose) in New Fuel Storage Room 25a to the FLEX Valve Station in Room 69. The hoses would be routed through the corridor at Fuel Handling Building floor elevation 1007', across the floor in Room 26, and up the stairwell (or through the floor opening) to the FLEX valve Station at 1025' floor elevation. Alternatively, the hoses could be routed directly to the Containment Spray B.5.b connections in Room 59, the SFP fill connection at the 1025' floor elevation (refer to Mod. 12), or other available Steam Generator (SG) and Reactor Coolant System (RCS) make-up connections (TBD).
- For the pump to be functional following a BDB flood, cables will be permanently routed from the pump motor through the opening at floor elevation 1007' in New Fuel Storage Room 25a. The cable will be proceed through the opening at the 1036' elevation of Room 25a, and capped (for future use) at the Spent Fuel Pool operating floor.

FCS FLEX Modification No. 9
FLEX Valve Station

Modification Purpose

The purpose of the modification is to provide for a central Valve Station to receive and supply water from various sources in support of the FLEX strategies.

Strategy Impact

The FLEX Valve Station is expected to be the distribution point to supply water to the Emergency Feedwater Storage Tank (EFWST), Reactor Coolant System (RCS), Spent Fuel Pool (SFP) cooling, Steam Generators (SG) and refilling of the Safety Injection Refueling Water Tank (SIWRT). Sources of water can consist of SIWRT, river water well water or other non-credited water sources if available.

The valve manifold is expected to provide the flexibility to manually align systems from one central location. The valve station will be positioned in Room 69 but is expected to be portable such that when not in use it can be stored in an unobtrusive location in Room 69.

Modification Description

The modification will consist of the following changes.

- Design a FLEX Valve Station with input connections (from flexible hose) and output connections and isolation capability.
- The manifold will use 4" hard pipe (to be confirmed later).
- The manifold will be movable such that it can be stored out of the way and moved into location in Room 69 for connecting when needed under the BDBEE conditions.
- A clear path for moving the manifold to the location for use will be defined.
- The valve station will fit the space requirements for storage and for use in Room 69 on 1025 ft elevation.
- The modification will provide for locations and anchoring mechanisms where the valve station will be staged and where it will be moved to (when required) and secured in place.

FCS FLEX Modification No. 10
Non-1E Battery Addition

Modification Purpose

There are two existing 1E 125 VDC Buses (DC-Bus-1 and DC-Bus-2) at Fort Calhoun Station (FCS). The capacity of the storage batteries in the two, separate DC systems is adequate for up to 8 hours operation of control and instrument devices. To achieve an 8 hour battery life, significant manual shedding of non-vital DC loads is required.

FCS is considering a modification to install a Non-1E battery / charger system and relocate non-essential loads to the new Non-1E battery. This will extend the 1-E battery life to 24 hours required for mitigating a postulated Extended Loss of AC Power (ELAP) event.

Strategy Impact

In case of an ELAP, the modification is expected to extend the life of 1E batteries to approximately 24 hours, while reducing the burden on the operators of most load shedding operations.

Modification Description

The modification will consist of the following main activities:

- Turbine Lube Oil Pump (LO-12B-M) Power Feed – transfer the power feed from the current 1E batteries to a Non-1E battery.
- Hydrogen Seal Oil Pump (LO-04-M) Power Feed – transfer the power feed from the current 1E batteries to a Non-1E battery.
- Additional Non-1E loads – transfer the power feed to other non-vital DC loads, such as Turbine Building DC distribution panel DC-PNL-1A.
- Re-analyze 1E DC bus loading to determine discharge time.
- The new Non-1E battery charger will be fed from a nearby safety related 480 switchgear (SWGR) backed by diesel generator source. This will allow continuous operation for LO-12B-M and LO-4-M in an event of Loss of Offsite Power. Separation requirements from safety related equipment and non-1E equipment will be met at a breaker at the 480V SWGR.

The above equipment has been verified in FCS Asset Suite Database as class Non-1E.

The amperage for the above loads is listed below:

Table 1: Relocation of Loads

Description	Horsepower (hp)	Amperage (A)	Location
LO-12B-M	25	29.60	Turb 992 0W' TD-8N'2
LO-4-M	25	123	Turb 1013 10W' TE-13'N'7
DC-PNL-1A	NA	82.29	Turb 1040 2W'B – 3N'4

FCS FLEX Modification No. 11
10 kW FLEX DG

Modification Purpose

This proposed modification will install a portable 10kW FLEX Diesel Generator (FDG) to power one (1) of the two (2) 1E 125 DC buses via Battery Charger 1 (EE-8C) or Battery Charger 2 (EE-8D), and the Control Room temporary fans in the event the 200 kW FDG is unavailable.

Strategy Impact

In case of an ELAP, this modification is expected to power and control critical instrument devices fed from the 1E DC buses when the 200 kW FDG is unavailable. Also, this modification may supply power to the temporary ventilation fans for the Control Room.

Modification Description

The modification will consist of the following main activities:

- Installation of one (1) potable 480VAC 10 kW 60 Hz FDG.
- Installation of temporary cabling from portable 10 kW FDG to existing battery chargers EE-8C or EE-8D.
- Installation of cabling to the Control Room lighting panel.

FCS FLEX Modification No. 12
SFP Fill Pipe

Modification Purpose

The purpose of the modification is to install a piping connection to fill the Spent Fuel Pool (SFP) taking make-up water from the new FLEX Valve Station which is located in Room 69.

Strategy Impact

In case of an ELAP, the modification is expected to provide a routing path to supply make-up water to the Spent Fuel Pool (SFP) from the new FLEX Valve Station.

Modification Description

The piping connection can be a combination of flexible hose where possible and hard pipe where installation of hose would be time consuming.

This modification will consist of transitioning a hard pipe vertically up the north wall of the SFP and over the top of the wall into the SFP (note: potential trip hazard at SFP operating floor to be evaluated). Consideration should be given to coordinating this modification with the installation of the new SFP level indication. The modification will consist of the following plant changes:

- Install a 4" diameter (or smaller size, as determined by modification calculations) vertical pipe run on the north wall of the Spent Fuel Pool at the 1025' floor elevation. The vertical pipe run would extend from the 1025' (nominal) floor elevation to the 1036' floor elevation and into the SFP. Pipe would be routed to avoid interference with existing 8" diameter Auxiliary Building Fire Protection (FP) supply header and conduits. The upstream pipe end will be threaded and capped for fit-up of hose adapter and hose when required.

- The pipe will be seismically supported using standard pipe supports.

FCS FLEX Modification No. 13
FLEX Alternate Power Cables

Modification Purpose

This proposed modification will install new power cables from the new portable 200 kW FLEX Diesel Generator (FDG) to directly power to the following:

- Either of the Charging Pumps CH-1A//B/C,
- Main Control Room exhaust fans VA-46A/B and Main the Lighting Panel LP-8,
- Battery Chargers 1 and 2 (EE-8C and EE-8D), and
- The Well Pump.

Strategy Impact

In case of an ELAP, alternate power supply is needed to operate the equipment as listed above.

Modification Description

The modification will consist of the following main changes:

- CH-1A/B/C – Installation of a temporary power cable from the new FLEX portable 480V switchgear (SWGR), that will be powered from the 200 kW FLEX DG and deployed in the Fuel Building Truck Bay, to the Charging Pumps CH-1A/B/C. If possible existing raceways and penetrations will be used.
- LP-8 – Installation of a temporary power cable from the new FLEX portable 480V SWGR to a new 480V / 120 – 208, 3-Phase 60 Hz transformer. New cabling from the transformer will be connected to Bus 1C4A which powers LP-8 (See FCS BDBEE Strategy Action 13). If possible existing raceways and penetrations will be used.
- VA-46A/B - Installation of a temporary power cable from the new FLEX portable 480V SWGR to a new manual transfer switch (See FCS BDBEE Strategy Action 13). The power cables will be then connected to MCC 4A1 and MCC 3A1 which power VA-46B and VA-46A. If possible existing raceways and penetrations will be used.
- EE-8C and EE-8D - Installation of a temporary power cable from the new FLEX portable 480V SWGR to Battery Chargers 1 and 2 (EE-8C and EE-8D). If possible existing raceways and penetrations will be used.
- Well Pump - Installation of a temporary power cable from the new FLEX portable 480V SWGR to the new well pump. Cable routing will be determined after the Well location is finalized.

FCS FLEX Modification No. 14
FVS to CH2501R Blind Flange Connection

Modification Purpose

In case of an ELAP, this modification provides a routing path from the new FLEX Valve Station to the CH2501R blind flange connection for Reactor Coolant System (RCS) makeup.

Strategy Impact

Water from the Safety Injection and Refueling Water Storage Tank (SIRWT), well, river, Blair City and other water sources will be routed through the FLEX valve station deployed in Room 69. Under BDBEE scenario water can be supplied to RCS via a connection from the FVS to the CH2501 R Blind Flange.

Modification Description

The routing path will consist of flexible hoses and hose fittings. Hard piping is not required. Flexible hose will be routed from the FLEX Valve Station down the adjacent stairwell and into the Charging Pump Room at the 989' floor elevation. The hose will tie into the existing CH2501R flange connection downstream of Charging Pump CH-1A.

Modification Purpose

In case of an ELAP, this strategy is expected to provide a routing path from the new FLEX Valve Station to Valve HCV-344 for Reactor Coolant System (RCS) makeup.

Modification Description

The routing path will consist of flexible hoses and hose fittings. Hard piping is not required (based on assumptions if no modifications are made to tap into the RCS 2" line). Flexible hose will be routed from the FLEX Valve Station down the adjacent stairwell, along the corridor at floor elevation 989' and into the mechanical penetration area (Room 13). The hose will tie into the existing pipe connection at Valve HCV-344 (if no modifications to the RCS piping are assumed).

FCS FLEX Modification No. 15
FVS to Valve SI-344 Connection

[[Withheld Under 10 CFR 2.390]]

GA Showing Routing Path on Ground Floor

FCS FLEX Modification No. 16

Not Used

Modification Purpose and Description:

A robust storage building is required to be built to contain the FLEX equipment. The building will have to be stout enough to provide protection to the equipment from DB events, such as; the SSE, flood and severe weather. In consideration of flood hazards, this building will be built on an elevated location located approximately 2,600 ft. west of the reactor building. A site plan showing the building location is shown in Figure 8-1 on the next page.

Preliminary list of major equipment to be located in the storage building is as follows:

- Front End Loader, for debris and/or snow removal,
- A four wheel drive truck with a snow blower,
- Fire Truck,
- Pontoon Boat for Diesel-Driven Pumps,
- Boats for transportation (2),
- Diesel-Driven Pump on a trailer,
- 600 kW DG on a trailer,
- 200 kW DG on a trailers,
- Diesel-Driven Pumps for EL. 995' (2),
- SIRWT Motor-Driven Pumps (2), and
- Communication systems, portable antennas, clothing for inclement weather.

A simplified sketch of the proposed facility is shown below.

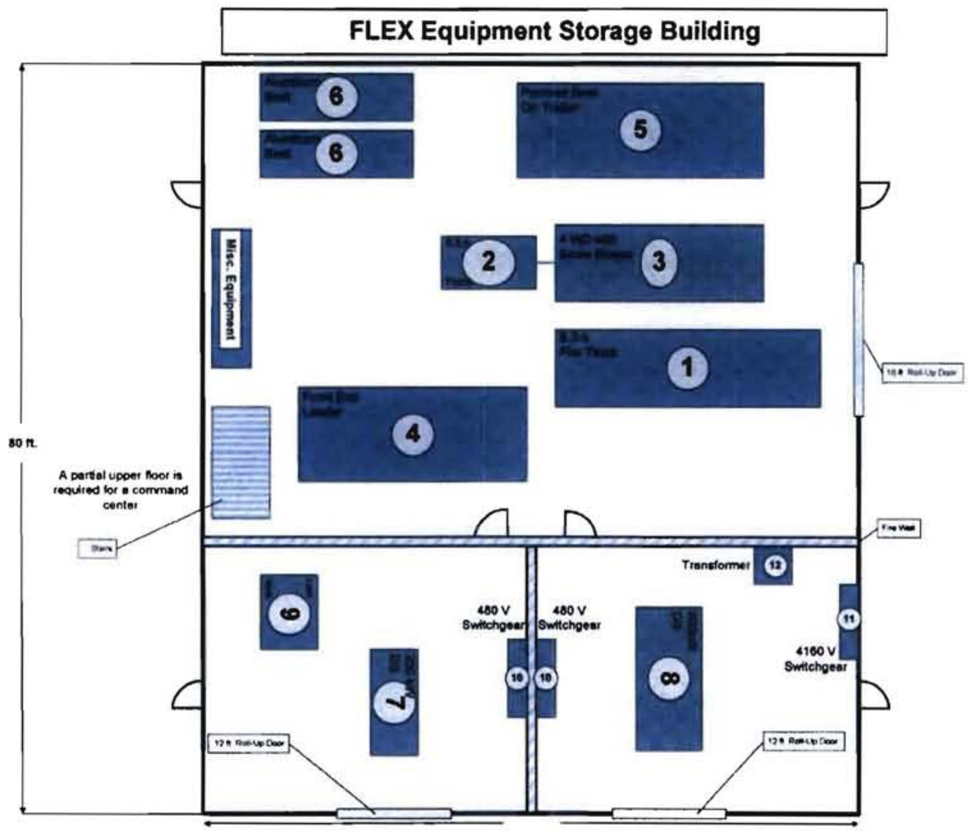
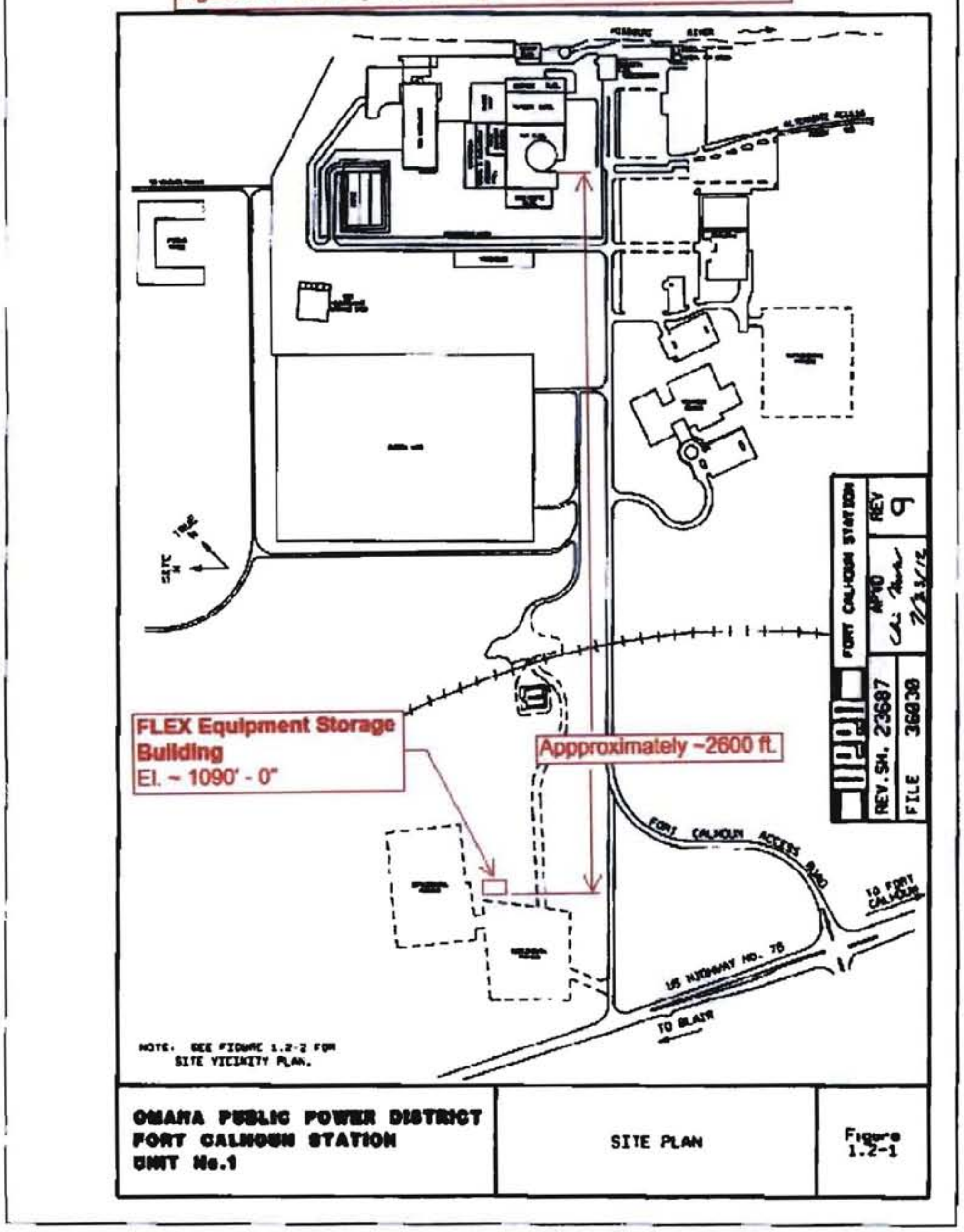


Figure 8-1 Site Layout Showing the FLEX Storage Building



FCS FLEX Modification No. 18
Well Construction

Modification Purpose and Description:

FCS is considering installing a well in order to get water that will be cleaner than the river water. The well can potentially be located to the east of the Auxiliary Building Truck Bay, between the east wall of the Truck Bay and the Containment. The well pump can receive power from the FLEX DG that will be deployed within the Truck Bay. Details of the well design will be finalized later.

FCS FLEX Modification No. 19
Pump Platform by the River at EL. 995'

Modification Purpose and Description:

In case the river level is low the fire truck may not be able to take water directly from the river. The min river level is reported to be 981'. Therefore this modification installs a platform by the river at EL. 996. A diesel driven pump will be placed there to take the water from the river and supply it to the fire truck for further pumping it to where it is needed.

FCS FLEX Modification No. 20
Diesel Fuel Transfer Piping

Modification Purpose and Description:

The purpose of the modification is to enable transfer of diesel fuel from the underground seismic category I tank to the Auxiliary Building Truck Bay.

Strategy Impact:

FLEX strategies rely upon portable diesel generators and diesel pumps for moving water as needed. Diesel fuel will be supplied to these components with the help of this modification.

Modification Description:

This modification will tap into the diesel supply piping from the underground diesel oil tank and install piping into the Truck Bay. There provisions will be made to use a battery pump to pump the oil into the DGs deployed in the Truck Bay.