Pacific Gas and Electric Company®

James M. Welsch
Vice President, Nuclear Generation

Diablo Canyon Power Plant
P.O. Box 56
Avila Beach, CA 93424

805.545.3242
E-Mail: JMW1@pge.com

July 28, 2016

PG&E Letter DCL-16-077

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

EA-12-049
10 CFR 50.4

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Pacific Gas and Electric Company's Notification of Full Compliance with Commission Order Modifying Licenses with Regard to Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Diablo Canyon Power Plant Units 1 and 2

References:

1. NRC Order Number 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. DCL-16-003, "Pacific Gas and Electric Company's Notification of Full Compliance with Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Diablo Canyon Power Plant Unit 1," dated January 5, 2016

Dear Commissioners and Staff:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1 to Pacific Gas and Electric Company (PG&E) regarding mitigation strategies required for Beyond-Design-Basis External Events. Reference 1 requires full implementation by no later than two refueling cycles after submittal of the Overall Integrated Plan or December 31, 2016, whichever comes first. Section IV.C.3 of Order EA-12-049 requires that licensees inform the NRC when full compliance is achieved. Reference 2 reported full compliance for PG&E's Diablo Canyon Power Plant (DCPP), Unit 1 after completing plant modifications during its nineteenth refueling outage (1R19). DCPP Unit 2 attained full compliance with Order EA-12-049 on June 1, 2016, during its nineteenth refueling outage (2R19). This letter provides final notification that both Units 1 and 2 are in full compliance with Order EA-12-049.

A151
NRR

Enclosure 1 to this letter provides a brief summary of the key elements associated with compliance with Order EA-12-049.

Reference 2 provided a summary response for each of the open and pending items tracked by the NRC Staff with regard to the order. Open Item NRC Interim Staff Evaluation (ISE) Confirmatory Item (CI) 3.2.1.6.A identified required actions and their sequence of implementation. Enclosure 2 contains PG&E's modified response to NRC ISE CI 3.2.1.6.A. The modifications are applicable to both Units 1 and 2.

Enclosure 3 provides the Final Integrated Plan in response to Order EA-12-049, which includes the current DCPP FLEX strategies.

PG&E makes no new or revised regulatory commitments (as defined by NEI 99-04) in this letter.

If you have any questions or require additional information, please contact Mr. Scott Maze at 805-542-9591.

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

Executed on July 28, 2016.

Sincerely,

James M. Welsch
Vice President, Nuclear Generation

mem6/4539/50466122-7
Enclosures
cc: Diablo Distribution
cc/enc: William M. Dean, NRC/NRR Director
Kriss M. Kennedy, NRC Region IV Administrator
John P. Reynoso, NRC Acting Senior Resident Inspector
Balwant K. Singal, NRR Senior Project Manager
Milton O. Valentin, NRC Project Manager

Compliance Elements with Order EA-12-049

Compliance Elements with Order EA-12-049

This enclosure summarizes Pacific Gas and Electric Company's Compliance with the Nuclear Regulatory Commission's order regarding mitigation strategies for beyond-design-basis events (EA-12-049) for Diablo Canyon Power Plant, Units 1 and 2.

1.0 Introduction

Pacific Gas and Electric Company (PG&E) developed an overall integrated plan (OIP) (Reference 2) to provide diverse and flexible coping (FLEX) strategies in response to Nuclear Regular Commission (NRC) Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (Reference 1). The OIP for Diablo Canyon Power Plant (DCPP) was submitted to the NRC on February 27, 2013 (Reference 2), and was supplemented by six-month status updates (References 3, 4, 5, 6, 7, and 16) in accordance with Order EA-12-049.

In DCL 16-003, (Reference 15), PG&E reported full compliance with Order EA-12-049 for DCPP Unit 1 on November 6, 2015.

Full compliance with the Order EA-12-049 for Unit 2 was completed on June 1, 2016. This date corresponds to the end of the second refueling outage for Unit 2 after submittal of the OIP (Reference 2) as required by Order EA-12-049. The information provided herein documents full compliance with Order EA-12-049 for DCPP Unit 2.

2.0 Open Item Resolution

Issues from the NRC Interim Staff Evaluation (ISE) for FLEX (Reference 8) and audit report (Reference 9) have been addressed by PG&E.

In Enclosure 2 of DCL-16-003 (Reference 15), PG&E provided responses to the issues that were identified as open and pending in the NRC audit report (Reference 9). Based on those responses PG&E had no open or pending items for Unit 1, or any that would affect the Unit 2 implementation. However, during the Unit 2 implementation effort, PG&E determined that some enhancements of the strategies would improve the response to an extended loss of alternating current power (ELAP)/loss of normal access to the ultimate heat sink (LUHS) event. The effects of these enhancements on the information previously provided in Reference 15 are discussed in Enclosure 2 of this letter. All of these enhancements have been validated for both Units 1 and 2.

There are no Open Items unresolved for DCPP Units 1 and 2.

3.0 Order EA-12-049 Compliance Elements Summary

The elements identified below for DCPP Unit 2 including the OIP (Reference 2), the six-month status updates (References 3, 4, 5, 6, 7, and 16), and additional docketed correspondence demonstrate compliance with Order EA-12-049.

Strategies – Complete

Strategy-related ISE open items, confirmatory items, or audit questions/audit report open items have been addressed as documented in References 9, 16, or in Enclosure 2. DCPP Units 1 and 2 strategies are in compliance with Order EA-12-049.

Modifications – Complete

The modifications required to support the FLEX strategies for DCPP Units 1 and 2 have been fully implemented in accordance with the station design control process.

Equipment – Procured and Maintenance and Testing – Complete

The equipment required to implement the FLEX strategies for DCPP Units 1 and 2 has been procured, received at DCPP, initially tested, and performance verified in accordance with NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," and is available for use.

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

Protected Storage – Complete

The storage facilities required to implement the FLEX strategies for DCPP Units 1 and 2 have been constructed and provide adequate protection from the applicable site hazards. The equipment required to implement the FLEX strategies for DCPP Units 1 and 2 is stored in its protected configuration.

Procedures – Complete

FLEX Support Guidelines (FSGs) for DCPP Units 1 and 2 have been developed and integrated with existing procedures. The FSGs and applicable procedures have been verified and are available for use in accordance with the site procedure control program.

Training – Complete
Training of personnel responsible for the mitigation of beyond-design-bases (BDB) external events at DCPP Units 1 and 2 has been completed in accordance with accepted training processes as recommended in NEI 12-06, Section 11.6.

Staffing – Complete
The PG&E Phase 1 Staffing Assessment (Reference 12) was completed in accordance with the 10 CFR 50.54(f) request for information with respect to Near-Term Task Force (NTTF) Recommendation 9.3 for Emergency Preparedness (Reference 11).

The PG&E Phase 2 Staffing Assessment (Reference 13) was completed in accordance with Reference 11.

The Updated Phase 2 Staffing Assessment was provided to the NRC on October 28, 2015 (Reference 14).

National Strategic Alliance for FLEX Emergency Response (SAFER) Response Centers – Complete
PG&E has established a contract with Pooled Equipment Inventory Company (PEICo) and has joined the National Strategic Alliance for FLEX Emergency Response (SAFER) Team Equipment Committee for offsite facility coordination. PG&E confirmed that PEICo is ready to support DCPP with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site-specific SAFER Response Plan.

Validation – Complete
PG&E has completed validation testing of the FLEX strategies for DCPP Units 1 and 2 in accordance with industry developed guidance. The validations assure that required tasks, manual actions and decisions for FLEX strategies are feasible and may be executed within the constraints identified in the OIP for Order EA 12 049.

FLEX Program Documents – Established
The PG&E DCPP FLEX program documents have been developed in accordance with the requirements of NEI 12-06.

4.0 References

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

(2) PG&E Letter DCL-13-007, “Pacific Gas and Electric Company’s Overall Integrated Plan in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies

for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 27, 2013

(3) PG&E Letter DCL-13-081, "Pacific Gas and Electric Company's First Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated August 22, 2013

(4) PG&E Letter DCL-14-014, "Pacific Gas and Electric Company's Second Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2014

(5) PG&E Letter DCL-14-076, "Pacific Gas and Electric Company's Third Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated August 21, 2014

(6) PG&E Letter DCL-15-026, "Pacific Gas and Electric Company's Fourth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated February 23, 2015

(7) PG&E Letter DCL-15-099, "Pacific Gas and Electric Company's Fifth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated August 26, 2015

(8) NRC Interim Staff Guidance, "Diablo Canyon Power Plant, Unit Nos. 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0958 and MF0959)," dated February 3, 2014

(9) NRC Letter, from T. Brown, NRC to E. Halpin, PG&E, "Diablo Canyon Power Plant, Unit Nos. 1 and 2 – Report for the Onsite Audit Regarding Implementation of Mitigation Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0958, MF0959, MP0963, and MF0964)," October 30, 2015

(10) NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 2

(11) NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and

9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012

(12) PG&E Letter DCL-13-040, "Response to March 12. 2012, NRC 10 CFR 50.54(f) Request for Information Regarding Recommendation 9.3, Phase 1 Staffing Assessment," dated April 24, 2013

(13) PG&E Letter DCL-15-063, "Response to March 12, 2012, NRC 10 CFR 50.54(f) Request for Information Regarding Recommendation 9.3, of Phase 2 Staffing Assessment," dated May 27, 2015

(14) PG&E Letter DCL-15-117, "Response to March 12, 2012, NRC 10 CFR 50.54(f) Request for Information Regarding Recommendation 9.3, Resubmittal of Phase 2 Staffing Assessment," dated October 28, 2015

(15) PG&E Letter DCL-16-003, "Pacific Gas and Electric Company's Notification of Full Compliance with Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Diablo Canyon Power Plant Unit 1," dated January 05, 2016

(16) PG&E Letter DCL-16-025, "Pacific Gas and Electric Company's Sixth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated February 29, 2016

PG&E's Modified Response to Open Item NRC ISE CI 3.2.1.6.A

PG&E's Modified Response to Open Item NRC ISE CI 3.2.1.6.A

This enclosure summarizes Pacific Gas and Electric Company's (PG&Es) changes to the previous responses to Open Item NRC Interim Staff Evaluation (ISE) Confirmatory Item (CI) 3.2.1.6.A for Diablo Canyon Power Plant, Units 1 and 2.

In PG&E Letter DCL-16-003, PG&E provided responses to the NRC open items identified within the audit report provided in NRC Letter, from T. Brown, NRC to E. Halpin, PG&E, "Diablo Canyon Power Plant, Unit Nos. 1 and 2 – Report for the Onsite Audit Regarding Implementation of Mitigation Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0958, MF0959, MP0963, and MF0964)," dated October 30, 2015.

In completing the implementation for Unit 2, PG&E made some enhancements to the required action items and the sequence of those items listed in the "sequence of events timeline" maintained in the OIP/FIP. For a tabulated version of this information see Table 4 "Sequence of Events Timeline," in Enclosure 3 "Final Integrated Plan." These enhancements affect both Units 1 and 2, and have been validated for Unit 2 and revalidated for Unit 1.

In support of the enhancements, the information below provides only the modified information and all other information provided previously in PG&E Letter DCL-16-003 in response to NRC ISE CI 3.2.1.6.A remains valid:

> Action Item 13, Request Assistance from the National Strategic Alliance for FLEX Emergency Response (SAFER) Response Center (NSRC): This action item number was changed from 14 to 13 aligning with the actual expected sequence of the actions.
>
> Action Item 14, Open doors to Control Room, Cable Spreading room, and Battery Charger/Inverter Room: This action item number was changed from 13 to 14 aligning with the actual expected sequence of the actions.
>
> Action Item 16, Plant Access Assessment: This action item number was changed from 17 to 16 as a result of deletion of the previous Item 16, Initial Site Damage Assessment. The raw water reservoir (RWR) configuration is procedurally controlled to ensure adequate volume of water is protected at all times which eliminates the requirement for the previous Action Item 16.
>
> Additionally, a reevaluation of the sequence of events determined this action is expected to begin at the 3rd hour of the event. It is still expected to take 30 minutes to complete and is completed within 3.5 hours. The time constraint is 6 hours. This provides 2.5 hours of margin. This action has to start 5.5 hours following the start of the event in order to meet the time constraint. The expected resource is a security officer.

Action Item 17, Deploy hoses to the spent fuel pool (SFP): This action item number was changed from 19 to17 aligning with the actual expected sequence of the actions.

Action Item 18, Transfer turbine driven auxiliary feedwater (TDAFW) Pump Suction to 0-1 Fire Water Storage Tank: This action item number was changed from 22 to18 aligning with the actual expected sequence of the actions. In addition, a reevaluation of the available water in the condensate storage tank (CST) determined this action is expected to begin at the 16th hour of the event prior to the CST reaching its minimum level. It is expected to take 20 minutes to complete and is completed within 16.3 hours. The time constraint is 17 hours. This provides 0.7 hours of margin. This action has to start 16.7 hours following the start of the event in order to meet the time constraint. The expected resource is a nuclear operator.

Action Item 19, Align second vital battery and secure initial battery: This action item number was changed from 20 to19 aligning with the actual expected sequence of the actions. To ensure that Reactor Vessel Level Instrumentation System (RVLIS) is available during the event, a reevaluation was completed that revised the battery life on the first battery to 19 hours. In addition, some conservatism was added to prepare the battery being aligned. As a result, this action is still expected to begin at the 18th hour of the event. However it is expected to take 26 minutes to complete and is completed within 18.43 hours. The time constraint is 19 hours. This provides 0.57 hours of margin. This action has to start 18.57 hours following the start of the event in order to meet the time constraint. The expected resource is a nuclear operator.

Action Item 20, Perform plant cooldown and depressurization: This action item number was changed from 18 to 20 aligning with the actual expected sequence of the actions. Units 1 and 2 have installed the third generation low leakage reactor coolant pump (RCP) seals. This has eliminated the previous 12 hour time constraint and results in a time constraint based on support of the start of the required Reactor Coolant System (RCS) boron injection at 20 hours following the start of the event. The injection requires the RCS to be depressurized to less than 1500 psi. This action is expected begin within 28 minutes of the event (0.5 hours). It is expected to take 2.3 hours to complete and is completed within 2.8 hours. The time constraint is 20 hours. This provides 17.2 hours of margin. This action has to start 17.7 hours following the start of the event in order to meet the time constraint. The expected resource is the minimum on-shift control room staff.

Action Item 21, Align 480 V generator and emergency reactor coolant system (ERCS) make-up pump from the boric acid storage tanks: This action is expected to begin at the 10th hour of the event. It is now expected to take 4.5 hours to complete and is completed within 14.5 hours. The time constraint is 20 hours. This provides 5.5 hours of margin. This action has to start 15.5 hours following the start of the event in order to meet the time constraint. The expected resources are four nuclear operators.

Action Item 22, Complete FLEX Deployment Damage Assessment: This action item number was changed from 23 to 22 aligning with the actual expected sequence of the actions.

Action Item 23, 480 V Generator Repower Battery Charger: This action item number was changed from 24 to 23 aligning with the actual expected sequence of the actions. The reevaluation of the battery life for RVLIS resulted in a reduction in the constraint time of one hour. A reevaluation of the sequence of events determined this action is expected to begin at the 13th hour of the event, and it is now expected to take 4.3 hours to complete. It is now completed within 17.3 hours. The time constraint is 27 hours. This provides 9.7 hours of margin. This action has to start 22.7 hours following the start of the event in order to meet the time constraint. The expected resources are one nuclear operator, a person (nonoperations) and a tow vehicle.

Action Item 24, Transfer TDAFW pump suction from 0-1 FWST to CST: This is a new action to ensure that all the Phase 1 seismically robust water is made available to support the TDAFW pump operation. When the TDAFW pump is aligned to the fire water storage tank (FWST) it recirculates 50 gallons per minute back to the CST. This action item allows the use of that volume of water. This action is expected to begin at the 28th hour of the event. It is expected to take 20 minutes to complete and is completed within 28.3 hours. The time constraint is 29.5 hours. This provides 1.2 hours of margin. This action has to start 29.2 hours following the start of the event in order to meet the time constraint. The expected resource is one nuclear operator.

Action Item 26, Align ERCS pump suction to refueling water storage tank (RWST): This action is expected to begin at the 24th hour of the event. It is expected to take 3.8 hours to complete and is completed within 27.8 hours. The time constraint is 43.7 hours. This provides 15.9 hours of margin. This action has to start 39.9 hours following the start of the event in order to meet the time constraint. The expected resources are one nuclear operator, a person (nonoperations) and a tow vehicle. This was modified to reflect the current design basis analysis.

Action Item 27, Align flexible hoses to RWR Supply Header for SFP Cooling: This action is still expected to occur at the 24th hour of the event. A reevaluation of the sequence of events and resources determined that it is now expected to take 6 hours to complete and is completed within 30 hours. The time constraint is still 67 hours. This provides 37 hours of margin. This action has to start 61 hours following the start of the event in order to meet the time constraint. The expected resources are one nuclear operator, a person (nonoperations) and a tow vehicle.

Action Item 29, Align 4160 V NSRC Generators: This action is still expected to occur after the 72nd hour of the event. A reevaluation of the sequence of events and resources determined that it is now expected to take 28.3 hours to complete and is completed within 100.3 hours. The time constraint is still 121 hours. This provides 20.7 hours of margin. This action has to start 92.7 hours following the start of the event in order to meet the time constraint. The expected resources are several nuclear operators, NSRC technicians, electricians, and tow vehicle.

Action Item 30, Align emergency auxiliary saltwater (EASW) pump: This action is still expected to occur after the 72nd hour of the event. A reevaluation of the sequence of events and resources determined that it is now expected to take 16.3 hours to complete and is completed within 88.3 hours. The time constraint is still 121 hours. This provides 32.7 hours of margin. This action has to start 104.7 hours following the start of the event in order to meet the time constraint. The expected resources are several personnel (including operations), a crane, a crane operator and two vehicles.

Enclosure 3
PG&E Letter DCL-16-077

Final Integrated Plan for Order EA-12-049

Final
Integrated
Plan
Diablo Canyon Power Plant
Units 1 and 2

Contents

Executive Summary

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049, *Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,* to all licensees requiring implementation of mitigation strategies for beyond-design-basis external events (BDBEE), as identified in Near-Term Task Force (NTTF) Recommendation 4.2. Order EA-12-049 required submission of a Final Integrated Plan (FIP) to the NRC after full compliance with the referenced orders. In order to assist the industry in responding to the NRC order, the Nuclear Energy Institute (NEI) developed guidance in report number 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide." NRC interim staff guidance (ISG) JLD-ISG-2012-01 endorses, with clarifications, the methodologies described in NEI 12-06.

This document describes the Diablo Canyon Power Plant (DCPP) FIP, including key assumptions implementing strategies, and operator action times for complying with the NRC order and Implementing FLEX, as described by JLD-ISG-2012-01 and NEI 12-06 Revision02. The DCPP FIP contains a description of the general elements of the plan, followed by a discussion of the safety functions that are identified in the order, which are core cooling, containment integrity and spent fuel pool cooling.

The NRC order requires that the underlying strategies for coping with BDBEE involve a three-phase approach:

- Phase 1- Initially cope relying on installed plant equipment and on-site resources
- Phase 2- Augment or transition from plant equipment to on-site FLEX equipment and consumables to maintain or restore key functions
- Phase 3- Obtain additional capability and redundancy from off-site FLEX equipment and resources until power, water and coolant injection systems are restored or commissioned.

These phases are discussed in the FIP in terms of how each phase addresses the identified safety functions. The first step of the FLEX strategy is establishment of the baseline coping capability to maintain or restore key plant safety functions under the conditions of an extended loss of alternating current (AC) power (ELAP) and loss of normal access to the ultimate heat sink (LUHS). These strategies are independent of a specific damage state or mechanistic assessment of external events. To meet the requirements of the NRC Order EA-12-049, the safety functions of core cooling, containment integrity, and spent fuel pool cooling need to be maintained indefinitely under ELAP and LUHS conditions. Using conservative operator action times and NEI 12-06 guidance, Pacific Gas and Electric (PG&E) has determined that the long term coping and approach to shutdown cooling is achievable without loss of natural circulation. DCPP procedures and processes address plant strategies for implementing the FIP.

DCPP FLEX coping strategies can be implemented regardless of the initiation of the external event (as identified in NEI 12-06). These strategies were developed to mitigate the impact of an ELAP and LUHS. However, based on NEI 12-06 screening guidance, the external hazards applicable to DCPP are extreme heat, extreme cold, seismic events and external flooding. Although station designs for these extremal hazards are conservative with ample margin of safety, PG&E has evaluated the functional threats from each of these hazards and identified FLEX equipment and strategies that are expected to be effective in mitigation of these events.

This FIP documents the completion of the commitments made in the OIP and subsequent communications with the NRC to comply with NRC Order EA-12-049 and supersedes any OIP or six month update previously submitted to the NRC by DCPP.

1. Background

In 2011, an earthquake-induced tsunami caused beyond-design-basis (BDB) flooding at the Fukushima Dai-ichi Nuclear Power Station in Japan. The flooding caused the emergency power supplies and electrical distribution systems to be inoperable, resulting in an ELAP in five of the six Units on the site. The ELAP led to (1) the loss of core cooling, (2) the loss of spent fuel pool cooling capabilities, and (3) the inability to maintain containment integrity. All direct current (DC) power was lost early in the event on Units 1 & 2 and after some period of time at the other Units. Core damage occurred in three of the Units along with a loss of containment integrity resulting in a release of radioactive material to the surrounding environment. On February 17, 2012, Chief Nuclear officers of the reactor operating companies approved an initiative to procure the first phase of the portable equipment for the FLEX Strategy (Reference 30)

The NRC assembled a NTTF to advise the Commission on actions the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report contained many recommendations to fulfill this charter, including assessing extreme external event hazards and strengthening station capabilities for responding to BDB external events.

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 on March 12, 2012, to implement mitigating strategies for BDBEEs. The order provided the following requirements for strategies to mitigate BDBEEs:

1) Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment integrity, and spent fuel pool (SFP) cooling capabilities following a BDBEE.

2) These strategies must be capable of mitigating a simultaneous ELAP and LUHS and have adequate capacity to address challenges to core cooling, containment integrity and SFP cooling capabilities at all Units on a site subject to the Order.

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

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

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

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

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

7) Submit an overall integrated plan (OIP), including a description of how compliance with the requirements would be achieved.

8) Complete implementation of the requirements no later than two refueling cycles after submittal of the OIP or December 31, 2016, whichever came first.

The NEI developed NEI 12-06 Revision 0, which provides guidelines for nuclear stations to assess extreme external hazards and implement the mitigation strategies specified in NRC Order EA-12-049. The NRC issued Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated August 29, 2012, which endorsed NEI 12-06 Revision0 with clarifications on determining baseline coping capability and equipment quality.

In December 2015, NEI issued "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," NEI 12-06, Revision 2 (Reference 22). On January 22, 2016, the NRC issued a revision to JLD-ISG-2012-01. The revised ISG endorses, with exceptions, additions, and clarifications, the methodologies described in the industry guidance document, NEI 12-06 Revision 2. The DCPP FIP is based on NEI 12-06, Revision 2. Aspects of NEI 12-06, Revision 2, while not applicable to this Order compliance, will be utilized for upcoming submittals (e.g. use of re-evaluated hazards, Appendix G & H) and rulemaking (e.g., references to NEI 13-06 and NEI 14-01).

2. NRC Order EA-12-049 --- Diverse and Flexible Mitigation Capability (FLEX)

2.1. General Elements – Assumptions:

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

2.1.1. Boundary Conditions

General Criteria and Baseline Assumptions are established to support development of FLEX strategies, as follows:

- The BDBEE occurs impacting both Units at the site.
- Both reactors are initially operating at full power, unless there are procedural requirements to shut down due to an impending event. The reactors have been operating at 100% power for the past 100 days.
- Each reactor is successfully shut down when required (i.e., all rods inserted, no Anticipated Transient Without Scram [ATWS]). Steam release to maintain decay heat removal upon shutdown functions normally, and reactor coolant system (RCS) overpressure protection valves respond normally, if required by plant conditions, and reseal.
- Onsite staff is at site administrative minimum shift staffing levels.
- No independent, concurrent events, e.g., no active security threat.
- All personnel onsite are available to support site response.
- The reactor and supporting plant equipment are either operating within normal ranges for pressure, temperature and water level, or available to operate, at the time of the event consistent with the design and licensing basis.

2.1.2. Initial Conditions applied:

The following initial conditions are to be applied:

- 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 offsite power for an extended period. The LOOP is assumed to affect all Units at a plant site.

- All installed sources of emergency onsite alternating AC power and station blackout (SBO) alternate AC power sources are assumed to be not available and not imminently recoverable. Station batteries and associated DC buses along with AC power from buses fed by station batteries through inverters remain available.
- Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to applicable hazards are available.
- 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.
- Fuel for FLEX equipment stored in structures with designs that are robust with respect to applicable hazards, remains available.
- Permanent plant equipment that is contained in structures with designs that are robust with respect to applicable hazards, are available.
- Other equipment, such as portable AC power sources, portable back up direct current (DC) power supplies, spare batteries, and equipment for 10 CFR 50.54(hh)(2), may be used provided it is reasonably protected from the applicable external hazards in accordance with NEI 12-06, and has predetermined hookup strategies with appropriate procedures/guidance and the equipment is stored in a relative close vicinity of the site.
- Installed electrical distribution system, including inverters and battery chargers, remain available provided they are protected consistent with current station design.
- No additional events or failures are assumed to occur immediately prior to or during the event, including security events.
- The fire protection system ring header as a water source is acceptable only if the header meets the criteria to be considered robust for the applicable hazards.

2.1.3. Reactor Transient:

The following additional boundary conditions are applied for the reactor transient:

- Following the loss of all AC power, the reactor automatically trips and all rods are inserted.

- The main steam system valves (such as main steam isolation valves, turbine stops, atmospheric dumps, etc.), necessary to maintain decay heat removal functions operate as designed.
- Safety/relief valves (S/RVs) or power-operated relief valves (PORVs) initially operate in a normal manner if conditions in the RCS so require. Normal valve reseating is also assumed.
- No independent failures, other than those causing the ELAP/LUHS event, are assumed to occur in the course of the transient

2.1.4. Reactor Coolant Inventory Loss:

Sources of expected pressurized water reactor (PWR) coolant inventory loss include:

- Normal system leakage
- Losses from letdown unless automatically isolated or until isolation is procedurally directed
- Losses due to reactor coolant pump (RCP) seal leakage. Refer to section 3.1.8 for information on installed low leakage seals.

2.1.5. Spent Fuel Pool (SFP) Conditions:

The initial SFP conditions are:

- All boundaries of the SFP are intact, including the liner, gates, transfer canals, etc.
- Although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the SFP.
- SFP cooling system is intact, including attached piping.
- SFP heat load assumes the maximum design basis heat load for the site.

2.1.6. Containment Isolation Valves:

It is assumed that the containment isolation actions delineated in current SBO coping capabilities is sufficient.

2.2. The Following Assumptions are Specific to the DCPP Site:

- DCPP is able to declare an ELAP event within 60 minutes in order to enable actions that place the plant outside of its current design and licensing basis.

- 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 FIP. As the re-evaluations are completed, seismic and flooding issues will be utilized for upcoming submittals (e.g. use of re-evaluated hazards, Appendix G & H).
- This plan defines strategies capable of mitigating a simultaneous loss of all AC power and loss of normal access to the UHS resulting from a BDB 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 have been incorporated into the Unit emergency operating procedures (EOPs) in accordance with established EOP change processes, and their impact to the design basis capabilities of the Unit evaluated under 10 CFR 50.59.
- The plant technical specifications (TS) contain the limiting conditions for normal Unit operations to ensure that design safety features are available to respond to a design-basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the BDB event may place the plant in a condition where it cannot comply with certain TS and/or with its Security Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p). (Reference 49)

2.3. Initial Site Access following an event.

The event impedes site access as follows:

- Post event time: 0-6 hours – No site access. This duration reflects the time necessary to clear roadway obstructions, use different travel routes, mobilize alternate transportation capabilities (e.g., private resource providers or public sector support), etc.
- Post event time: 6-24 hours—Limited site access: Individuals may access the site by walking, personal vehicle, or via alternate transportation resources that are available to deliver equipment, supplies, and large numbers of personnel.
- Post event time: 24+ hours – Improved site access. Site access is restored to a near-normal status and/or augmented transportation resources are available to deliver equipment, supplies, and large numbers of personnel.

2.4. Staffing assumptions

The following is assumed for site staffing following an event:

- To support time-sensitive FLEX actions, staffing is assumed to be consistent with NEI 12-06 guidance.

Note:

Required staffing levels have been verified by walkthroughs, tabletops, and simulations of the identified FLEX strategies as a part of the Phase 2 staffing studies conducted in accordance with NEI 12-01 (PG&E Letter DCL-12-048, 60-Day Response to NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident."

3. Strategies

The Objective of the FLEX strategies is to establish a long term plant coping capability in order to:

- Prevent damage to the fuel in the reactor and the spent fuel pool.
- Maintain containment integrity.

These strategies address station coping capability as a result of a BDBEE that would result in an ELAP and LUHS.

DCPP's coping capability is attained through the implementation of pre-determined FLEX strategies that are focused on maintaining or restoring key reactor core, containment and spent fuel pool safety functions. The FLEX strategies are not tied to any specific damage state or mechanistic assessment of events. Rather, the FLEX strategies are developed to maintain key plant safety functions based on the evaluation of plant response to a coincident ELAP event. A safety function-based approach provides consistency and allows coordination with existing plant EOPs. FLEX strategies are implemented using FLEX Support Guidelines (FSGs).

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

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

The duration of each phase is specific to the installed and portable equipment utilized for the particular FLEX strategy employed to mitigate the plant condition. The FLEX strategy phases, as described above, are for Units experiencing an initiating external event at 100% power. Phase duration for other plant modes are discussed in the applicable sections of this report.

The FLEX strategies described below are capable of mitigating an ELAP/LUHS resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at both Units at DCPP. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios the FLEX strategies are also diverse and flexible to encompass a wide range of possible conditions.

These pre-planned strategies which have been developed to protect the public health and safety are incorporated into the DCPP EOPs in accordance with established EOP change processes, and their impact to the design basis capabilities of the Unit evaluated under 10 CFR 50.59

3.1. Maintain Core Cooling and Heat Removal

Reactor core cooling involves the removal of decay heat through the secondary side of the nuclear steam supply system (NSSS) and maintaining sufficient RCS inventory to ensure the continuation of natural circulation in the primary side of the NSSS. The FLEX strategy for reactor core cooling and decay heat removal is to release seam from the steam generators (SGs) using the 10 percent steam dump valves, while adding the corresponding amount of auxiliary feedwater (AFW) to the SG's via the turbine driven AFW (TDAFW) pump. The feedwater flow and the 10 percent steam dump valves will be manually controlled. Additionally, the TDAFW can be locally started if required (Reference 1). Initial alignment of the TDAFW pump suction is from the seismically-qualified CST for that Unit. If necessary, the TDAFW pump suction can then be manually transferred to the seismically-qualified backup supply, the common unit fire water storage tank (FWST). While drawing suction from the FWST, a portion of the TDAFW flow is recirculated to the condensate storage tank (CST). When necessary the TDAFW pump suction will be manually transferred back to the CST. PG&E's analysis demonstrates that there is sufficient seismically-protected inventory to provide the TDAFW pump for at least 39.9 hours after the initiating event (Reference 7).

RCS cooldown will be initiated within the first 30 minutes following a BDBEE that initiates an ELAP/LUHS event (Reference 9 and 10). DCPP does not intend to cooldown using less than all four steam generators.

DC bus load stripping will be initiated within the first hour following a BDBEE to ensure Class 1E battery life is extended to 27 hours (Reference 25). Portable generators will be used to repower instrumentation prior to battery depletion.

RCS volume makeup and boron injection following a BDBEE to ensure natural circulation, reactivity control, and boron mixing is maintained in the RCS are discussed in Section 3.2, below

3.1.1. Phase 1 Strategy

Following the occurrence of an ELAP/LUHS event, the reactor will trip and the plant will initially stabilize at no-load RCS temperature and pressure conditions, with reactor decay heat removal via steam release to the atmosphere through the main steam 10 percent atmospheric dump valves (ADVs). Natural circulation of the RCS will develop to provide core cooling and the TDAFW pump will provide flow from the CST to the SGs to make up for steam release.

Operators will respond to the ELAP/LUHS event in accordance with EOPs to confirm RCS, secondary system, and containment conditions. A transition to ECA-0.0, Loss of All AC Power, will be made upon the diagnosis of the total loss of AC power. This procedure directs isolation of RCS letdown pathways, verification of containment isolation, reduction of DC loads on the station Class 1E batteries, and establishes electrical equipment alignment in preparation for eventual power restoration. The operators align AFW flow to all 4 SGs, establish manual control of the 10 percent ADVs, and initiate a rapid cooldown of the RCS to minimize inventory loss through the RCP seals. ECA-0.0 also directs local manual control of AFW flow to the SGs and manual control of the 10 percent ADVs to control steam release and the RCS cooldown rate, as necessary.

The Phase 1 FLEX strategy for reactor core cooling and heat removal relies on installed plant equipment and water sources for supplying AFW flow to the SGs and steam to the atmosphere. The TDAFW pump automatically starts on the loss of offsite power condition, and does not require either AC or DC electrical power to provide AFW to the SGs. In the event that the TDAFW pump does not start on demand or trips after start, an operator will locally reset the turbine and the pump will be restarted. Sufficient time (at least 30 minutes) will be available to restart the TDAFW pump to prevent SG dry-out (Reference 50). No operator action is required to align AFW flow to all four SGs since the AFW system is normally aligned for the TDAFW pump to deliver flow to all 4 SGs. However, manual control of TDAFW pump flowrate to the SGs is required to establish and maintain proper water levels in the SGs.

Steam release from the SGs will require manual operator control at the 10 percent ADVs, using the installed manual control handwheel. In accordance with procedures for response to loss of all AC power, an RCS cooldown will be initiated at a maximum rate of 100ºF/hr to a minimum SG pressure of 300 psig (References 9 and 10). The rapid RCS cooldown minimizes the adverse effects of high temperature RCS coolant on RCP shaft seal performance and reduces SG pressure to allow for eventual AFW injection from a portable pump phase two of this strategy. The minimum established SG pressure is high enough to prevent nitrogen gas from the safety injection (SI) accumulators from entering the RCS (Reference 21).

Initially, AFW supply is provided by the installed Unit specific CST. Each CST has a minimum usable capacity of approximately 222,600 gallons and will provide a suction source to the TDAFW pump for a minimum of 17 hours of RCS decay heat removal. Prior to depletion of the usable CST inventory, the TDAFW pump suction will be aligned to the seismically qualified, FWST. The FWST, which is common to both Units, will provide water to support TDAFW pump operation in both Units for an additional 12.5 hours. In addition, the recirculation configuration of the TDAFW pumps while taking suction from the FWST directs 50 gpm of water back to the associated CST. As a result, the TDAFW pump suction would be realigned to the CSTs to gain an additional 10.4 hours of supply volume in each Unit, for a total of 39.9 hours of cooling capability from seismically qualified water sources (Reference 7).

Electrical/Instrumentation - Load stripping of all non-essential loads would begin within 60 minutes after the occurrence of an ELAP/LUHS and completed within the next 30 minutes. With load stripping, the useable station Class1E battery life has been calculated to be twenty seven (27) hours for each Unit.

3.1.2. Phase 2 Strategy

The Phase 2 strategy for each Unit will continue cooling through the SGs using a combination of a common diesel-driven raw water reservoir (RWR) pump and diesel-driven emergency auxiliary feedwater (EAFW) pump to continue to supply cooling water. The RWR pump and EAFW pump are placed in service prior to the depletion of the TDAFW pump water supply. The common unit RWR pump will be staged at the RWR, drawing water from the RWR through a suction hose equipped with a strainer. The RWR pump suction strainer will prevent transporting any large debris from the RWR to the FLEX suction header that could impact the FLEX strategies. The RWR pump will supply water through flexible hoses to a portable common unit FLEX suction header located at the 115-ft elevation bench area. The RWR has two sections, each capable of containing at least 2.5 million gallons of water. One section of the RWR with a lowest expected volume (approximately 1.5 million gallons) of usable seismically-evaluated water is capable of supplying both Units' coping strategies for approximately 84 hours at the expected strategy flow rates (Reference 7). The RWR pump and associated strainer and flexible hose will be stored at the FLEX storage facilities.

The two EAFW pumps, one for each Unit, will also be staged at the 115-ft elevation bench area. The EAFW pumps will draw water from the portable FLEX suction header and inject water into the associated Unit's SGs through flexible hoses connected to permanent connections on plant installed systems. The two EAFW pumps and associated flexible hose are stored at the FLEX storage facilities.

As shown on Figures 3 (Unit 1) and 4 (Unit 2), the primary connection point is on the AFW system crosstie between the discharge lines from the motor-driven auxiliary feedwater (MDAFW) pumps. An isolation valve and a threaded connection with a standardized hose connection have been installed to allow connection of the supply hose from the EAFW pumps. The alternate connection to the AFW system does not require a permanent modification.

The Phase 2 FLEX strategy also includes re-powering of vital 120 VAC buses within 27 hours using a portable 480 VAC Diesel Generator (DG) stored onsite for both Units. Prior to depletion of the Class 1E batteries on each Unit, selected vital 120 VAC circuits will be re-powered to continue to provide key parameter monitoring instrumentation.

The primary strategy for re-powering 125 VDC battery chargers circuits is to use one 480 VAC DG connected to each Unit's 480 VAC vital battery charger through preinstalled BDB receptacle connections and transfer switch. The portable 480 VAC DG will be deployed west of the Unit 1 and Unit 2 Turbine building, centered between the two units. The generator will be connected via a load center and cables to a FLEX receptacle panel located in the Bus H 480 VAC switchgear room of each Unit. The FLEX receptacle panel in each 480 VAC switchgear room is connected to a FLEX transfer switch via pre-installed cable and conduit. Each 480 VAC DG powers a trailer-mounted FLEX distribution panel (one per generator), which provides power to the vital 125 VDC battery charger for that Unit. The 480 VAC DG, load center and associated cables for both Units will be stored in the FLEX storage facilities.

The alternate FLEX strategy for re-powering 125 VDC vital battery charger is the connection of the portable load center power cables directly to the input terminals of the battery charger. The 480 VAC DG allows for recharging the Class 1E batteries and restoring other instrument AC loads in addition to providing power to key parameter monitoring instrumentation.

3.1.3. Phase 3 Strategy

The Phase 3 strategy involves re-establishing one primary cooling train for the RCS. It includes the use of a portable diesel-driven 4160 VAC generator set from the National SAFER Response Center (NSRC) to repower one 4160 VAC bus in each Unit. By restoring the Class 1E 4160 VAC bus, power can be restored to the Class 1E 480 VAC system via the 4160/480 VAC transformers to power selected 480 VAC loads. The repowered 4160 VAC bus will power a residual heat removal (RHR) pump and component cooling water (CCW) pump for that Unit.

Two 1MW, 4160 VAC generators will be connected to a distribution panel (also provided from the NSRC) in order to meet the required 4160 VAC load requirements for each Unit. These DGs will be deployed to staging locations outside the turbine building shown in figures 1 and 2. Cables are run from the 4160 VAC generators into the turbine building at the 85ft. level where these cables will be spliced into the output cables from the installed Emergency Diesel Generator (EDG) Bus G (primary) or Bus H (alternate). The primary connection is at the plant installed EDG 1-2 for Unit 1 and 2-2 for Unit 2. If the primary is not available in Unit 1 EDG 1-1 will be used and in Unit 2 EDG 2-1 will be used as the alternate connection point. The deployment route is the same for both diesels in each Unit. The NSRC provides adequate lengths of cable with each generator set to make the connections described above.

This strategy also includes deploying two portable diesel-driven EASW pumps, one for each Unit, and rigid piping segments to restore the UHS function. The EASW pumps and associated rigid piping segments are staged at the location in the intake cove shown in Figure 1. Each EASW pump suction line is equipped with a strainer assembly that will prevent debris from clogging the CCW heat exchanger. The piping segments will be tied into the existing ASW piping in the ASW vacuum breaker vault, located in the parking lot area by the main Meteorological tower at approximate elevation 75'. The tie in will be created by removing an existing spool piece in the ASW piping within the vacuum breaker vault. Two portable dewatering pumps and portable diesel generators, one set for each Unit, are provided as FLEX equipment along with adequate amounts of flexible hose to dewater the vaults and access the ASW tie-in point, as required. The flow from the EASW pump will provide cooling water to the CCW heat exchangers.

To complete the Phase 3 strategy, RHR suction valves, accumulator isolation valves, and other valves inside containment are required to be manipulated. FSG procedures and provided equipment deployed in this phase will ensure that the valves inside containment that are required to be manipulated will be operated electrically. With one train of RCS cooling restored or functional, the plant can restore a shutdown cooling loop and achieve cold shutdown.

As discussed above, in Phase 3, placing the EASW pumps and 4160 VAC generator sets in service will re-establish a train of CCW which provides cooling to a single RHR train. With one train of cooling restored or functional, DCPP can restore a shutdown cooling loop and achieve cold shutdown.

3.1.4. Systems, Structures and Components

3.1.4.1 Turbine Driven Auxiliary Feedwater Pump

The TDAFW pump is maintained to meet Technical Specification 3.7.5. The TDAFW pump will automatically start and deliver AFW flow to all four SGs following an ELAP/LUHS event. There are two motor-operated steam flow control valves on each of the two supply steam lines to the TDAFW pump turbine. These control valves are normally open. The two steam supply lines join together into a common line prior to entering the pump turbine-driver. This common line contains a normally-closed 125 VDC Class 1E powered motor-operated flow control valve. By powering this valve with 125 VDC Class 1E power, initiation and operation of the turbine-driven pump is independent of all AC power. This common Design Class 1 steam supply flow control valve can be operated manually, as required, in response to an ELAP/LUHS event. During an ELAP, procedures ensure that the common control valve is opened and that steam flow is controlled manually. In the event the TDAFW pump fails to start, procedures direct the operators to manually reset and start the pump (which does not require electrical power for motive force or control). Approximately 30 minutes are available to manually start the pump and initiate flow prior to steam generator dryout (Reference 50). The TDAFW pump is sized to provide more than the FLEX design basis AFW flow requirements and is located in a safety related structure designed for protection from applicable design basis external hazards.

3.1.4.2 Steam Generator 10 Percent Atmospheric Dump Valves (ADVs)

During an ELAP/LUHS with the loss of all AC power and instrument air, reactor core cooling and decay heat will be removed from the SGs for up to 121 hours (Reference 7) by manually opening/throttling the SG ADVs. The SG ADVs are safety-related, seismically qualified valves, and located in a safety related structure designed for protection from applicable design basis external hazards. The ADVs are maintained to meet Technical Specification 3.7.4. Manual operation of the SG ADVs locally will continue until one of the RHR cooling trains is re-established in Phase 3.

3.1.4.3 Batteries

The vital Class 1E vital batteries and the associated DC distribution systems are located within safety-related structures designed to meet applicable design basis external hazards, and will be used to initially power required key instrumentation and applicable DC components. Load stripping of non-essential equipment and loads has been conservatively calculated to provide a total service time of 27 hours of operations without recharging (Reference 25).

3.1.4.4 Condensate Storage Tank (CST)

The CST provides an AFW water source at the initial onset of the event. The CST is Design Class I tank and has a capacity of 425,000 gallons. The tank is designed to withstand the applicable design basis external hazards stated in NEI 12-06 (Reference 3). The minimum CST useable volume available is 222,600 gallons in each CST (Reference 30). The CST is normally aligned to provide emergency makeup to the SGs.

3.1.4.5 Fire Water Storage Tank (FWST)

The FWST is safety related tank and has a capacity of 300,000 gallons. The tank is designed as a single common tank to both Units. The FWST is designed for protection from applicable design basis external hazards. The minimum FWST useable volume available is 260,000 gallons in the FWST as maintained by ECG 18.1 (Reference 32). The FWST is normally aligned to provide makeup to the fire protection system.

3.1.4.6 Raw Water Reservoir (RWR)

The RWR is the seismically robust backup water source to the seismically qualified CST and FWST. There are two sections to the RWR, each capable of containing a minimum 2.5 million gallons. During normal operation one section is in service and the other section is isolated to maintain a seismically-evaluated source of water. The underground pipelines from the RWR to the plant are not seismically qualified and may fail during a seismic event, causing the aligned RWR section to drain until isolated. To ensure that a sufficient volume of water is available in the RWR for a total dual-Unit FLEX coping time of 84 hours after the CST/FWST are depleted, a useable minimum of 1.5 million gallons shall be protected in a RWR section at all times (Reference 7).

The RWR is considered seismically robust because it was excavated in a stable rock terrace east of and above the main power block, and was evaluated for slope movements causing a slide into the RWR during a Hosgri earthquake and overflow due to the effects of a seiche caused by ground displacement (Reference 47 & 48).

Although the reservoir itself has been evaluated to remain intact following a seismic event, the piping from the reservoir to the plant is not seismically qualified or robust, and cannot be credited to remain intact following a seismic event. Since a postulated pipe break could drain one section of the RWR in a BDBEE seismic event, PG&E maintains one section of the RWR isolated with adequate volume for Phase 2 in both Units. During periodic RWR drain downs for cleaning and maintenance, the required minimum FLEX volume is procedurally controlled to be maintained in one isolated section of the RWR, or an operator is required to be staged locally to isolate the RWR section after an event.

By using a portable diesel-pump and hoses to pump water from the RWR, water is supplied down to the FLEX suction header on the 115 ft bench area east of the Units following a seismic event.

3.1.5. FLEX Strategy Connections

3.1.5.1 Primary EAFW Pump Connection

As shown on Figures 3 (Unit 1) and 4 (Unit 2), the primary EAFW connection point is on the AFW system crosstie piping between the discharge lines from the motor-driven auxiliary feedwater (MDAFW) pumps. An isolation valve and a threaded connection with a standardized hose connection were permanently installed to allow connection of the supply hose from the EAFW pumps.

A flexible discharge hose will be routed from the EAFW pump staged on the 115 ft bench area outside the auxiliary building to the primary connection inside the auxiliary building. Hydraulic analysis of the flowpath from the CST to the primary EAFW pump discharge connection has confirmed that applicable performance requirements are met (Reference 15).

3.1.5.2 Alternate EAFW Connection

In the event that the primary AFW connection is not available, an alternate connection is located in the auxiliary building at one of two check valves on the AFW supply lines to the SGs. Only a single valve is required, however two valves have been identified. The valve bonnet and internals would be removed and a modified valve cover, equipped with a hose connection, would be bolted in place.

The EAFW pump staged on the 115 ft bench area outside the auxiliary building supplies water via a flexible discharge hose to the alternate connection. Hydraulic analysis of the flowpath from the CST to the alternate EAFW pump discharge connection has confirmed that applicable performance requirements are met (Reference 15).

3.1.5.3 Primary Electrical Connection

The 480 VAC DG for repowering the vital batteries will be connected to a dedicated quick connection point in the vital switchgear areas located in the safety related auxiliary building. A manual transfer switch installed in the same area will be used to disconnect the normal plant power circuit from the battery charger and align the generator to the charger.

The cables required to connect the 480 VAC DG are stored on the trailer of the load center. The 480 VAC DG, load center and associated cables are located in a FLEX storage facility protected from the applicable design basis external hazards stated in NEI 12-06 (Reference 22)

3.1.5.4 Alternate Electrical Connection

The alternate connection method will disconnect the normal source of 480 VAC power at the battery charger input termination in each unit. The FLEX cable ends will be lugged as required, connecting directly to the battery charger input terminations.

3.1.5.5 4160 VAC Electrical Connection

Two (2) 1 MW, 4160 VAC generators delivered to the site from the NSRC will be connected to a distribution panel (also delivered from the NSRC) in order to meet the required Phase 3, 4160 VAC load requirements for each Unit. The 4160 VAC generators will be deployed to areas near the existing EDG Rooms north and south of the DCPP Units. Cables are run from the 4160 VAC generators into the turbine building at the 85ft. level where these cables will be spliced in to the output cables from the installed EDG Bus G (primary) or Bus H (alternate). The primary connection is at the plant installed EDG 1-2 for Unit 1 and 2-2 for Unit 2. If the primary is not available in Unit 1 EDG 1-1 will be used and in Unit 2 EDG 2-1 will be used as the alternate connection point.

3.1.6. Key Reactor Parameters

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

- SG wide range level or narrow range level with AFW flow indication
- SG pressure
- CST level
- Firewater Level

For all instruments listed above with the exception of the firewater level, the normal power source and long-term power source are the 125 VDC vital batteries. The firewater level will be read locally at the tank.

- SG Level can be monitored using either wide range (WR) or narrow range (NR) level indication in the control room. If NR is selected to monitor this parameter AFW flow is required to be available. AFW Flow will validate the SG function continues with the SG level being off scale on the NR instrument as a result of shrinkage during the transient.
- SG pressure will provide indication in the control room of RCS pressure during plant cooldown to monitor the potential for nitrogen injection from the accumulators. SG pressure will also provide indirect indication of RCS temperature to monitor excessive cooldown for reactivity control and to maintain minimum TDAFW steam supply pressure.
- CST level is to be monitored in the control room to indicate adequate inventory is available to supply the TDAFW pump and determine if water source transfer is required.
- FWST Level is to be monitored locally at the FWST to determine adequate inventory is available to supply the TDAFW pump and determine if water source transfer is required.

Portable FLEX equipment credited in Phase 2 is supplied with the local instrumentation needed to operate the equipment. The use of these instruments is detailed in the associated FSGs for use of the equipment. These procedures are based on inputs from the equipment suppliers, operating experience, and expected equipment function in an ELAP/LUHS.

In the unlikely event that 125 VDC power is not available, guidance for alternately obtaining the critical parameters locally is provided in FSG-7, *Loss of Vital Instrumentation of Control Power.*

3.1.7. Thermal Hydraulic Analyses

3.1.7.1. Secondary Cooling Water Requirements

Calculations were performed to determine the inventory required for core decay heat removal, RCS cooldown, and to maintain steam generator levels and dryout times associated with the volumes of various onsite AFW water sources. For Phase 1 the conclusions from this analysis showed that the existing CST usable volume is 222,600 gallons in each CST (Reference 30) which would be depleted in approximately 17 hours at which time the TDAFW pump suction will be aligned to the FWST. The FWST, which is common to both Units, will provide water to support TDAFW pump operation in both Units for an additional 12.5 hours. Because of the recirculation configuration of the TDAFW pumps, while taking suction from the FWST, 50 gpm of water is directed back to the associated CST. As a result, the TDAFW pump suction would be realigned to the CSTs to gain an additional 10.4 hours of supply volume in each Unit, for a total of 39.9 hours of cooling capability from seismically qualified water sources (Reference 7).

In Phase 2 the water supply is from the RWR which will supply as a minimum useable volume of 1.5 million gallons which will support both Units 1 and 2 for 84 hours.

In Phase 3, a RHR train is placed in service and secondary makeup is not required. If required to extend decay heat removal capability water can be supplied indefinitely, by several other onsite sources including the UHS (Pacific Ocean). Refer to table 3 for water sources.

3.1.8. Reactor Coolant Pump Seals

PG&E installed new low leakage third generation SHIELD™ RCP seals during the FLEX implementation refueling outages. These new low leakage seals significantly decrease the potential seal leakage from 21 gpm to 1 gpm per loop. As a result of this modification RCS inventory is not a significant concern during an ELAP scenario and the time required before RCS makeup is 43.7 hours to maintain single-phase natural circulation (Reference 12). Refer to section 3.2 for RCS make-up strategy.

3.1.9. Shutdown Margin Analysis

A Shutdown Margin (SDM) Analysis was performed for the reactor core based on data for DCPP Unit 1 Cycle 18 and DCPP Unit 2 Cycle 18. The SDM Analysis determined that RCS boration is required, due to xenon decay, to achieve the required RCS boron concentration within 24 hours of ELAP initiation.

Calculations (Reference 12) show that injection of 4,449 gallons of 7,000 ppm borated water from the BASTs for both DCPP Units will be adequate to meet shutdown reactivity requirements at the limiting end-of-cycle condition. This additional boron requirement is injected in less than 3 hours by the FLEX ERCS make-up pump which has a flow rate of 30 gpm. The RCS volume change due to contraction caused by decreased RCS temperature and pressure provides sufficient volume for the injection of the borated water from the BAST without venting the RCS. Refer to section 3.2 for a discussion on the strategy to maintain reactor cooling system inventory control using the FLEX ERCS pumps.

The RCS boration injection is initiated using the ERCS make-up pump no later than 20 hours following an ELAP/LUHS event. The borated water injection into the RCS will be complete within 24 hours to maintain core reactivity shutdown margin of 1% following an ELAP/LUHS, including one hour for boron mixing.

The SDM calculations are based on the uniform boron mixing model. Boron mixing was identified as a generic concern by the NRC and was addressed by the Pressurized Water Reactor Owner's Group (PWROG). The NRC endorsed the PWROG boron mixing position paper (Reference 39) with the clarification that a one hour mixing time was adequate provided that the flow in all loops is greater than or equal to the corresponding single-phase natural circulation flow rate (Reference 40). The DCPP long term sub-criticality calculations meet the limitations documented in References 39 and 40.

The boration calculation (Reference 12) is conservative for typical DCPP core designs. It has been determined that this boration calculation is conservative for long term use at DCPP and that a cycle specific revision to Reference 12 is not necessary (Reference 38).

3.1.10. FLEX Pumps and Water Supplies

3.1.10.1 Diesel-Driven Raw Water Reservoir Pump

The RWR pump has been designed to provide 1,200 gpm of water to the FLEX suction header through parallel hose runs. The RWR pump provides water from the RWR at sufficient flowrate and pressure to support EAFW operation and the SFP cooling requirements in both Units. The RWR pump is stored in a FLEX storage location that protects the pump from the applicable design basis external hazards stated in NEI 12-06 (Reference 22).

A single portable RWR pump, stored in the secondary FLEX storage facility, will be moved to a staging location at the RWR and placed in service. The RWR pump will take suction from one section of the RWR through non-collapsible hose and connection fittings to ensure that the suction hose does not collapse as the pump operates. The suction line is provided with dual filters (strainers) placed on the end of the suction hose. A flexible hose will connect the RWR pump discharge to a discharge manifold, with outlet connections that allow the RWR pump discharge to be directed through three runs of flexible hoses and fittings, down the hillside east of the plant to the FLEX suction header located on the 115-ft bench area just east of the auxiliary building.

When staged for operation, the RWR pump and discharge manifold will be located outdoors near the RWR. The pump is self-priming. The pump is equipped with a 275 gallon fuel tank, which will allow for a minimum of 18 hours of operation at the specified flow rate. The fuel tank will be refilled as necessary by onsite fuel caddies or fuel trucks.

3.1.10.2 Diesel-Driven Emergency Auxiliary Feedwater Pump (EAFW)

The EAFW pump strategy provides adequate SG makeup from a portable diesel-driven, trailer-mounted EAFW pump. The pumps are designed to deliver a flow rate of 300 gpm at a minimum total developed head of 566 feet (Reference 15).

The pumps are capable of operating with a suction side pressure of up to 200 psig (Reference Calculation STA-294). The pumps have suction side strainers to prevent the injection of debris which may have an adverse impact on plant equipment. The EAFW pump is stored in a FLEX storage facility that protects the pump from the applicable design basis external hazards stated in NEI 12-06 (Reference 22).

When it is required for service, the EAFW pump will be moved to the 115-ft elevation bench area. The portable EAFW pump will draw water from the FLEX suction header staged in this same area. The EAFW pump will inject water into the AFW system, at either the primary or alternate connection point, to maintain the capability to remove decay heat using the SGs. Approximately 300 feet of discharge hose is provided to connect the EAFW pump to either the primary or alternate connection point. The EAFW pump requires that the SGs have been depressurized to no greater than 300 psig, while the TDAFW pump is still in service as directed by emergency operating procedure ECA-0.0.

3.1.10.3 Emergency Auxiliary Salt Water (EASW) Pumps

This strategy also includes deploying two portable diesel-driven emergency auxiliary saltwater (EASW) pumps, one for each Unit, and rigid piping segments which will be used to restore the UHS function. After the event the EASW pumps will be staged at the south end of the intake cove, as shown in Figure 1. The EASW pump is designed to provide 3000 gpm of water to the CCW heat exchangers (Reference 16). Each EASW pump suction hose is equipped with a strainer assembly that will prevent debris that could block the CCW heat exchangers from entering the line. The rigid piping segments will be routed from the EASW pump to the ASW vacuum breaker vault and connected to the installed ASW piping by removing an existing spool piece in this piping. Two portable dewatering pumps, one for each Unit, are provided as FLEX equipment along with adequate amounts of flexible hose to dewater the vaults and access the ASW tie-in point, as required. The flow from the EASW pump will provide cooling water to the CCW heat exchangers. Removal of the spool piece and installation of riser pipe and flange requires a crane or other heavy lifting equipment. Several of these cranes and frontend loaders are located onsite. The EASW pumps, associated rigid piping, fittings, and dewatering pumps are stored in a FLEX storage facility and are protected from the applicable design basis external hazards stated in NEI 12-06 (Reference 22).

3.1.10.4 FLEX Suction Header

The FLEX suction header is a portable header that will be staged east of the auxiliary building on the 115-ft bench area. It has three inlet hose connections, each with a manual valve for isolation. The header has have a variety of outlet hose connections to supply the core cooling and heat removal and SFP cooling strategies for both Units, simultaneously. These outlet connections each have a manual isolation valve. The FLEX suction header is stored in a FLEX storage facility that protects the header from the applicable design basis external hazards stated in NEI 12-06 (Reference 22).

3.1.10.5 Water Supplies

- Condensate Storage Tank (CST)

  Refer to section 3.1.4.4
- Fire water Storage Tank (FWST)

  Refer to section 3.1.4.5
- Raw Water Reservoir (RWR)

  Refer to section 3.1.4.6
- Pacific Ocean

  The Pacific Ocean is a source of water for the ultimate heat sink and can provide EASW support indefinitely.

3.1.11. Electrical Analysis

The Class 1E battery duty cycle of 27 hours for DCPP was calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles (Reference 4). The time margin between the calculated battery duration for the FLEX strategy and the expected deployment time for FLEX equipment to supply the DC loads is approximately 9.7 hours for DCPP (as shown in Table 4).

The strategy to re-power the stations vital AC/DC buses requires the use of diesel powered generators. For this purpose, each Unit shares one (1) 480 VAC DG and one (1) 480 VAC load center.

The 480 VAC DG has a rating of 275 KW. The generator is trailer mounted with a 370 gallon diesel fuel tank built into the trailer. The load center is also trailer mounted.

Additional replacement 480 VAC DGs and 4160 VAC generators are available from the NSRC for the Phase 3 strategy. The specifications and ratings for this equipment are listed in Table 2.

3.2. Maintain Reactor Cooling System Inventory Control

The coping strategy provided to maintain RCS inventory control and subcriticality is intended for use during or following an ELAP/LUHS with the RCS intact. In this configuration, since the normal RCS make-up pumps are not functioning as a result of the ELAP/LUHS, core cooling is maintained by establishing and maintaining natural circulation in the RCS until the RHR system is re-established.

RCS cooldown will be initiated within the first hour following a BDBEE that initiates an ELAP/LUHS event.

Refer to section 3.17 for the strategy for maintaining RCS function when the RCS is not intact.

3.2.1. Phase 1 Strategy

For coping in Phase 1, per the guidance of NEI 12-06, it is assumed that prior to the event the Unit is operating at 100% power and all systems are operating normally. As a result of the BDBEE the reactor has tripped and the normal RCPs are not running due to an ELAP/LUHS. It is also assumed that the RCS remains intact with limited leakage because of the installed low leakage RCS pump seals. In this configuration for Phase 1, adequate inventory is maintained within the RCS, and there is no additional RCS make-up actions required. The RCS temperature and pressure are controlled through use of the operating TDAFW pump and all four available SGs.

RCS isolation will be verified to have occurred automatically, and RCS leakage will be assumed to be through the RCP seals (Refer to section 3.1.8). Without additional RCS inventory, single phase natural circulation will continue for approximately 44 hours after the ELAP. Keff is calculated to be less than 0.99 at the described RCS conditions for approximately 24 hours (Refer to section 3.1.9).

3.2.2. Phase 2 Strategy

Boration of the RCS is required to be completed within 24 hours after reactor shutdown to ensure subcriticality at xenon-free and cold conditions (Reference 12). Natural circulation is maintained by ensuring adequate RCS inventory.

In Phase 2 an electric driven ERCS pump with a corresponding diesel generator to provide motive power, will be used to provide additional make-up to the RCS. The ERCS make-up pump (refer to section 3.2.10.1) for each Unit is powered from a single 480 VAC DG that has a rating of 150kW. The generator is trailer mounted with a 255 gallon diesel fuel tank built into the trailer. A primary injection point has been identified in an existing vent line the CVCS System, and an alternate connection has been identified in an existing vent line in the SI system. Initial borated water supply comes from the Boric Acid Storage Tanks (BASTs), and a new tie-in point in each unit has been installed for this purpose. After initial injection, there would be approximately 9,500 gallons available for use from the BASTs before the tanks are depleted. Further injection is required for inventory control approximately 44 hours into the event. As inventory control does not require continuous injection of water into the RCS, once the initial injection is completed and prior to depleting the BASTs, the ERCS make-up pump will be stopped and the pump suction removed from the BASTs and re-connected to the RWST. The suction line will be connected to an existing 4 inch drain valve and blind flange located at the bottom of the RWST. Any additional required borated water injections will be accomplished using the RWST for supply.

In Phase 2 during shut down modes, when Steam Generators are not available to provide core cooling, the strategy is to use the EAFW Pump with the suction connected to the RWST, and the discharge connected to a dedicated tie-in point in the Residual Heat Removal (RHR) system, refer to section 3.15 for details.

3.2.3. Phase 3 Strategy

For coping in Phase 3, the RHR system is returned to operation and RCS temperature is maintained by that system (Refer to section 3.1.3). Since, over time, it is possible that further adjustments in RCS inventory may be required, the portable ERCS equipment with suction aligned to the RWST will remain available.

3.2.4. Systems, Structures and Components:

3.2.4.1 Boric Acid Storage Tank (BAST)

The BAST serve as the reservoir for 4% concentrated boric acid used by the CVCS for RCS boron concentration control, both for normal plant reactivity control, for emergency boration, and plant shutdown to cold shutdown. The ability to borate the RCS to support cold shutdown is a safety-related function, and the inventory of boric acid required for this function is safety-related and governed by the ECGs and Improved Technical Specifications. The safety related BASTs are seismically qualified. Each of the two BASTs per Unit has a capacity of 8060 gallons for a total capacity of 16,120 gallon. PG&E evaluated the potential for boron precipitation during ELAP/LUHS mitigation in the BASTs at the lowest expected outside temperature and determined that as a result of the remaining heat loads in the auxiliary building, significant precipitation is not a concern (Reference 20)

3.2.4.2 Refueling Water Storage Tank (RWST)

Each Unit is equipped with one RWST located in the plant yard (outside) east of the fuel handling building at the 115 ft elevation. The tanks are safety-related and seismically qualified. During "at power" operations each operating Unit's RWST borated volume is maintained greater than 455,300 gallons at a boron concentration between 2300 and 2500 ppm. The RWST is the secondary borated water source for the ERCS Injection.

3.2.5. FLEX Connections

3.2.5.1 Primary ERCS Makeup Pump Connection

The ERCS make-up pump will inject water through a high pressure discharge hose into a cold leg SI test vent located in the 100-ft elevation auxiliary building containment penetration area. These vent valves are equipped with a NPT nipple with a screwed cap which will be removed to install a fabricated connection and vent assembly.

3.2.5.2 Alternate ERCS Makeup Pump Connection

The ERCS make-up pump alternately injects water into a cold leg SI test vent located in the 100-ft elevation auxiliary building containment penetration area. This vent valve is equipped with quick connect fittings. This connection point will also use a fabricated connection and vent assembly with an additional adaptor to a quick connect fitting.

3.2.5.3 ERCS Makeup Pump Suction Connection (From BAST)

The pre-staged ERCS make-up pump draws water through non-collapsible suction hose connected to the boric acid transfer pump (BATP) suction crosstie lines, located on the 100-ft elevation of the auxiliary building.

3.2.5.4 ERCS Makeup Pump Suction Connection (from RWST)

The ERCS make-up pumps will draw water through a 4" hose connected to the RWST drain, located outside on the 115-ft RCA bench.

3.2.6. Key Reactor Parameters

Instrumentation providing the following key parameters is credited for all phases of the RCS Inventory Control strategy:

- Core exit thermocouple (CET) temperature
- RCS hot leg temperature (Thot) if CETs not available
- RCS cold leg temperature (Tcold)
- RCS wide range pressure
- Wide range accumulator level indication (RCS passive injection level)
- Pressurizer level

- Reactor vessel level indicating system (RVLIS) (backup to pressurizer level)
- Neutron flux

For all instruments listed above, the normal power source and long-term power source are the 125-VDC vital batteries.

- Core Exit Thermocouples (CETs} can be used to determine real time RCS high temperature, if T_{hot} is not available. One train of CETs would be required to consider the CETs available. RCS lot leg temperature is monitored to recognize SAMG entry and used for RCS subcooling calculations.
- RCS Hot Leg temperature (T_{hot}) can be used to determine real time RCS high temperature, if the CETs are not available. If T_{hot} is used, one channel per SG being steamed is required until natural circulation is no longer required.
- RCS Cold Leg temperature (T_{cold}) can be used to verification that the RCS temperature has not reached a level where RCP seal integrity would be affected. In addition, T_{cold} can be used to confirm natural circulation and to establish cooldown rate. (T_{cold}) is not required, if one channel of SG pressure indication is available per SG being steamed. T_{sat} of SG pressure can be used to determine the RCS parameters.
- RCS Wide Range Pressure can also be used for RCS subcooling calculations. Indication on one RCS loop is adequate as RCS pressure is constant throughout the RCS.
- Wide Range Accumulator Level indication (RCS passive injection level) indicates of the amount of RCS passive injection provided from the accumulators. For FLEX, PG&E does not have a discharge strategy for boration/inventory that requires maximum use of RCS passive injection of water, therefore this indication is not required. However, the RCS pressure controls injection and RCS pressure is constant throughout the RCS which will allow all of the accumulators to inject at a similar rate. RCS pressure is procedurally controlled to limit passive injection and having indication on one accumulator provides indication to operators that the accumulator levels are approaching a level that might result in nitrogen injection into the RCS.
- Pressurizer Level Indication is used to provide RCS inventory indication while the RCS is subcooled early in the BDBEE to diagnose unexpected leakage, and later in the event, if the reactor remains subcooled, to monitor RCS level while further stabilizing the plant during RCS boration/makeup activities using a portable FLEX pump. If the reactor vessel level indicating (RVLIS) system is available it can be used as a back-up to the pressurizer level indication and once the RCS is

depressurized there may be a bubble in the reactor vessel and pressurizer level may not by itself provide an accurate indication of RCS inventory.

- Reactor Vessel Level Indicating System (RVLIS) will provide plenum head level, reactor full range level, RCS WR temperature, and RCS WR pressure. Although having all of these indications is helpful, only the reactor full range level indication is desired to be available as a back-up to pressurizer level per the PWROG (Reference 32). This indication will provide indication that the reactor is full when RCS is subcooled. RVLIS can also provide reactor level when the RCS is no longer subcooled and a bubble has formed in the reactor vessel. The RCS temperature and pressure indications are not credited for FLEX, but may be used to confirm other indications.
- Neutron Flux will provide indication of reactor return to criticality and the need for boration. The indication of a trend towards subcriticality is a minimum requirement for monitoring. PWROG guidance (Reference 33) indicates that for plants that have a potential to go critical during initial cooldown, wide range post-accident monitoring instrumentation may not be sensitive enough. During the initial cooldown, evaluations of core conditions indicate that DCPP would not be expected to return to critical prior the time when boration capability is restored. The amount of available shutdown margin, rod worth, and the passive injection will preclude criticality during the cooldown period. In addition, the wide range nuclear instrumentation employed at DCPP is designed to Regulatory Guide 1.97 requirements and indicates both in the power range (0-200% reactor power) and in the source range. The source range portions of these monitors are not credited for FLEX as they are not considered seismically robust. However, the seismically robust wide range post-accident monitors will be credited for neutron flux indications.

PG&E procedure FSG 07 provides direction for reading this instrumentation locally, where applicable, using a portable instrument as required by NEI 12-06 Loss of Vital Instrumentation or Control Power.

3.2.7. Thermal Hydraulic Analyses

3.2.7.1 RCS Response

The model used for the determination of RCS response was the same model used in the generic analysis in Section 5.2.1 of WCAP-17601 (Reference 10), and updated for Westinghouse 4-loop plants in WCAP-17792 (Reference 11). Section 5.2.1 of WCAP-17601 provides a Reference Case which assumes standard Westinghouse OEM RCP seal packages to determine the minimum adequate core cooling time with respect to RCS inventory (i.e., core uncovery). The Reference Case models a Westinghouse 4-loop plant with a core height of

12 feet (i.e., a 412 plant), a Tcold upper head, at 3723 MWt, with Model F Steam Generators and Model 93A/A-1 Reactor Coolant Pumps.

3.2.8. Reactor Coolant Pump Seals

PG&E installed new low leakage (SHIELD) RCP seals during the FLEX implementation refueling outages. The new low leakage seal limit the potential seal leakage to one gpm per loop (total of 4 gpm); and extends the time until core uncovery and required RCS inventory makeup.

3.2.9. Shutdown Margin Analysis

Refer to section 3.1.9 for a discussion of shutdown margin analysis.

3.2.10. FLEX Equipment and Water Supplies

3.2.10.1 Emergency Reactor Coolant System (ERCS) Makeup Pump

As determined by PG&E calculation FLEX-002 (Reference 12), the ERCS pump minimum required discharge pressure is 1500 psia. The ERCS make-up pump is designed to provide 30 gpm of borated water at 1500 psig (Reference 15). When staged for operation, each Unit's ERCS make-up pump will be located inside the auxiliary building on the 100-ft elevation near the suction point, or alternatively at the 115-ft elevation next to the BASTs.

The ERCS make-up pumps are required to initially inject 4,449 gallons of borated water per Unit within the first 24 hours to ensure subcriticality (Reference 12). As the event continues the ERCS make-up pumps can be operated intermittently to maintain RCS inventory. Operators will monitor RCS level using vital instrumentation to determine when makeup must be made, and when the RCS has returned to an acceptable water level the pumps will be turned off.

Hydraulic analysis of the ERCS makeup pump with the associated hoses and installed piping systems confirm the ERCS makeup pump minimum flow rate and head capabilities exceed the FLEX strategy requirements for maintaining RCS inventory.

One ERCS make-up pump is pre-staged in each DCPP Unit. In the event one of the pre-staged pumps becomes unavailable, there is an onsite backup trailer mounted ERCS make-up pump that can be staged on the 115ft elevation area near the BASTs to replace the unavailable pump.

3.2.10.2 FLEX 480 VAC Diesel Generator/Distribution Center

One common portable 480 VAC DG with a rating of 150kW supports both the Units 1 and 2 ERCS makeup pumps (Reference 34). This generator is staged east of the auxiliary building on the 115-ft bench area of the radiation controlled area (RCA) (primary) or west of the turbine building central to Unit 1 and 2 (alternate). The alternate location would be utilized if the 500kV lines have fallen on the 115-ft elevation, and grounding and removal of these lines cannot be accomplished in time to support deployment of this generator. A second backup generator is located onsite. Both of these generators are deigned in accordance with NEI 12-06 and are stored in FLEX storage facilities.

Staged with the generator is a distribution center, which is a trailer mounted set of equipment that receives power from the 480 VAC DG, through a circuit breaker. The distribution center is configured to accept a nominal 150kW power source. Each distribution center is capable of accepting all FLEX load configurations, and has trailer mounted distribution transformers, and onboard three phase distribution panels. There is a backup distribution center located on site. Both of these distribution centers are designed in accordance with NEI 12-06 and are stored in diverse locations FLEX Storage Facilities.

Each FLEX generator and associated distribution center is interconnected through quick connect cables, color coded to maintain phasing, and in varying sizing and lengths to accommodate individual loads. The cabling will be laid on the ground without the use of raceway. The cables used to power the ERCS make-up pumps are pre-staged inside the auxiliary building and on the load center trailers stored in the FLEX storage facilities.

3.2.10.3 Boric Acid Storage tank

Refer to section 3.2.4.1

3.2.10.4 Refueling Water Storage Tank

Refer to section 3.2.4.2

3.2.11. Electrical Analysis

Refer to section 3.2.10.2

3.3. Spent Fuel Pool Cooling

DCPP has two Unit specific SFP, one in each Unit. The basic FLEX strategy for maintain SFP cooling is to monitor SFP level and provide sufficient makeup water to the SFP to maintain the normal SFP level.

3.3.1. Phase 1 Strategy:

In accordance with NRC Order EA 12-051, PG&E has installed reliable wide-range SFP instrumentation to monitor the SFP level (Reference 33).

In Phase 1 of this strategy, installed plant equipment capable of maintaining SFP cooling will be unavailable. The loss of the SFP cooling system will result in the heating of the water in the SFP until it begins to boil, causing water inventory to be lost over time. If the BDBEE is seismic in origin, it is possible that a maximum of 16.4 inches of water inventory from the SFP will be lost due to sloshing (Reference 5 and 6).

Analysis of boiling in the SFP was done for all relevant loading conditions boiling occurs at 13 hours, and boil off to a level 10 ft above the fuel occurs in approximately 67 hours (Reference 5).

To reduce the effects on the SFP area environment as a result of heating up of the pool the FLEX related procedures require various doors to be opened to establish a ventilation path for the area early in the event.

Early in Phase 1 some of the equipment used for Phase 2 of this strategy, including hoses, restraints, adaptors, and spray nozzles for the appropriate distribution configuration will be deployed to the SFP 140-ft. elevation deck before environmental conditions limit access.

3.3.2. Phase 2 Strategy:

The Phase 2 strategy is to initiate SFP makeup in each Unit using flexible hoses that deliver water from the RWR supply header capable of providing sufficient makeup assuming the design basis heat load.

Two runs of flexible hoses (one per Unit) will take water from the portable FLEX suction header and inject water directly into the top of the associated SFP. The end of the hoses will be restrained at the edge of the pool to ensure that they remain capable of makeup to the pool.

The portable diesel-driven RWR pump staged in support of the EAFW strategy will be staged at the RWR to provide water to the FLEX suction header at a pressure and volume that supports the SFP cooling requirements in both Units.

Additionally, as required by NEI 12-06, two portable spray monitor nozzles for each Unit will be available to provide spray capability. These spray monitor nozzles will be attached to two hoses (one for each monitor) provided to the pool and supplied by the same FLEX header discussed above. A redundant set of portable spray monitor nozzles will be stored at a FLEX storage facility.

As discussed above, procedures require the flexible hose and portable spray monitor nozzles deployment on the 140-ft deck around the SFP early after the event, prior to bulk boiling of the SFP.

3.3.3. Phase 3 Strategy

For Phase 3 the SFP strategy is to repower an SFP cooling pump using the NSRC 4160-V generators as discussed in Section 3.1. This will provide indefinite heat removal capability.

3.3.4. Systems, Structures and Components:

3.3.4.1 Primary Connection

The primary distribution configuration is on the SFP deck, elevation 140-ft. For deployment of this distribution configuration, hose will be run from the portable FLEX suction header on the 115-ft bench into the auxiliary building up to the 140-

ft deck. On the 140-ft elevation, hose will be secured to the handrail surrounding the SFP to control hose movement, and support discharge directly into the SFP.

3.3.4.2 Alternative Connection

The alternate configuration supplies water to a SFP cooling system valve located on the 100-ft elevation, in the SFP cooling system pump room. Hose from the FLEX suction header on the 115-ft bench is connected to this valve and injects water into the return line of the SFP cooling system. The bonnet on this valve is removed and a fabricated adaptor with a hose connection is installed to allow injection of water into the line and the SFP. This configuration can be implemented if conditions prevent operators from entering the SFP deck area.

3.3.4.3 Spray Option

The spray distribution configuration is the same as the primary configuration except for the addition of two portable spray monitors attached on the end of the discharge hose. Implementation of this configuration requires the SFP discharge hose be split on the 140-ft deck to supply both nozzles. Although it is assumed there will be no damage to the SFP liner, the monitors will be deployed if leakage from the pool exceeds makeup capability, as required by NEI 12-06. The monitor nozzles will be positioned on opposite sides of the pool to cover the surface area of the SFP with their spray pattern.

Spray monitors will be secured to the handrail using straps to counter the reaction force during operation. The nozzles will be adjusted to a non-oscillating fog setting, such that the surface area of the SFP will be covered by the spray.

3.3.4.4 Fuel Building Ventilation

Ventilation requirements to prevent excessive steam accumulation in the fuel building are included in a FSG procedure. FSG-11 implements this method of ventilation for the fuel building and directs operators to open doors in the Fuel Building to establish a natural circulation flowpath early after the event. Airflow through these doors provides adequate vent pathways through which steam generated by SFP boiling can exit the fuel building.

3.3.5. Key Parameters

The key parameter for the SFP makeup strategy is the SFP water level. The SFP water level is monitored by the instrumentation that was installed in response to Order EA-12-051, Reliable Spent Fuel Pool Level Instrumentation (Reference 41).

3.3.6. Thermal Hydraulic Analysis

Analyses were performed that determined:

Operating, pre-fuel transfer or post-fuel transfer

For the post refueling decay heat load and considering the results of the sloshing evaluation, boiling in the SFP will occur at approximately 13 hours. Boil off decreases the water level to 10 ft above the fuel in approximately 67 hours (Reference 5).

Fuel in Transfer or Full Core Offload

Refer to section 3.15.2 for a discussion of SFP Cooling during shutdown modes, when a full core offload during a refueling outage is present in the SFP.

Deployment of the SFP hose and the spray monitors on the SFP operating deck area is procedurally required within 6 hours to limit the environment operators will be required to work in. A flow rate of 250 gpm will maintain the pool level during boil off.

Initiation of the RWR strategy will be complete within 39.9 hours, and this will provide a design flow of 250 gpm to each SFP which provides adequate makeup to restore the SFP level and maintain an acceptable level of water for shielding purposes.

3.3.7. FLEX Water Supplies

3.3.7.1 RWR

Refer to section 3.1.4.6.

3.3.7.2 FLEX Suction Header

Refer to section 3.1.10.4.

3.3.8. Electrical Analysis

The SFP will be monitored by instrumentation installed in response to Order EA-12-051. The installed power supply panel will have sufficient battery backup to power the SFP level instrumentation for 72 hours following an ELAP. An external connector and transfer switch will be available to connect an external power source to provide power to the instrumentation and display panels and to recharge the backup battery. FSG procedures direct the installation of this external power supply to the diesel generator provided to power the ERCS Pumps (section 3.2.10.2), or any other available FLEX generator prior to 72 hours.

For Phase 3 the SFP cooling system is repowered by the NSRC 4160-V generators which are brought onsite, discussed in Section 3.1.3.

3.4. Maintain Containment Integrity

3.4.1. Phase 1 Strategy

In the ELAP scenario, pressure and temperature inside containment does not approach any containment integrity limits; therefore, no Phase 1 strategy is required to maintain containment integrity. (Reference 28)

3.4.2. Phase 2 Strategy

In the ELAP scenario, pressure and temperature inside containment does not approach any containment integrity limits; therefore, no Phase 2 strategy is required to maintain containment integrity. (Reference 28)

3.4.3. Phase 3 Strategy

PG&E has determined that restarting a containment fan cooler Unit (CFCU) is necessary to control containment heat-up over an extended time and ensure no challenge to containment integrity (Reference 28). In Phase 3 of the core cooling and heat removal strategy (Section 3.1.3), a core cooling loop is repowered using a 4160-V generator set and distribution center supplied by the NSRC. Restoration of this cooling loop provides cooling water and power to a CFCU which maintains long term containment temperature and pressure below allowable limits.

3.4.4. Systems, Structures and Components

The Phase 3 containment cooling strategy uses installed plant systems with no additional equipment connections.

The existing site equipment required to implement the Containment cooling options discussed above are components of safety-related systems and are both seismically qualified structures and are also protected from floods and extreme high and low temperatures.

3.4.5. Key Reactor Parameters

- Containment pressure
- Containment temperature

For all instruments listed above, the normal power source and long-term power source are the 125-VDC vital batteries.

Following the declaration of an ELAP, with limited expected RCS leakage, there is no significant heat source which might raise the temperature and pressure within the containment and challenge its integrity. However, containment pressure and temperature indications are used to determine the current and any changing conditions in the containment. As a result, pressure and temperature indication remain powered and available in all phases.

PG&E procedure FSG 007, Loss of Vital Instrumentation or Control Power, provides direction for reading this instrumentation locally, where applicable, using a portable instrument as required by NEI 12-06.

3.4.6. Thermal Hydraulic Analysis

An evaluation concluded that containment temperature and pressure will remain below containment design limits and that key parameter instruments subject to the containment environment will remain functional in Phases 1 and 2 (Reference 28). For Phases 1 and 2, no action beyond monitoring containment pressure is credited for FLEX in this configuration.

The Containment temperature will be procedurally monitored and, if necessary, the Containment temperature will be reduced in Phase 3 using the strategy discussed above to ensure that key Containment instruments will remain within their analyzed limits for equipment qualification.

Refer to section 3.15.1 for a discussion on procedures to maintain containment integrity during shutdown modes.

3.4.7. FLEX Pump and Water Supplies

3.4.7.1 Emergency Auxiliary Salt Water (EASW) Pump

The EASW pump is discussed in Section 3.1.10.3. The Phase 3 strategy of repowering a CFCU uses the EASW to supply Pacific Ocean water to the component cooling water heat exchanger which provides cooling water to the CFCU.

3.4.8. Electrical Analysis

One (1) of the three (3) Class 1E 4160 VAC buses is required in each Unit to repower a CFCU. The 4160 V equipment being supplied from the NSRC will provide adequate power to perform the Phase 3 containment cooling strategies.

The necessary components to implement containment cooling have been included in the calculations to support the sizing of the 4160 VAC generators being provided by the NSRC.

The NSRC is supplying 4160 VAC generator and distribution center sets to repower a single 4160-V bus which powers a CCW pump and a CFCU fan to support long term containment temperature and pressure control.

3.5. Characterization of External Hazards

PG&E has evaluated DCPP in accordance with NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide." The following applicable hazards have been identified:

- Seismic events
- External flooding
- Extreme heat
- Extreme cold

PG&E has determined the functional threats from each of these hazards and identified FLEX equipment that may be affected. The FLEX storage locations will provide the protection required from these hazards.

3.5.1. Seismic

Per NEI 12-06 (Reference 22), seismic hazards must be considered for all nuclear sites. DCPP Updated Final Safety Analysis Report (UFSAR) (Reference 1) includes the seismic criteria for three design basis earthquake spectra (design earthquake, double design earthquake, and the postulated 7.5M Hosgri). Additionally, the UFSAR provides a discussion of the earthquakes postulated for the DCPP site and the effects of these earthquakes in terms of maximum free-field ground motion accelerations and corresponding response spectra at the DCPP site, as well as additional information on the seismic characteristics of the DCPP site.

In addition to the NEI 12-06 guidance, NTTF Recommendation 2.1, Seismic, required that facilities re-evaluate the site's seismic hazard. Since potential effects from the new seismic analysis were unknown at the time of design, PG&E prudently applied increased seismic design criteria for the storage of FLEX equipment installed inside the power block facility and in the design of the FLEX storage facilities. The purpose of this increased seismic design criteria was to provide additional assurance that the FLEX equipment in storage, and the equipment permanently staged in the facilities would remain available after a BDB seismic event. The increased seismic criteria were provided by PG&E Geosciences, and consists of a general requirement for 1.25 times the worst case of the Newmark and Blume generated Hosgri ground response spectra at 5% damping (Reference 36). It is important to note that the increased seismic criteria is a conservative design requirement implemented voluntarily by PG&E. DCPP's Hosgri event envelopes the ASCE 7-10 seismic response spectra required per NEI 12-06.

The FLEX equipment has been evaluated to the above criteria to ensure that it will remain accessible and available after a BDB seismic event and that it will not become a target or source of a seismic interaction from other systems, structures or components.

The FLEX strategies developed for DCPP include documentation ensuring that FLEX equipment, any storage locations and deployment routes meet applicable seismic criteria.

3.5.2. External Flooding

The DCPP design basis addresses all of the external hazards that must be considered in accordance with NEI 12-06, which includes external flooding. Reference 22 indicates the maximum flood level for the DCPP site is so small that it cannot affect the plant and results in the majority of the site not being susceptible to external flooding. The one area of the DCPP site that may be exposed to external flooding from storm or tsunami is the intake structure and specifically the auxiliary saltwater (ASW) pump vaults housed in this structure. The potential for this area to be affected by a design basis event has been mitigated with watertight vaults and ventilation snorkels.

The installed plant equipment and connection points credited for mitigation of the BDBEE scenario are located in existing plant structures that have been evaluated for external flooding and found to not be susceptible. FLEX-credited portable equipment will be maintained in storage locations of the DCPP site considered dry and not susceptible to flooding. The LUHS is a part of the BDBEE event for FLEX and is mitigated by the use of EASW pumps. One EASW pump and associated equipment are provided for each Unit and stored in the FLEX Storage facilities on site. From these storage locations, two of the EASW pumps and the associated equipment will be deployed for FLEX Phase 3 mitigation in an area of the site potentially susceptible to storm and/or tsunami flooding events. As specified in NEI 12-06 storm flooding and/or recurring tsunamis following an ELAP event are not required to be assumed initial conditions. However, if the deployed pumps and equipment were damaged by storm or recurring tsunami flooding, there are two backup EASW pumps and associated equipment available as they are stored in locations not susceptible to flooding or tsunami.

PG&E has developing procedures and strategies for delivery of offsite FLEX equipment during Phase 3, which considers regional impacts from flooding.

In summary, DCPP is generally considered a dry site and flooding is not a hazard for FLEX equipment.

3.5.3. High Wind

As discussed in NEI 12-06, hurricanes are extremely uncommon on the west coast of the United States (U.S.) and are not considered to affect the DCPP site. When considering the applicability of tornadoes to specific sites, data from the NRC's latest tornado hazard study, NUREG/CR-4461, is used. Tornadoes with the capacity to do significant damage are generally considered to be those with winds above 130 mph. NEI 12-06, provides a map of the U.S. in 2° latitude/longitude blocks that shows the tornado wind speed expected to occur at a rate of 1-in-1 million chances per year. This clearly bounding assumption allows selection of plants with expected tornado wind speeds greater than 130 mph. All other plants are not required to address tornado hazards impacting FLEX deployment. In accordance with the NEI 12-06, DCPP is not susceptible to tornadoes that generate wind speeds of 130 mph or more.

In summary, based on the NEI 12-06 guidance, the DCPP site would not experience winds at or exceeding 130 mph from severe weather. Therefore, the hazard screened out.

3.5.4. Extreme Cold, Snow, and Ice

In accordance with NEI 12-06, all sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment. In accordance with the guidance in NEI 12-06, DCPP is considered susceptible to extreme cold temperatures, but not susceptible to significant ice or snow. As discussed in DCPP UFSAR, Section 1.2.1.3 and the temperature along the central coast may be as low as 24°F in the winter. Therefore, PG&E has considered the site minimum expected temperature of 24°F in the specifications, storage, and deployment requirements for FLEX equipment.

3.5.5. Extreme Heat

In accordance with NEI 12-06, all sites must address high temperatures. The DCPP UFSAR, Section 1.2.1.3 indicates that the extreme high temperature along the central coast may be as high as 104°F in the summer. Therefore, PG&E has considered the site maximum expected temperatures of 104°F in the specifications, storage, and deployment requirements for FLEX equipment.

3.6. Protection of FLEX Equipment

FLEX equipment is stored in the following on-site locations:

- Primary FLEX Storage Facility
- Secondary FLEX Storage Facility
- Auxiliary Building

The majority of portable equipment that is required to implement the FLEX strategies is stored at the Primary and Secondary FLEX Storage Facilities. Additional FLEX equipment is also stored at alternative locations within the Safety Related Units 1 & 2 Auxiliary Building (specifically the U-1 and U-2 ERCS Pumps and associated power supply cables, hoses, and fittings, as well as SFP hoses and spray nozzles). Additional details on each storage facility are provided below.

3.6.1. Primary and Secondary FLEX Storage Facilities

The Primary FLEX Storage Facility is located inside Building 113, commonly referred to as Warehouse B. This structural steel facility is located south of the main power block along the site's main access road, at an elevation of 150 ft.

The Primary FLEX Storage Facility was evaluated for the effects of local seismic ground motions consistent with ASCE 7-10 code requirements, as well as the increased seismic spectra (Hosgri + 25% as discussed in section 3.5.1) and found to have adequate structural margin to remain functional (i.e., collapse is not expected and access to the interior of the structure is retained).

The location of the facility was selected to preclude interaction with potential failures associated with seismically-induced failures of nearby structures or components, seismically-induced small landslide debris flow, and is not susceptible to flooding.

At the Primary FLEX Storage Facility, additional FLEX equipment is stored on custom designed steel equipment racks. The racks and concrete anchorage design conservatively utilized the increased seismic spectra (Hosgri + 25% as discussed in section 3.5.1).

The Secondary FLEX Storage Facility is a reinforced concrete pad located to the west of the 500KV switchyard, in an area previously designated as Parking Lot#10, at an elevation of 308'. The concrete slab is designed in accordance with ASCE 7-10 code requirements. Use of the increased seismic spectra (Hosgri + 25% as discussed in section 3.5.1) was not required for the design of the concrete pad; however, increased structural performance criteria were considered in the design of the slab (e.g. large differential settlements, sliding) to ensure equipment survivability. The location of the facility was selected to preclude interaction with potential failures associated with seismically-induced failures of nearby structures or components, seismically-induced small landslide debris flow, and is not susceptible to flooding.

Portable FLEX equipment designated for storage at the Primary and Secondary BDB Storage facilities has been analyzed for overturning and sliding in all directions, and tie-downs are provided. The concrete anchors and tie-down equipment (e.g. straps or chains) utilized for FLEX equipment storage was evaluated to withstand loading forces subject to seismic ground motion. The restraint system at these locations was conservatively designed to the increased seismic accelerations (Hosgri + 25% as discussed in section 3.5.1).

3.6.2. Other FLEX Equipment Storage Locations

Some FLEX equipment is permanently stored inside the power block in close proximity to the specified deployment location. A list of this equipment is included below:

- U-1 and U-2 FLEX ERCS pumps. These pumps are stored in their deployed location on the 100' elevation of the U-1 and U-2 safety related Auxiliary Building.
- U-1 and U-2 ERCS electrical power supply cables, hoses, fittings, and required tooling are staged in the FLEX Equipment Storage Rack. This rack is located in a hallway on the 115' elevation of the U-2 safety related Auxiliary Building.
- U-1 and U-2 SFP hoses, spray nozzles, and required tooling is stored in dedicated storage boxes, one adjacent to each units' spent fuel pool on the 140' elevation of the U-1 and U-2 safety related Fuel Handling Building.

All of the above items have been seismically evaluated and restrained to the increased seismic accelerations (Hosgri + 25% as discussed in section 3.5.1), and are in locations where they are not impacted by any non-seismically qualified equipment.

3.7. Planned Deployment of FLEX Equipment

PG&E has differentiated between the route from a storage location to its staging location, which is the "staging route," and the path from a staging location to the source and/or supply plant connections, which is the "deployment path." The staging routes will be followed to transport the FLEX equipment from the FLEX storage facilities to the required staging locations. The deployment paths will be followed to connect the FLEX equipment to the associated plant structures, systems, and components to allow the strategies to be implemented. The routes and paths applicable to the plant mode in which the plant is operating are maintained available in accordance with plant procedures.

Additionally, in order to implement the containment integrity strategy during shut-down modes, appropriate FLEX equipment is pre-staged inside the units during shutdown/refueling.

3.7.1. Staging Routes/Deployment Paths

Pre-determined, preferred staging routes and deployment paths have been identified and documented in the FSGs. Figures 1 and 2 show the deployment paths and staging locations for FLEX equipment from the primary and secondary FLEX storage facilities. These deployment paths have been evaluated for potential soil liquefaction, which determined that the FLEX staging routes and deployment paths are not subject to liquefaction hazards. Additionally the deployment paths minimize travel through areas with trees, power lines, narrow passages and other potential debris to the extent practical. However it is possible for debris from sources to interfere with planned deployment paths. Debris removal equipment stored on-site is protected from hazards such that the equipment remains functional and deployable to clear obstructions from the designated deployment paths between the FLEX storage facilities and associated staging locations.

The deployment of onsite FLEX equipment in Phase 2 requires that deployment paths between the FLEX Storage Facilities and various staging locations be clear of debris resulting from a BDBEE. The stored FLEX debris removal equipment includes front end loaders equipped with buckets and lifting forks to move or remove debris from deployment paths.

The planned deployment paths between the staging locations and the source and/or supply plant connections have been walked down and evaluated to determine the potential for availability at the time of deployment. Potential for seismic interaction, integrity of the structures, and potential for debris were all considered

Phase 3 of the FLEX strategies involves receipt of equipment from offsite sources including the NSRC and various commodities such as fuel and supplies/ Delivery of this equipment can be through airlift or via ground transportation. Debris removal for the pathway between the site and the NSRC receiving "Staging Areas" and from the various plant access routes may be required, however in this scenario, plans have been created to airlift equipment from the various pre-identified staging areas to the site.

3.7.2. Accessibility

The potential impairments to required access are: 1) doors and gates, and 2) site debris blocking personnel or equipment access. The coping strategy to maintain site accessibility through doors and gates is applicable to all phases of the FLEX coping strategies, but is essential as part of the immediate activities required during Phase 1.

Doors and gates serve a variety of barrier functions on the site. One primary function, security, is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and HELB. These doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following a BDB external event and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables through various barriers in order to connect portable FLEX equipment to station fluid and electric systems. For this reason, certain barriers (gates and doors) will be opened and remain open. This departure from normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies.

The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies. Security doors and gates that rely on electric power to operate opening and/or locking mechanisms are barriers of concern. The security force will initiate an access contingency upon loss of the security diesel and all AC/DC power as part of the Security Plan. Access to the owner controlled area, site protected area, and areas within the plant structures will be controlled under this access contingency as implemented by security personnel. Access authorization lists are prepared daily and copies are protected from the various BDBEE for use post-ELAP/LUHS event. Duplicate sets of FLEX and security keys are stored on site in a security controlled location.

Vehicle access to the protected area is via Gates 1 and 20 both gates have pop up barriers which can be controlled manually in the event of power loss to allow delivery of FLEX equipment (e.g., generators, pumps) and other vehicles such as debris removal equipment into the Protected Area.

For access into the two FLEX storage facilities multiple routes have been established using both physical keyed access and standalone electronic access which does not require offsite power to function. The primary FLEX storage facility has a battery operated lock which can also be accessed with a key that is stored in the control rooms. Both rollup doors can be operated manually in an ELAP. The secondary FLEX storage facility is an open pad protected from seismic and other external factors. As there are no doors to this Facility access is assured even in a BDBEE including an ELAP/LUHS.

3.8. Deployment Strategies

See the figures contained in section 6 for diagrams of the deployment routes, flowpaths, and equipment required for all strategies.

3.8.1. Core Cooling and Heat Removal Strategy

For Phase 2 the RWR provides adequate water resources for the suction of an EAFW pump in each Unit for core cooling and heat removal. The RWR volume is also used for Phase 2 makeup to the SFP in both Units. The RWR is seismically robust and will remain available for any of the external hazards listed in Section 3.5.

A single portable RWR pump, stored in the secondary FLEX storage facility, will be moved to a staging location at the RWR and placed in service. The RWR pump will take suction from one section of the RWR through non-collapsible hose and connection fittings to ensure that the suction hose does not collapse as the pump operates. The suction line is provided with dual filters (strainers) placed on the RWR end of the suction hose. A flexible hose will connect the RWR pump discharge to a discharge manifold, with outlet connections that allow the RWR pump discharge to be directed through three runs of flexible hoses and fittings, down the hillside east of the plant to the FLEX suction header located on the 115-ft bench area just east of the auxiliary building. The security fencing on the hillside between the RWR and the 115-ft bench area has been considered and provision provided to eliminate the obstacle during deployment of the strategy after a BDBEE.

The FLEX suction header is a portable header that has three inlet hose connections, each with a manual valve for isolation. The header also has a variety of outlet hose connections to supply the core cooling and heat removal and SFP cooling strategies for both Units, simultaneously. These outlet connections each have a manual isolation valve.

SG makeup to each unit is provided from portable diesel-driven, trailer-mounted EAFW pumps from the FLEX suction header. One EAFW pump for each unit and the FLEX suction header will be moved from a FLEX storage facility to the 115-ft bench area east of the auxiliary building. Flexible hoses will be routed from the FLEX suction header to each EAFW pump. Separate flexible hoses will be routed from the discharge of the EAFW pumps to the primary or alternate connection points in each unit.

Both the primary and alternative connection points are located within the Safety Related Auxiliary Building. The primary FLEX connection point is a dedicated tie in point located at elevation 100' on the motor driven AFW pump discharge crosstie line.

The alternate connection point is either one of two AFW check valves located at elevation 115' on the AFW supply lines. Only a single valve will be used, depending upon operator preference. The valve bonnet and internals would be removed and a modified valve cover, equipped with a hose connection, would be bolted in place.

3.8.2. RCS Makeup Strategy

The ERCS pumps are stored in the U-1 and U-2 Safety Related Auxiliary Building, and are protected against all external hazards described in Section 3.5.

The primary and alternate ERCS pump discharge connections are located inside of the Safety Related Auxiliary Building of each unit and provide a path to the RCS hot legs of that unit. Accordingly, these connections are protected against all BDB external hazards.

The primary supply connection from the BAST for the ERCS pump is located in the Safety Related Auxiliary Building of each unit. Accordingly, these connections are protected against all BDB hazards. When the volume of the BAST is exhausted, the supply of borated water is relocated to the RWST.

As a backup, a third trailer mounted ERCS makeup pump stored in a FLEX storage facility can be moved to a staging location on the 115-ft elevation of the auxiliary building near the BASTs. A flexible hose will be routed from the same connections on the BATP crosstie lines or the RWST drain to the suction connection on that pump. A flexible hose will also be routed from the pump discharge line to the same primary or alternate connection on the 100-ft elevation of the Auxiliary Building.

The unit specific ERCS make-up pumps are both powered by a single diesel-driven 480 VAC DG located outdoors at the 115-ft bench area, or alternatively on the 85-ft elevation on the west side of the turbine building central to Unit 1 and 2. The alternate location would be utilized if the 500kV lines have fallen on the 115-ft elevation, and grounding and removal of these lines cannot be accomplished in time to support deployment of this generator. Cables are run from the staged generator/distribution center to the staged location of the ERCS makeup pumps. The generator and load center for this function are stored in the FLEX Storage Facilities.

3.8.3. Spent Fuel Pool Cooling Strategy

The Maintain SFP Cooling strategy uses make-up water supplied from the RWR to make-up the boil off of the SFP. The RWR water is supplied to the FLEX suction header discussed in Section 3.1.2. There is significant head developed as a result of the location of the RWR on a hill east of the plant and the FLEX suction header located on the 115-ft bench area. This head ensures that adequate make-up is available without use of a pump to the SFPs in both Units, prior to the SFP level decreasing below 10 ft above the fuel. The head will provide a minimum of 250 gpm to each SFP. The required boiling make-up in each SFP is less than 90 gpm. NEI 12-06 guidance requires a flow of 250 gpm per Unit to drive the monitors which bounds the boiling make-up.

The primary distribution configuration is on the SFP deck, elevation 140-ft. For deployment of this distribution configuration, hose will be run from the portable FLEX suction header on the 115-ft bench into the Seismic Category 1 auxiliary building to the edge of the SFP at the 140 ft elevation. The discharge point of the hose will be secured to the handrail surrounding the SFP to control hose movement, and discharge directly into the SFP.

The spray distribution configuration is the same as the primary configuration, except with the addition of two portable spray monitors attached on the end of the discharge hose. Implementation of this configuration will require the SFP discharge hose to be split to supply both nozzles. The monitor nozzles will therefore be positioned on opposite sides of the pool in such a way to cover the surface area of the SFP with their spray pattern.

Spray monitors will be secured to the handrail using straps to counter the reaction force during operation. The nozzles will be adjusted to a non-oscillating fog setting, such that the surface area of the SFP (down to the elevation of the fuel) is covered by the spray.

Deployment of the hoses in the SFP area is procedurally directed in the FSGs to take place before water from the RWR is available, in order for hoses to be installed prior to potential environmental issues in the SFP area (i.e., potential high dose and heat issues after boiling is initiated).

3.8.4. Electrical Strategy

The 480 VAC diesel generators (DGs) and 480/208/120 VAC Load centers are stored in the FLEX storage facilities and are, therefore, protected from the BDB external hazards identified in Section 3.5

One (1) 480 VAC DG for both Units will be deployed to the west of the Unit 1 & 2 turbine building, centered about the two Units to power a battery charger in each Unit and selected critical communication equipment. The 480 VAC DG has one output circuit, which supplies a load center with six (6) 480V output breakers, and a 3-phase 208/120V distribution panel with breakers. Each circuit from the 480 VAC load center has a single FLEX designated output breaker, weatherproof cam lock type connectors, flexible and weatherproof cable with weatherproof connectors at both ends which connects to a receptacle panel located in the associated Unit's Bus H 480V switchgear room (to support battery charging) and one in the Unit 1 cable spreading room (to support communications equipment). The connecting cables for both Units are stored on the load center trailer and are, therefore, protected from the BDBEE hazards identified in Section 3.5

One (1) 480 VAC DG for both Units will be deployed to the east of the auxiliary building, centered about the two Units to power an ERCS Pump in each unit. The 480 VAC DG has one output circuit, which supplies a load center with six (6) 480V output breakers, and a 3-phase 208/120V distribution panel with breakers. Each circuit from the load center has a single FLEX designated output breaker, weatherproof cam lock type connectors, flexible and weatherproof cable with weatherproof connectors at both ends which connects to a receptacle panel on each Units' ERCS Pump skid, located in the associated Unit's hallway on the 100-ft elevation. The connecting cables for both Units are pre-staged in a rack in the Unit 2 auxiliary building, 115-ft elevation with additional cables on the load center trailer and are, therefore protected from the BDB external event hazards identified in Section 3.5.

The 480 VAC DGs each have a set of color coded cables which connect from the deployed generators to a receptacle panel located in the associated Unit's Bus H 480V Switchgear Room, the ERCS pump locations, and in the Unit 1 Auxiliary Building Cable Spreading Room. The color coded cables from each generator output circuit will be connected with proper phase rotation to the color coded mating receptacles in the receptacle panel located on the equipment. The FLEX validation process verified that all 480 VAC DG and load center combinations result in the same phase rotation for all FLEX loads.

Two (2) 480 VAC DGs and a load center are stored in the FLEX primary storage facility. In addition, two (2) backup 480 VAC DGs and a load center are stored in the FLEX secondary storage facility and are, therefore, protected from the BDBEE hazards identified in Section 3.5.

The NSRC will also provide a backup 480 VAC diesel-driven generator and associated load center, which is capable of interfacing with the required equipment.

To support Phase 3 strategies, the NSRC will provide a portable diesel-driven 4160 VAC generator set, of two generators, for each Unit, with the capability to supply 2 MW to each unit. Each 4160 VAC generator set will be used to repower one train of cooling in a Unit, which includes one CCW pump, one RHR pump, and any 480-V loads required to support repowering for that Unit. Each generator set will also repower one CFCU for maintaining the containment environment and one SFP pump for SFP cooling.

The Unit 1 generator set will be staged outside the north end of the turbine building. The Unit 2 generator set will be staged outside the south end of the turbine building. The NSRC provides enough cable with each generator set to connect to DCPP. Each circuit from the NSRC load center has a single FLEX designated output breaker, weatherproof cam lock type connectors, flexible and weatherproof cable with weatherproof connectors at both ends which connect to the output cables of the plants 4160 VAC DEG located in the associated Unit's 85' elevation Turbine Building. A connection fitting is required to be installed on the ends of the cable to connect to the tie-in point, and instructions are provided in the FSG for this purpose. Proper phase rotation of the generators is verified in the FSG by starting a non-essential fan prior to supplying power to the required loads.

3.8.5. Fueling of Equipment

The diesel powered FLEX equipment is stored in the fueled condition. Fuel tanks are typically sized to hold 16 hours of fuel. Once deployed during a BDB external event, trailer mounted fuel caddies will be used to refuel this equipment in the first 16 hours or sooner as required.

The primary source of diesel fuel for portable equipment is the two onsite safety-related, 50,000 gallon in ground EDG diesel fuel tanks. These tanks are seismically qualified and are protected from the BDB external hazards. Fuel can be obtained using a fuel pump and attaching the pump suction to a dedicated tie-in point in the Diesel Fuel Oil (DFO) pump supply lines in the DFO Pump Vault, and pumping the diesel fuel to suitable fuel containers for transport.

A diesel powered pump with hoses will take fuel from either underground tank and fill fuel caddies which are transported to the FLEX equipment to refuel and maintain this equipment operating. The diesel fuel oil transfer pump with transfer hoses is stored in the Unit 1 turbine building buttress area which is seismically robust. The diesel fuel caddies and a back-up diesel fuel oil transfer pump with transfer hoses are stored in the FLEX storage facilities.

Diesel fuel in the fuel oil storage tanks is routinely sampled and tested to assure fuel oil quality is maintained to ASTM standards. This sampling and testing surveillance program also assures the fuel oil quality is maintained for operation of the station EDGs. Portable equipment powered by diesel fuel is designed to use the same low sulfur diesel fuel oil as the installed EDGs.

The above fuel oil source will be used to fill the fuel caddies, which each have a capacity of approximately 100 gallons and a self-powered transfer pump. The fuel caddies will be deployed using the dedicated tow vehicles from the FLEX Storage Facilities to refill the diesel fuel tanks of FLEX equipment and to the diesel fuel oil tank location where it will be pumped full. Based on a fuel consumption study (Reference 44), a conservative combined fuel consumption rate was determined to be approximately 68 gal/hr. The fuel caddies have sufficient capacity to support continuous operation of the major FLEX equipment expected to be deployed and placed into service following a BDB external event. At this conservative fuel consumption rate, the two 50,000 gallon underground DFO Storage Tanks have adequate capacity to provide the onsite FLEX equipment with diesel fuel for > 45 days. The NSRC will also be able to provide diesel fuel for diesel operated equipment, thus providing additional margin.

The diesel fuel consumption information above does not include diesel fuel requirements for the portable 4160 VAC diesel generators (DGs) to be received from the NSRC and the EASW Pumps. Provisions for receipt of diesel fuel from offsite sources are in place to facilitate the Phase 3 re-powering strategy with the portable 4160 VAC DGs and use of the EASW pumps.

3.9. Offsite Resources

3.9.1. National SAFER Response Centers (NSRCs)

The industry established two NSRCs to support utilities during a BDBEE. Each NSRC holds five sets of equipment. Four of the sets are able to be fully deployed when requested. The fifth set will have equipment in a maintenance cycle. Equipment will be moved from an NSRC to a local assembly area, which has been identified by the strategic alliance for FLEX emergency response

(SAFER) team and DCPP. Per the EOP and FSG procedures, communications will be established between DCPP and the SAFER team and required equipment moved to the site as needed.

In the event of a BDB external event and subsequent ELAP/LUHS condition, equipment will be moved from an NSRC to a local assembly area established by the Strategic Alliance for FLEX Emergency Response (SAFER) team. From there, equipment can be taken to the Diablo Canyon site and staged at the SAFER onsite Staging Area "B" in an on-site parking lot by helicopter if ground transportation remains unavailable. First arriving equipment, as established during development of DCPP's Safer Response Plan (SRP), will be delivered to the site within 24 hours from the initial request. PG&E established contracts with the Pooled Equipment Inventory Company (PEICo, the NSRC vendor) to participate in the process for support of the NSRCs as required.

3.9.2. Equipment List

The equipment stored and maintained at the NSRC for the transportation to the local assembly area to support the response to a BDBEE at DCPP is listed in Table 2. Table 2 identifies the equipment that is specifically credited in the FLEX strategies for DCPP, but also lists the equipment that will be available for backup/replacement should onsite equipment be unavailable. Since all the equipment will be located at the local assembly area, the time needed for the replacement of a failed component will be minimal.

3.10. Equipment Operating Conditions

3.10.1. Ventilation

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

The key areas identified for all phases of execution of the FLEX strategy activities are the Control Room, Cable Spreading Room (CSR), Battery Rooms, Battery Charger/Inverter Rooms, Turbine Driven Auxiliary Feedwater (TDAFW) Pump Room, and the Spent Fuel Pool area of the Fuel Handling and Auxiliary Buildings. These areas have been evaluated to determine the temperature profiles following an ELAP/LUHS event, with the results of each area as described below.

An evaluation of the Control Room, Cable Spreading Room (CSR), Battery Rooms, and Battery Charger/Inverter Rooms concludes that opening various doors will maintain the room temperature below the manufacturer's recommended maximum temperatures, as well as limit heat build-up in the Control Room to acceptable levels (Reference 3). This door opening strategy is provided in ECA-0.0, *Loss of All AC Power,* and will be performed within 1.5 hours.

An evaluation of the TDAFW Pump rooms concluded that the elevated temperatures in these rooms will remain below the rated temperature limits for all equipment required to be operated in these rooms following an ELAP (Reference 51). Personnel entries into these rooms would only be for brief periods to pass through the high temperature area of the TDAFW pump rooms. Personnel would not be in the rooms for extended times or performing work in the rooms. The estimated time of exposure to the high temperatures is less than one minute, and would not impact the personnel's ability to implement the strategies. Therefore, no personnel protective measures are required for entry into the TDAFW pump rooms.

Additionally, two 120/240 VAC DGs, ventilation fans, and associated electrical connection cables are stored at the FLEX storage facilities to support area ventilation, if needed.

An evaluation of the heat build-up in the SFP area after an ELAP indicates that boiling starts at 13 hours after event initiation (Reference 5). Procedures require that doors in the fuel handling building area will be opened to support natural circulation and reduce development of an extreme environment on the 140-ft elevation of the SFP prior to this time. Additionally, the appropriate FSG directs the deployment of hoses in the areas affected by these elevated temperatures prior to this time.

An additional ventilation concern applicable to Phase 2 is the potential buildup of hydrogen in the battery rooms. Off-gassing of hydrogen from batteries is only a concern when the batteries are charging. An evaluation was performed that concludes that under both extreme high and low temperature conditions, with airflow only through the supply and exhaust vents in the rooms with no fans running, there is sufficient natural ventilation to maintain the battery rooms at a hydrogen concentration of less than 1 percent by volume with no operator action (Reference 52). This is conservative since the doors would be opened following an extended loss of alternating current power as discussed above, providing additional ventilation.

3.10.2. Heat Tracing

Major components for FLEX strategies are fully qualified to store and operate in the postulated minimum temperatures at the plant site and assure equipment reliability. Electrical equipment is provided with space heaters to minimize condensation buildup.

An evaluation of the Boric Acid systems relied upon in the Maintain Reactor Cooling System Inventory Control (section 3.2) was performed that concluded that at the low temperature conditions, the required systems will continue to function without the need for heat tracing (Reference 53).

3.11. Habitability

Habitability was evaluated as discussed in Section 3.10.1 in conjunction with equipment operability and determined to be acceptable.

3.12. Lighting and Electrical

Various areas of the plant including the control room are equipped with emergency backup lighting ("Appendix R Battery Operated Lights"), which is verified to be capable of illumination for at least 8 hours (References 13 and 14). Personal headlamps and flashlights are also staged in the Control Room, and additional battery powered light stands are provided in the FLEX Storage Facilities if needed.

For outdoor lighting, 120/240 VAC DG light towers will be deployed to provide light at the various FLEX staging and operating locations as required. These light towers are stored at the FLEX storage facilities.

3.13. Communications

A comprehensive BDB Communications plan has been developed for DCPP, which is implemented by an FSG. This FLEX Support Guideline provides instructions for the use of beyond design basis or FLEX designated communications equipment that is available for use during a BDBEE. This equipment includes portable communications trailers stored onsite at the FLEX Storage facilities and off site, satellite phones "footballs," hand held Iridium satellite phones, desktop phones, paging system and single and dual-band radios. This equipment is qualified to work in an ELAP or LUHS. Radios and satellite phones are stored and maintained in a variety of locations at DCPP, in order to ensure access to communications equipment during a BDBEE.

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

DCPP plant communications equipment is backed by a battery system for up to 24 hours. A 480 VAC DG will provide 480 VAC power to an installed transformer to energize the battery charger/inverter on this communications system to maintain this system indefinitely.

3.14. Water Sources

3.14.1. Water Sources – Secondary Side

Table 3 provides a list of potential water sources that may be used to provide cooling water to the SGs, their capacities, and an assessment of availability following the applicable hazards identified in Section 3.5. Descriptions of the preferred water usage sources identified in Table 3 are provided below and are in sequence in which they would be utilized, based on their availability after an ELAP/LUHS event. As noted in Table 3, at least three water sources would survive all applicable hazards for DCPP and are credited for use in FLEX strategies.

There are two seismically qualified water sources which have been evaluated for use in the SGs and credited for FLEX:

- The CST is a normal AFW water source during operation of the plant when the AFW is required.
- The FWST can be used as a backup to the CST.

There is one seismically robust water source: the RWR, which is the normal backup to the CST and is credited for FLEX and normal operation of the AFW system. The water quality of the RWR is maintained through scheduled drain downs and cleaning operations for each section separately. The make-up to the RWR is provided by an onsite Reverse Osmosis (RO) facility which limits contaminants.

The RWR is considered seismically robust because it was excavated in a stable rock terrace east of and above the DCPP and was evaluated for slope movements causing a slide into the RWR during a Hosgri earthquake, and overflow due to the effects of a seiche caused by ground displacement (Reference 47 and 48).

Use of the three sources would allow the Units to provide secondary side cooling for a minimum of 121 hours. The use of these three sources is not considered adverse to the SGs. For FLEX, use of the secondary for cooling is limited to the time required to restore a RCS cooling train which would eliminate the need for the secondary side cooling. Restoration of a train of RCS cooling will be complete prior to the limit of the secondary water supply.

If required and available, use of the potentially available onsite non-seismically robust clean water, such as the primary water storage tank and the condenser hotwell, are limited only by their quantities (i.e. not chemistry). DCPP has a long term cooling strategy which was licensed with the plant and evaluated the use and access to various potential onsite sources including the ones in Table 3 for use in the secondary. This evaluation included the use of the Pacific Ocean directly. Per that evaluation the NSSS supplier does not recommend use of ocean water directly in the SGs as it will cause degradation of the tubes over time. However, if required the ocean is available as an indefinite source and onsite equipment and issued procedures can provide for its use.

3.14.2. Water Sources - Primary Side

Table 3 also includes the two credited sources for borated water available onsite: the RWSTs (one per Unit) and the BASTs (two per Unit). Both of these sources are safety-related and seismically qualified and protected from the BDB external hazards discussed in Section 3.5.

3.14.3. Water Sources - Spent Fuel Pool (SFP)

At DCPP, any water source available is acceptable for use as makeup to the SFP; however, the primary source would be from the RWR via the RWR Pump. Water quality is not a significant concern for makeup to the SFP. Likewise, boration is not a concern since boron is not being removed from the SFP when boiling.

3.15. Shutdown and Refueling Modes Analysis

DCPP is abiding by the NEI position paper entitled "Shutdown/Refueling Modes," Dated September 18, 2013, addressing mitigation strategies in shutdown and refueling modes Ref 29. This position paper has been endorsed by the NRC.

The maintain core cooling and heat removal strategies in section 3.1 are effective as long as the RCS is intact and the steam generators are available. The window between the loss of natural circulation availability (when steam generators are isolated and a vent path is open in the RCS) and when the refueling cavity is flooded is considered in the mode 5 and 6 core cooling strategy development. During this window the reactor coolant loops are isolated and the RCS has a vent path established.

Should an event occur in this window, the immediate response to the loss of shutdown cooling is to remove air from containment and initiate gravity to the RCS from the RWST. RCS gravity refill from the RWST is expected to be sufficient to maintain cooling until the portable EAFW pump can be placed into service to provide forced injection of borated water.

3.15.1. Heat Removal During Shutdown and Refueling Modes

For core cooling with SGs not available the initial strategy for heat removal will be through boiling the water in the reactor vessel with an available vent path. The lowest allowed level in the RCS, when SGs are not available to provide core cooling, is not more than 1 ft below the vessel flange during the removal of the reactor vessel head. The strategy will initially rely on gravity feed to the RCS from the RWST, if necessary, using current plant procedures (Reference 8).

Prior to the loss of gravity feed, injection of borated water from either Unit's RWST to the reactor using the EAFW pumps through flexible hoses connected to permanent plant systems at installed tie-in points will be established (reference figures 1 to 15 for deployment routes and tie-in locations). This configuration provides an extended period that is adequate to ensure that repowering of a cooling RHR train will be completed and eliminate the requirement for injection.

In addition, supplemental non-seismic onsite water sources could be used, if available, including the condenser hotwells, primary water storage tank, and ocean water to further extend the period.

3.15.2. Containment Closure and Alternative Cooling

An ELAP event will result in a loss of RHR and the Operations staff will be directed to establish containment closure. This activity directs the evacuation of the containment and the closure of all open containment penetrations including the personnel access hatch and the equipment access hatch. In an ELAP the containment ventilation system is also not operating. The Modes 5 and 6 core cooling strategy will cause water/steam to "spill" into containment causing the containment pressure to slowly increase. In order to maintain the containment within its design pressure limits, a vent path is necessary and will be procedurally required to be established following an ELAP event while in Modes 5 or 6.

FSG 12 has been issued to provide guidance on using an existing containment penetration as the vent path to adequately reduce the pressure and maintain containment integrity. As a part of outage preparation, the procedures provide direction to pre-stage the equipment to modify a penetration flange arrangement external to the containment and to remove the internal penetration flange arrangement prior to the plant going below Mode 4. The external flange bolting arrangement will be modified to allow the flange to be loosened to the point that will allow the adequate venting. To ensure that an operator can perform this task without harm, the procedures require the pre-staging of steam suits in the proximity of the action to be undertaken.

This vent path has been confirmed by analysis to be adequate for stopping containment pressurization and maintaining the pressure well below the design limit on the containment, as well as maintaining pressure low enough to not impact the ability of the gravity feed of supply water from the RWST.

3.15.3. Spent Fuel Pool

For the maximum design heat load with a full core offloaded into the SFP at the time of the event, and considering the results of the sloshing evaluation, boiling in the SFP will occur at approximately 6 hours. The time when boil off decreases the water level to 10 ft above the fuel is approximately 30 hours (References 5 and 6). Ten feet of water above the top of the fuel provides adequate radiation shielding for a person standing on the SFP operating deck.

Since one unit will be in the "no mode" condition during a refueling outage, resources that would normally be allocated to implement FLEX coping strategies in that unit for normal power operations (as described in the Maintain Core Cooling and Heat Removal and the Maintain Reactor Coolant System (RCS) Inventory Control FLEX strategies) can instead be utilized to install temporary hoses to provide cooling to the SFP within the required timeframe. In addition, the number of personnel available on site will be increased as a result of the refueling outage that would accompany this scenario.

3.16. Sequence of Events

Table 4 presents a Sequence of Events (SOE) Timeline for an ELAP/LUHS event at DCPP. Validation of each of the FLEX time constraint actions has been completed in accordance with the FLEX validation process outlined in NEI 12-06 Revision 2 and includes consideration for staffing. Time to clear debris to allow equipment deployment has been evaluated and is within the required time constraints in Table 4. Debris removal equipment is stored at the FLEX Storage Facilities or at an evaluated location protected from the external hazards.

3.17. Programmatic Elements

3.17.1. Overall Program Documents

DCPP administrative procedures and engineering documents provide a description of the Diverse and Flexible Coping Strategies (FLEX) Program for DCPP. The key elements of the program include:

- Maintenance of the FSGs including any impacts on the interfacing procedures (EOPs, APs, etc.)
- Maintenance and testing of FLEX equipment (i.e., portable FLEX equipment, FLEX support equipment, SFP level instrumentation, emergency communications equipment, and FLEX support vehicles)
- Validation of time sensitive operator actions
- The FLEX Storage Facilities and the National SAFER Response Center
- Hazards considerations (Flooding, Seismic, High Winds, etc.)
- Supporting evaluations, calculations and BDB drawings
- Tracking of equipment unavailability
- Staffing, Training, and Revalidations of Strategies
- Configuration Management
- Program Maintenance

In addition, the program description references:

- A list of the FLEX basis documents that will be kept up to date for facility and procedure changes,
- A historical record of previous strategies and their bases, and the basis for ongoing maintenance and testing activities for the FLEX equipment.

Existing design control procedures have been revised to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

Future changes to the FLEX strategies may be made without prior NRC approval provided:

1) The revised FLEX strategies meet the requirements of NEI 12-06 Revision 2, and
2) an engineering basis is documented that ensures that the change in FLEX strategies continues to ensures that the change in FLEX strategies continues to ensure the key safety functions (containment, core and SFP cooling) are met.

3.17.2. Procedural Guidance:

The inability to predict actual plant conditions that require the use of FLEX equipment makes it impossible to provide specific procedural guidance. As such, the FSGs provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs ensures that FLEX strategies are used only as directed for BDB external event conditions, and are not used inappropriately in lieu of existing procedures. When FLEX equipment is needed to supplement EOPs or Abnormal Procedures (APs) strategies, the EOP or AP directs the entry into and exit from the appropriate FSG procedure.

FLEX support guidelines have been developed in accordance with Pressurized Water Reactor Owner's Group (PWROG) guidelines, and site specific FSGs have been developed to provide additional guidance as required. The FSGs provide instructions for implementing available, pre-planned FLEX strategies to accomplish specific tasks in the EOPs or APs. FSGs are used to supplement (not replace) the existing procedure structure that establishes command and control for the event.

Procedural Interfaces have been incorporated into both units' EOP ECA-0.0, *Loss of All AC Power,* to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, procedural interfaces have been incorporated into the following APs to include appropriate reference to FSGs:

- OP AP-11 “Malfunction of Component Cooling Water System” was revised to point to FSG 51 “Placing Emergency ASW Pumps in Service.”
- OP AP-22 “Spent Fuel Pool Abnormalities” was revised to point to FSG 11 “Alternate SFP Makeup and Cooling.”
- OP AP-23 “Loss of Vital DC Bus” was revised to point to FSG 04 “ELAP DC Bus Load Shed and Management” for ELAP response.
- OP AP SD-1 “Loss of AC Power” (Shutdown AP) was revised to point to FSG 05 “Initial Assessment and FLEX Equipment Staging” to enter the FSG network for an ELAP response during modes 5 or 6.

- OP AP SD-4 "Loss of Component Cooling Water" (Shutdown AP) was revised to point to FSG 51 "Placing Emergency ASW Pumps in Service."

Additionally, other plant procedures have been revised as a result of FSG development:

- OP L-6 "Cold Shutdown/Refueling" was revised to ensure preparations are completed during a plant transition to MODE 5 and 6 to support shutdown FSG-12 "Alternate Containment Cooling" prerequisites.
- Surveillance Test Procedure STP I-1C "Routine Weekly Checks Required by Licenses" and OP F-3 "Raw Water System" series normal operating procedures were revised to ensure water inventory requirements are maintained to support FLEX assumptions.
- Extreme Damage Mitigation Guideline EDMG EDG-15 "Emergency ASW Pumps - Place in Service" was rescinded in favor of FSG 51 "Placing Emergency ASW Pumps in Service" for operating new FLEX EASW equipment which replaced that previously utilized for B.5.b compliance.
- OP K-9 "Instructions for Operation of the DCPP Radio System" was revised to remove instructions for operating Beyond Design Basis Communications equipment in favor of FSG 47 "Operation of FLEX Communications Equipment."

FSG maintenance is performed in accordance with the DCPP administrative procedure control process.

FSGs have been reviewed and validated by the involved groups to the extent necessary to ensure that implementation of the associated FLEX strategy is feasible. Specific FSG validation was accomplished via table top evaluations and walk-throughs of the guidelines when appropriate.

3.17.3. Staffing:

To support time-sensitive FLEX actions, staffing is assumed to be consistent with NEI 12-06, Section 11.7. Required staffing levels have been verified by walkthroughs, tabletops, and simulations of the identified FLEX strategies as a part of the Phase 2 staffing studies conducted in accordance with NEI 12-01 (PG&E Letter DCL-12-048, 60-Day Response to NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident" (Reference 2)

Using the methodology of (Nuclear Energy Institute) NEI 12-01, *Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities* (Reference 42), an assessment of the capability of DCPP on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDB external event was performed. The results were provided to the NRC in a letter dated October 28, 2015 (Reference 43).

The assessment assumptions were based on the guidance provided in NEI 12-01, which were:

1. A large-scale external event occurs that results in:
    - all onsite units affected
    - extended loss of AC power
    - impeded access to the units
2. Initially, all onsite reactors are operating at full power and are successfully shut down.
3. A hostile action directed at the affected site does not occur during the period that the site is responding to the event.
4. The event impedes site access as follows:
    a) Post event time: 6 hours- No site access.
    b) Post event time: 6 to 24 hours- Limited site access. Individuals may access the site by walking, personal vehicle, or via alternate transportation resources that are available to deliver equipment, supplies, and large numbers of personnel.
    c) Post event time: Greater than 24 hours- Improved site access. Site access is restored to a near-normal status and/or augmented transportation resources are available to deliver equipment, supplies, and large numbers of personnel.
5. On-shift personnel are limited to the minimum complement allowed by the site E-Plan (i.e., the minimum required number for each required position). This would typically be the on-shift complement present during a backshift, weekend, or holiday.

The task analysis was conducted on April 1, 2015, using a tabletop procedural analysis with DCPP subject matter experts and an outside consultant. Current DCPP procedures, EOPs, and FSGs were utilized to determine if tasks had been sufficiently analyzed for performance by the minimum on-shift staff. The participants reviewed the assumptions and applied existing procedural guidance, including applicable FSGs for coping with a BDB external event using minimum on-shift staffing. Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and time motion analyses of NEI 10-05, *Assessment of On-Shift Emergency Response Organization Staffing and Capabilities* (Reference 45). The staffing analysis concluded that there were no task overlaps for the activities that were assigned to the on-shift personnel.

The expanded ERO assessment concluded that sufficient augmenting ERO resources exist to fill the expanded ERO functions. Thus, the ability of the responding ERO members to implement Transition Phase coping strategies performed after the end of the "no site access" 6-hour time period had been assessed and determined to be adequate.

The staffing assessments noted above were performed in conjunction with the development of procedures and guidelines that address NRC Order EA-12-049. Once the FSGs were developed, a validation assessment of the FSGs was performed using communication equipment determined available post-BOB external event and the staff deemed available per the staffing studies. The validation process was performed and documented in accordance with NEI Guidance (Reference 46).

3.17.4. Training:

DCPP's Training Program has been revised to assure personnel proficiency in utilizing FSGs and associated FLEX equipment for the mitigation of BDB external events is adequate and maintained. These programs and controls were developed and have been implemented in accordance with the Systematic Approach to Training (SAT) Process. Initial training has been provided and periodic training will be provided to site emergency response leaders on FLEX emergency response strategies and implementing guidelines. Personnel assigned to direct the execution of the FLEX mitigation strategies for BDB external events have received the necessary training to ensure familiarity with the associated tasks, considering available job aids, instructions, and mitigation strategy time constraints.

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

In accordance with NEI 12-06, ANSI/ANS 3.5, *Nuclear Power Plant Simulators for use in Operator Training* (Reference 29), certification of simulator fidelity is considered to be sufficient for the initial stages of the BDB external event scenario until the current capability of the simulator model is exceeded. Full scope simulator models will not be upgraded to accommodate FLEX training or drills.

When required by regulations, integrated FLEX drills will be organized on a team or crew basis and conducted periodically. All time-sensitive actions will be evaluated over a period of not more than eight years. It is not required to connect/operate equipment during these drills.

3.17.5. Equipment List:

The equipment stored and maintained at the DCPP FLEX Storage Facilities necessary for the implementation of the FLEX Strategies in response to a BDBEE is listed in Table 1. Table 1 identifies the quantities, applicable strategy and other important information for the major FLEX equipment components only. It does not specify details regarding fittings, tools, hose lengths, consumable supplies etc.

3.17.6. N+1 Equipment Requirement

NEI 12-06 Revision 2 invokes an N+1 requirement for the major FLEX equipment that directly performs a FLEX mitigation strategy for core cooling, containment, or SFP cooling in order to assure reliability and availability of the FLEX equipment required to meet the FLEX strategies. Sufficient equipment has been purchased to address all functions at all Units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of equipment required by FLEX strategies for all Units on-site. Therefore, where a single resource is sized to support the required function of both Units a second resource has been purchased to meet the +1 capability. In addition, where multiple strategies to accomplish a function have been developed, (e.g., two separate means to repower instrumentation) the equipment associated with each strategy does not require N+1 capability.

The N+1 capability applies to the portable FLEX equipment that directly supports maintenance of the key safety functions identified in Table 3-2 of NEI 12-06. Other FLEX support equipment provided for mitigation of BDB external events, but not directly supporting a credited FLEX strategy, is not required to have N+ 1 capability.

In the case of hoses and cables associated with FLEX equipment required for FLEX strategies, an alternate approach to meet the N+1 capability has been selected, in accordance with Method 1 of NEI 12-06, Revision 2. These hoses and cables are passive components being stored in a protected facility. It is postulated the most probable cause for degradation/damage of these components would occur during deployment of the equipment. Therefore the +1 capability is accomplished by having sufficient hoses and cables to satisfy the N capability +10% spares or at least 1 length of hose and cable. This 10% margin capability ensures that failure of any one of these passive components would not prevent the successful deployment of a FLEX strategy.

The N+1 requirement does not apply to the FLEX support equipment, vehicles, and tools. However, these items are covered by an administrative procedure and are subject to inventory checks, requirements, and any maintenance and testing that are needed to ensure they can perform their required functions.

3.17.7. Equipment Maintenance and Testing

Initial Component Level Testing, consisting of Factory Acceptance Testing and Site Acceptance Testing, was conducted to ensure the portable FLEX equipment can perform its required FLEX strategy design functions. Factory Acceptance Testing verified that the portable equipment performance conformed to the manufacturers rating for the equipment as specified in the Purchase Order. Verification of the vendor test documentation was performed as part of the receipt inspection process for each of the affected pieces of equipment and included in the applicable Vendor Technical Manuals. Site Acceptance Testing confirmed Factory Acceptance Testing to ensure portable FLEX equipment delivered to the site performed in accordance with the FLEX strategy functional design requirements.

The portable FLEX equipment that directly performs a FLEX mitigation strategy for the core cooling, containment, or SFP cooling strategies is subject to periodic maintenance and testing in accordance with NEI 12-06 rev 2 (Reference 22) and INPO AP 913, *Equipment Reliability Process,* (Reference 23), to verify proper function. Additional FLEX support equipment that requires maintenance and testing will have Preventive Maintenance to ensure it will perform its required functions during a BDB external event.

EPRI has completed and has issued *Preventive Maintenance Basis for FLEX Equipment - Project Overview Report* (Reference 24). Preventative Maintenance Templates for the major FLEX equipment including the portable diesel pumps and generators have also been issued.

The PM Templates include activities such as:

- Periodic Static Inspections - Monthly walkdown
- Fluid analysis - Annually
- Periodic operational verifications
- Periodic performance tests

Preventive maintenance (PM) procedures and test procedures are based on the templates contained within the EPRI Preventive Maintenance Basis Database, or from manufacturer provided information/recommendations when templates were not available from EPRI. The corresponding maintenance strategies were developed and documented. The performance of the PMs and test procedures are controlled through the site work order process. FLEX support equipment not falling under the scope of INPO AP 913 is maintained as necessary to ensure continued reliability. Performance verification testing of FLEX equipment is scheduled and performed as part of the DCPP PM process.

An administrative procedure was established to ensure the unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy for core cooling, containment, and SFP cooling is managed such that risk to mitigation strategy capability is minimized. Maintenance/risk guidance conforms to the guidance of NEI 12-06 rev 2 as follows:

- Portable FLEX equipment may be unavailable for 90 days provided that the site FLEX capability (N) is available.
- Portable FLEX equipment may be unavailable for 45 days provided that the site FLEX capability (N) is available but not fully protected.
- If portable equipment becomes unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., use of alternate suitable equipment or supplemental personnel) within 72 hours.

4. References

(1) Diablo Canyon Power Plant Updated Final Safety Analysis Report, Revision 22

(2) PG&E Letter DCL-12-048, "60-Day Response to NRC Letter, 'Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident,' dated March 12, 2012," dated May 9, 2012

(3) PG&E Calculation STA-295, Battery Charger / Inverter Room and Control Room Heat up Evaluation due to loss of HVAC as a result of loss of complete AC power, Revision 2, DCA 9000041455-002-01

(4) PG&E Calculation FLEX-009, "Westinghouse Calculation CN-PEUS-12-10, Diablo Canyon FLEX Battery Coping Analysis," Revision 5, DCA 9000041622-000-00

(5) PG&E Calculation RE-20130204, SFP Sloshing Impact on Heat Up Time Estimates, Revision 0, DCA 9000041639-000-00

(6) PG&E SAPN 50539719: Extension of RE-20130204 Analysis

(7) PG&E Calculation RE-20111111, Coping Time Estimates for IER L1-11-4 Item 1, Revision 5, DCA 9000041892-001-00.

(8) OP AP SD-0, Loss of, or Inadequate Decay Heat Removal, Revision 12

(9) EOP ECA-0.0 Unit 1, Loss of All Vital AC Power, Revision 31

(10) EOP ECA-0.0 Unit 2, Loss of All Vital AC Power, Revision 24

(11) Calculation FLEX-005, Determine Time Requirements to Isolate Raw Water Reservoir, Revision 0, DCA 9000041634-000-00

(12) PG&E Calculation FLEX-002, "Westinghouse Calculation CN-FSE-13-2-Redacted, Boration Calculation," Revision 0, DCA 9000041627-000-00

(13) PG&E Calculation 335-DC, Emergency Lighting and Communications – System 68, Revision 1013, DCA 9000032684-010-00

(14) MP E-67.5A, Testing and Maintenance of Battery Operated Lights Inside Power Block, Revision 35

(15) PG&E Calculation STA-294, Fukushima Emergency Pump Sizing, Revision 4, DCA 9000041413-001-00

(16) PG&E Calculation STA-286, Alternate ASW Pump, Revision 2, DCA 9000041291-002-00

(17) Diablo Canyon Power Plant Emergency Plan, Revision 4

(18) OP D-1:V Unit 1, Auxiliary Feedwater System – Alternative Auxiliary Feedwater Supplies, Revision 22

(19) OP D-1:V Unit 2, Auxiliary Feedwater System – Alternate Auxiliary Feedwater Supplies, Revision 20

(20) PG&E SAPN 50618989: FLEX Borated Water Usage Time: Update

(21) Westinghouse Letter LTR-FSE-14-55, "Assessment of Diablo Canyon Unit 1 and Unit 2 (PGE/PEG) Reactor Coolant System (RCS) Inventory and Shutdown Margin Analyses to Support the Diverse and Flexible Coping Strategy (FLEX) in Support of Setpoint Change," dated July 10, 2014

(22) NEI 12-06 Diverse and Flexible Coping Strategies (FLEX) Implementation Guide Revision 2 December 2015

(23) INPO AP 913 Equipment Reliability Process Description, Institute of Nuclear Power Operations

(24) EPRI Preventive Maintenance Basis for FLEX Equipment - Project Overview Report EPRI Report 30020000623

(25) Calculation FLEX-015, Diablo Canyon FLEX Battery 11 and 21 Coping Analysis, Rev 0, DCA 9000041771-000-00.

(26) OP AP SD-1, Loss of AC Power, Revision 21

(27) Calculation M-1182, Diesel Fuel Oil Consumption During FLEX Phase 2, Revision0

(28) Calculation FLEX-011, Diablo Canyon ELAP Containment Environment Analysis, Revision 0, DCA 9000041684-000-00.

(29) NEI Position Paper, "Shutdown/Refueling Modes", September 18, 2013, ADAMS ACCESSION ML13273A514.

(30) NEI LTR-12-0081 "Industry initiative on procurement of equipment for the diverse and flexible coping strategy (FLEX) 2/24/2012

(31) PG&E Calculation M-1095, Plenum Requirements for Condensate Storage Tanks, Revision 0

(32) Engineering Controlled Guidelines (ECG) 18.1 Fire Suppression Systems/Fire Suppression Water Systems.

(33) PWROG PA-PSC-0965-PWROG Generic FLEX Support Guidelines and Interfaces, Revision 0, Dated December 2012, Guidance Supplement 14, PWROG ELAP Instrumentation Recommendations.

(34) FLEX Diesel Generator Sizing, DCA 9000041641

(35) PGE-073-C-1, DCPP U1/U2 Spent Fuel Pool and Raw Water Reservoir Seismic Sloshing and Water Loss

(36) PG&E Calculation FLEX-016, DCA 9000041781

(37) PG&E Calculation DCA 9000041579-000-00, DCPP Bounding Response Spectrum for Use for FLEX Equipment

(38) PG&E SAPN 50800456: FLEX Update boration calculation each cycle

(39) "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Boron Mixing in Support of the Pressurized Water Reactor Owners Group (PWROG)," dated August 16, 2013 (ML13235A135)

(40) Letter to Mr. J. Stringfellow (Westinghouse) from Mr. J. R. Davis (NRC) dated January 8, 2014 endorsing the Westinghouse Position Paper on Boron Mixing (ML 13276A183)

(41) NRC Order EA-12-051, "Reliable Spent Fuel Pool Level Instrumentation"

(42) NEI 12-01 "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities." May 2012

(43) DCL-15-117 Letter dated October 28, 2015

(44) PG&E Calculation M-1182 (SAP 9000041544), "Diesel Fuel Oil Consumption During FLEX Phase 2." August 10, 2015

(45) NEI 10-05, "Assessment of On-Shift Emergency Response Organization Staffing and Capabilities." June 2011

(46) NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements of Mitigation Strategies for Beyond-Design-Basis External Events."

(47) Supplemental Safety Evaluation Report (SSER) No. 5, September 1976

(48) Supplemental Safety Evaluation Report (SSER) No. 8, November 1978

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

(50) WCAP-16800-NP, Revision 0, "Insights for Operating Steam Generators to Minimize RCS Inventory Loss Following a Loss of All AC and DC Power (PA-OSC-0356)," dated November 2007.

(51) PG&E Calculation M-0912, "Fire Protection (Appendix R); Station Blackout (10 CFR 50.63)," Revision 6, DCA 9000039758.

(52) PG&E calculation HVAC 83-46, "Battery Rooms Exhaust During a LOOP and/or Loss of Class II Ventilation System", Revision 5, DCA 9000017980.

(53) PG&E SAPN 50619822: FLEX Auxiliary Building Heat Loss Evaluation

5. Tables

Table 1: DCPP Portable Equipment Stored Onsite

List of portable equipment	Use and (potential / flexibility) diverse uses						Performance Criteria
	Core Cooling	Containment	RCS Makeup	SFP	Instrumentation	Accessibility	
Three EAFW diesel-driven pumps, and associated hoses and fittings.	X						300 gpm at 245 psid (Reference 15)
Three ERCS electric make-up pumps, and associated hoses and fittings.			X				30 gpm at 1500 psig (Reference 12)
Four EASW diesel-driven pumps, and associated piping and fittings.	X	X		X			3000 gpm at 140-ft head (Reference 16)
Two RWR diesel-driven pumps, and associated headers, hoses, and fittings	X			X			1200 gpm at 150 psid (Reference 15)
Three ASW vacuum breaker vault dewatering pumps, and associated hoses						X	150 gpm
Two 480 VAC diesel-driven generators, and associated cables and connectors and switchgear (for repowering battery chargers and telecommunications equipment)					X		275 kW

Table 1: DCPP Portable Equipment Stored Onsite

List of portable equipment	Use and (potential / flexibility) diverse uses						Performance Criteria
	Core Cooling	Containment	RCS Makeup	SFP	Instrumentation	Accessibility	
Two 480 VAC diesel-driven generators, and associated cables and connectors and switchgear (for powering the ERCS make-up pumps)			X				150 kW
Two 120/240 VAC diesel-driven generators, and associated cables and fittings						X	6.5 kW
Two 120/240-V diesel-driven generators, and associated cables and fittings						X	20 kW
Ten diesel-driven generators with lighting masts						X	5.2 kW

Table 2: Portable Equipment From NSRC

List Portable Equipment	Quantity Req'd /Unit	Quantity Provided/ Unit	Power	Use and (potential/Flexibility) Diverse Uses					Performance Criteria		Notes
				Core Cooling	Cont. Cooling/Integrity	Access	Instrumentation	RCS Inventory			
Medium Voltage Generators	2	2	Jet Turbine	X	X		X		4160 VAC	1 MW	(1)
Low Voltage Generators	0	1	Jet Turbine				X	X	480 VAC	1100 KW	(2)
High Pressure Injection Pump	0	1	Diesel					X	3000 PSIG	60 GPM	(2)
SG/RPV Makeup Pump	0	1	Diesel	X				X	500 PSID	500 GPM	(2)
Low Pressure/ Medium Flow Pump	0	1	Diesel	X					300 psid	2500 GPM	(2)
Low Pressure/ High Flow Pump	0	1	Diesel	X	X				150 psid	5000 GPM	(2)
Lighting Towers	0	1	Diesel			X				440,000 Lu	(2)
Diesel Fuel Transfer	0	1/1	N/A	X	X	X	X	X		264 Gal 500 Gal	(2)

Notes:

(1) - NSRC 4160 VAC generator supplied in support of Phase 3 for core cooling, containment cooling, and instrumentation FLEX strategies.

(2) - NSRC Generic Equipment - Not required for FLEX strategy- Provided as Defense-in-Depth.

Table 3 - Water Sources

Water Source	Usable Volume (Gallons)	Applicable Hazard					Time Based On Decay Heat	Cumulative Time Based on Decay Heat
		Satisfies Seismic	Satisfies Flooding	Satisfies High Winds	Satisfies Low Temp	Satisfies High Temp		
CST (qty. 2)	222,600 (1)	Yes	Yes	Yes	Yes	Yes	27.4 (3)	
FWST	247,815 (2, 3)	Yes	Yes	Yes	Yes	Yes	12.5 (3)	39.9 (3)
RWR	1.5 million (2)	Yes	Yes	Yes	Yes	Yes	84 (3)	123.9 (3)
Pacific Ocean	Indefinite	Yes	Yes	Yes	Yes	Yes	Indefinitely	Indefinitely
Other Water Sources								
Condenser Hotwells	141,232(4,6)	No	Yes	Yes	Yes	Yes	N/A	N/A
Primary Water Storage Tank	200,000(5,6)	No	Yes	Yes	Yes	Yes	N/A	N/A

(1) CST total usable volume (per unit)
(2) Usable volume (for both units)
(3) See Reference 7 for details
(4) Total condensate stored at maximum operating level
(5) Total Capacity
(6) Usable volume unknown post event

Table 4: Sequence of Events Timeline

Action Item	Action	Estimated Start Time[(a)]	Duration	Time Constraint Y/N	Time Constraint Finish (Hours)	Margin	Note
	Event Starts	0	N/A	N	N/A		Plant at 100% Power
1	Verify reactor and turbine trip	N/A	N/A	N	N/A		
2	Isolate RCS	N/A	N/A	N	N/A		
3	Verify AFW status	N/A	N/A	N	N/A		
4	Start generators from control room / fail	N/A	N/A	N	N/A		
5	Manually start generators / fail	N/A	N/A	N	N/A		
6	Manually restore offsite power / fail	N/A	N/A	N	N/A		
7	Verify SGs isolated	N/A	N/A	N	N/A		
8	Verify cooldown and depressurization in progress	N/A	N/A	N	N/A		
9	Isolate containment	N/A	N/A	N	N/A		
10	Establish offsite and onsite communications	N/A	N/A	N	N/A		

Action Item	Action	Estimated Start Time[(a)]	Duration	Time Constraint Y/N	Time Constraint Finish (Hours)	Margin	Note
11	Declare ELAP	34mins	1 min	Y	1	25 mins	ELAP entry conditions can be verified by control room staff and it is assumed that EDGs are not available. Procedure EOP.ECA 0.0 provides guidance to operators to perform ELAP actions, Action Items 1 through 9, when ELAP entry conditions are met.
12	Control room portable lighting	N/A	5 hours	N	N/A	N/A	Installed emergency battery powered and personal lighting is available in the control room for 8 hours, after which portable battery powered lighting will be used.
13	Assistance requested from NSRC	53 mins	1 min	Y	1.25	21 mins	DCPP has a standing contract with the NSRC to provided phase 3 coping equipment within 24-72 hours.
14	Doors to control room, cable spreading room, and battery charger/inverter rooms are blocked open	53 mins	18 mins	Y	1.5	19 mins	Doors blocked to allow for cable routing and to provide a natural ventilation path to support habitability.

Action Item	Action	Estimated Start Time[(a)]	Duration	Time Constraint Y/N	Time Constraint Finish (Hours)	Margin	Note
15	Vital DC battery load stripping is completed	55 mins	14 mins	Y	1.5	21 mins	The combination of two of the vital batteries sequenced in each Unit will provide power to those loads for at least 24 hours. The strategy removes one battery from service in each unit and the load shed scheme limits the loads on the remaining in service vital batteries to necessary instrumentation and controls.
16	Plant access assessment	3 hours	0.5 hours	Y	6	2.5 hours	Supports personnel arriving from offsite.
17	Deploy hoses to SFP and open doors to FHB to ventilate SFP	6 hours	1.8 hours	Y	13	5.2 hours	Prior to pool boiling initiation.
18	Transfer TDAFW pump suction to 0-1 FWST	16 hours	20 mins	Y	17	40 mins	CST Minimum level reached.
19	Align second vital battery and secure initial battery	18 hours	26 mins	Y	19	34 mins	Realigns batteries to extend necessary emergency dc and vital emergency 120-V instrumentation and controls are available.
20	Perform plant cooldown and depressurization	28 mins	2.3 hours	Y	20	17.2 hours	Cooldown and depressurization is performed to support RCS coping strategies.
21	Align ERCS make-up pump from BASTs	10 hours	4.5 hours	Y	20	5.5 hours	Time sensitive action initiated to provide boration to maintain subcriticality at target RCS temperature following cooldown as xenon decays.

Action Item	Action	Estimated Start Time[(a)]	Duration	Time Constraint Y/N	Time Constraint Finish (Hours)	Margin	Note
22	FLEX deployment damage assessment complete	1.5 hours	1.5 hours	Y	24	21 hours	Supports Phase 2 coping strategy deployment. This will be performed by onsite operators and other available personnel.
23	480 VAC generator repowers battery chargers	13 hours	4.3 hours	Y	27	9.7 hours	Station Class 1E batteries are depleted 27 hrs into the ELAP event.
24	Transfer TDAFW pump suction from 0-1 FWST to CST	28 hours	20 mins	Y	29.5	1.2 hours	While drawing suction from the FWST, a portion of the TDAFW flow is recirculated to the CST. Transferring suction back to the CST allows the TDAFW pump to use entire CST and FWST water volumes.
25	EAFW and RWR equipment in service	24 hours	6 hours	Y	39.9	9.9 hours	CST and FWST water supplies depleted and RWR water supply now utilized.
26	Align ERCS pump suction to RWST	> 24 hours	3.8 hours	Y	43.7	15.9 hours	Additional injection required to maintain natural circulation.
27	Align flexible hoses to RWR supply header for SFP cooling	> 24 hours	6 hours	Y	67	37 hours	Based on the boil down time required to reach 10 ft above fuel assuming maximum post-refueling heat load.
28	Establish alternate fuel supply[(b)]	> 24 hours	15 mins	Y	<72	N/A	DCPP has sufficient diesel fuel oil supply in the underground, seismically qualified DFO storage tanks to run the Phase 2 FLEX equipment for greater than 7 days. Fuel storage (i.e. fuel bladders) will be provided by the NSRC[(b)].

Action Item	Action	Estimated Start Time[(a)]	Duration	Time Constraint Y/N	Time Constraint Finish (Hours)	Margin	Note
29	Align large generators[(b)]	> 72 hours	28.3 hours	Y	121	20.7 hours	Required for long term decay heat removal.
30	Align EASW pump	> 72 hours	16.3 hours	Y	121	32.7 hours	Required for long term decay heat removal.

[(A)] As part of the Phase 2 staffing studies and strategy validation, operator action times have been verified by walkthroughs, tabletops, and simulations for each time sensitive action.

[(b)] To be delivered from the NSRC and available to be placed in service within 72 hours after notifying the NSRC. PG&E also has MOU's with suppliers of diesel fuel which will be initiated when needed. DCPP has adequate supplies for >72 hours of operation of Phase 2 FLEX Equipment. The NSRC will also provide a backup set of Phase 2 equipment.

Table 5: NSSS Significant Reference Analysis Deviations Table

Item	Parameter of interest	WCAP value (WCAP-17601-P Revision 1 January 2013)	WCAP page	Plant applied value	Gap and discussion
	None	N/A	N/A	N/A	No deviations

6. Figures

Figure Number	Title
1	Staging Routes – Primary FLEX Storage Facility
2	Staging Routes – Secondary FLEX Storage Facility
3	AFW Connection Points, SGs Available, Unit 1
4	AFW Connection Points, SGs Available, Unit 2
5A	Alt Sources – RWR, Unit 1 & 2
5B	Alt Sources – RWR, Unit 1 & 2
6A	All Strategies – Primary, Units 1 and 2, Elevation 115'
6B	All Strategies – Primary, Unit 1, Elevation 100'
6C	Deleted
6D	Deleted
6E	RHR Crosstie Connection Point, Unit 1
7A	All Strategies – Primary, Unit 2, Elevation 115'
7B	All Strategies – Primary, Unit 2, Elevation 100'
7C	Deleted
7D	Deleted
7E	RHR Crosstie Connection Point, Unit 2
8A	All Strategies – Alternate, Units 1 and 2, Elevation 115'
8B	All Strategies – Alternate, Unit 1, Elevation 100'
8C	All Strategies – Alternate, Unit 1, Elevation 85'
9A	All Strategies – Alternate, Unit 2, Elevation 115'
9B	All Strategies – Alternate, Unit 2, Elevation 100'
9C	Deleted
9D	All Strategies – Alternate, Unit 2, Elevation 85'
10	BAST Suction Connection Point, Unit 1
11	BAST Suction Connection Point, Unit 2
12	RCS Primary Connection Point, Unit 1
13	RCS Primary Connection Point, Unit 2
14	RCS Alternate Connection Point, Unit 1
15	RCS Alternate Connection Point, Unit 2
16	Spent Fuel Pool Primary Connection, Unit 1, Elevation 140'
17	Spent Fuel Pool Primary Connection, Unit 2, Elevation 140'

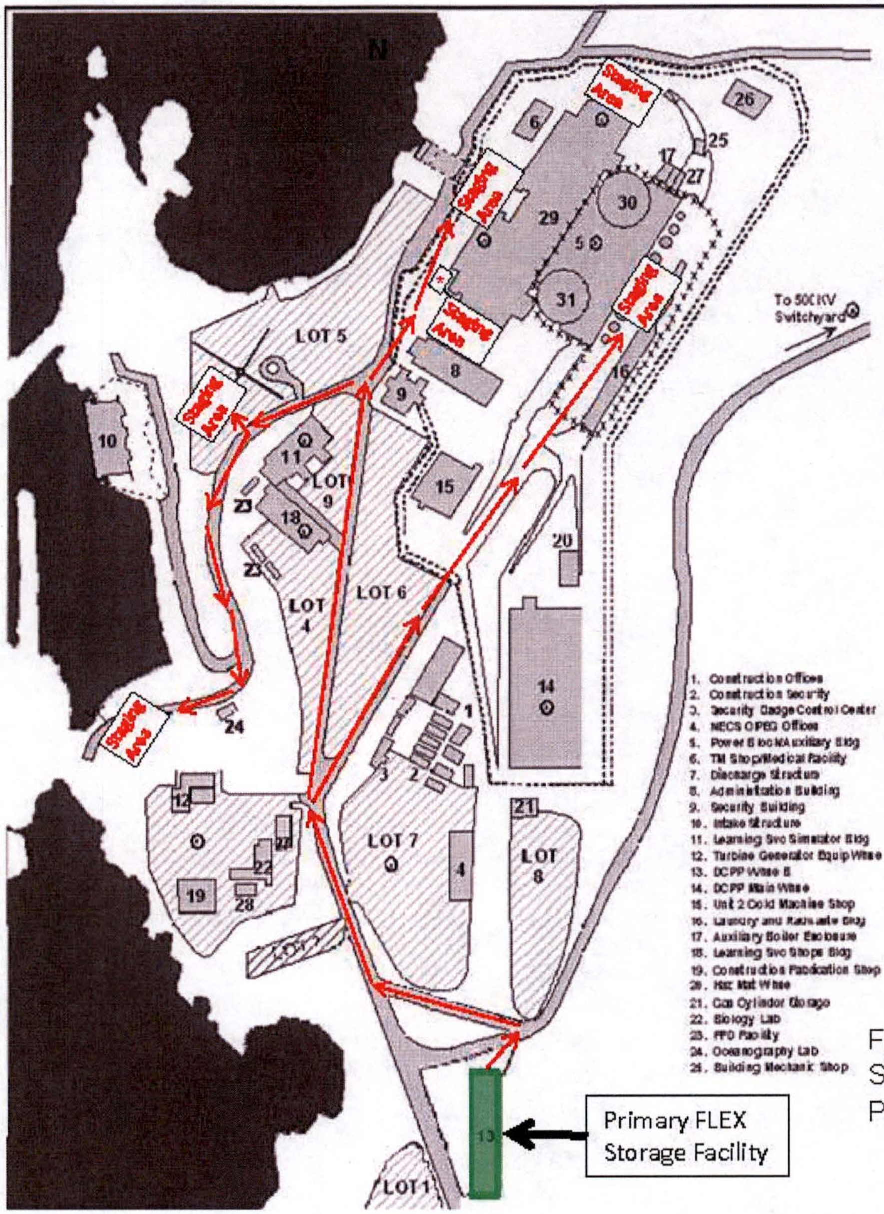


Figure 1
Staging Routes
Primary FLEX Storage Facility

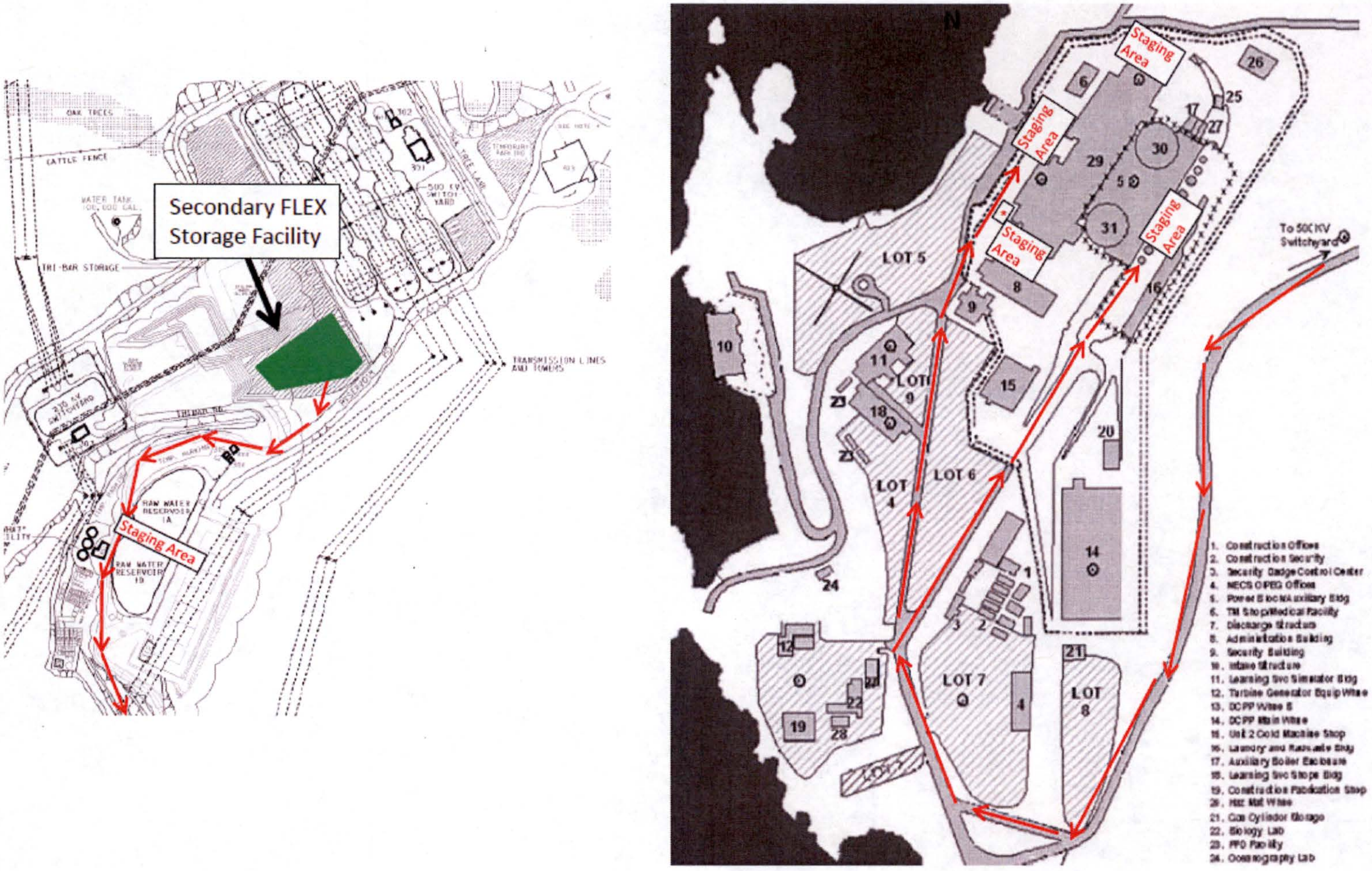
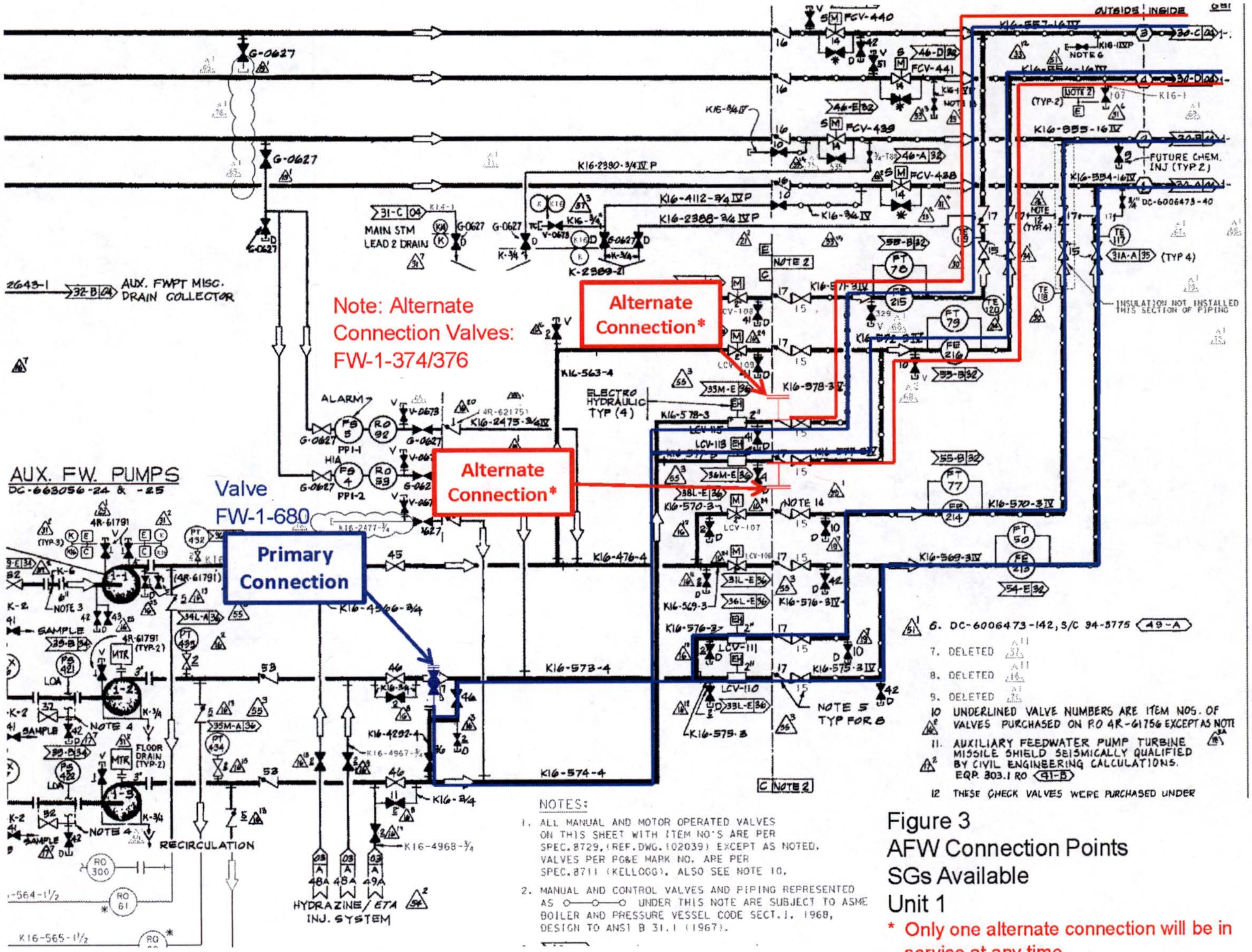


Figure 2
Staging Routes
Secondary FLEX Storage Facility



Note: Alternate Connection Valves: FW-1-374/376

Alternate Connection*

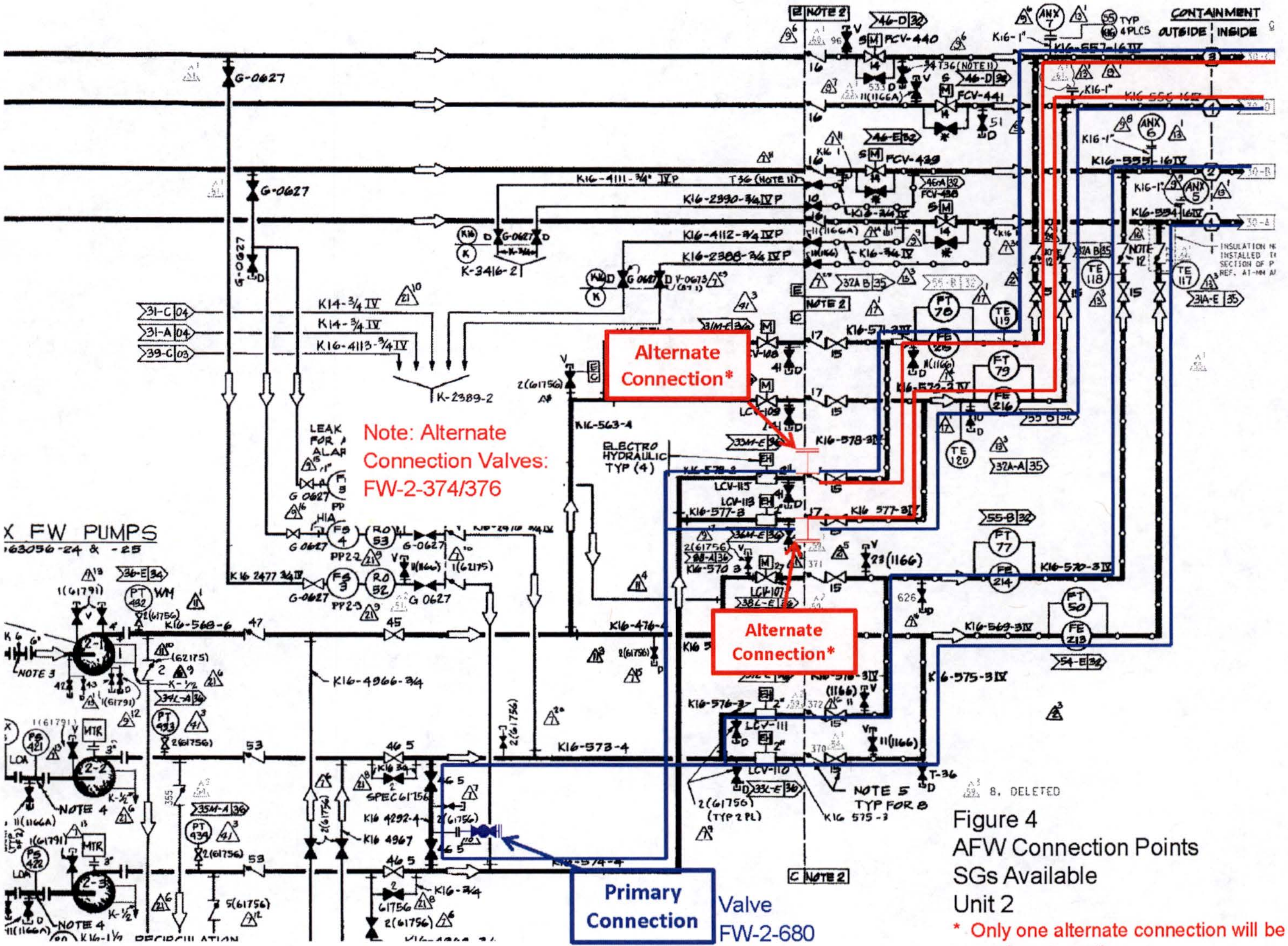
Alternate Connection*

Valve FW-1-680

Primary Connection

Figure 3
AFW Connection Points
SGs Available
Unit 1

* Only one alternate connection will be in service at any time.



Alternate Connection*

Note: Alternate Connection Valves: FW-2-374/376

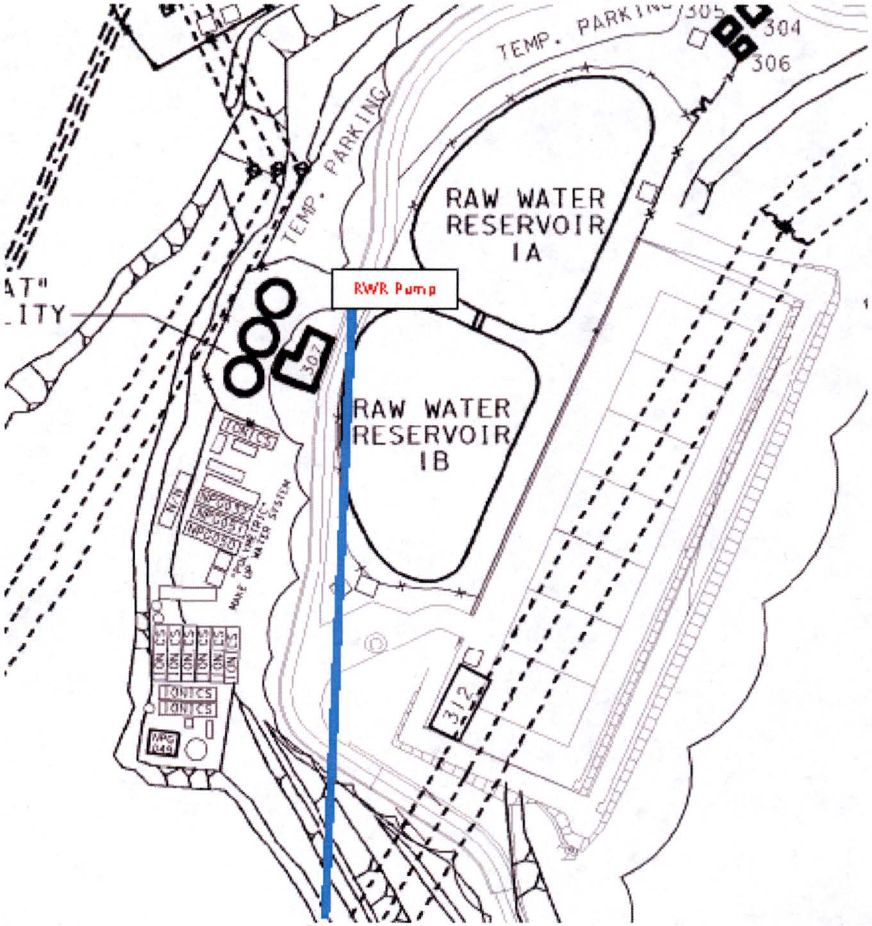
Alternate Connection*

Primary Connection

Valve FW-2-680

Figure 4
AFW Connection Points
SGs Available
Unit 2

* Only one alternate connection will be in service at any time.



To Fig. 5B

Figure 5A
Alt Sources – RWR
Unit 1 & 2

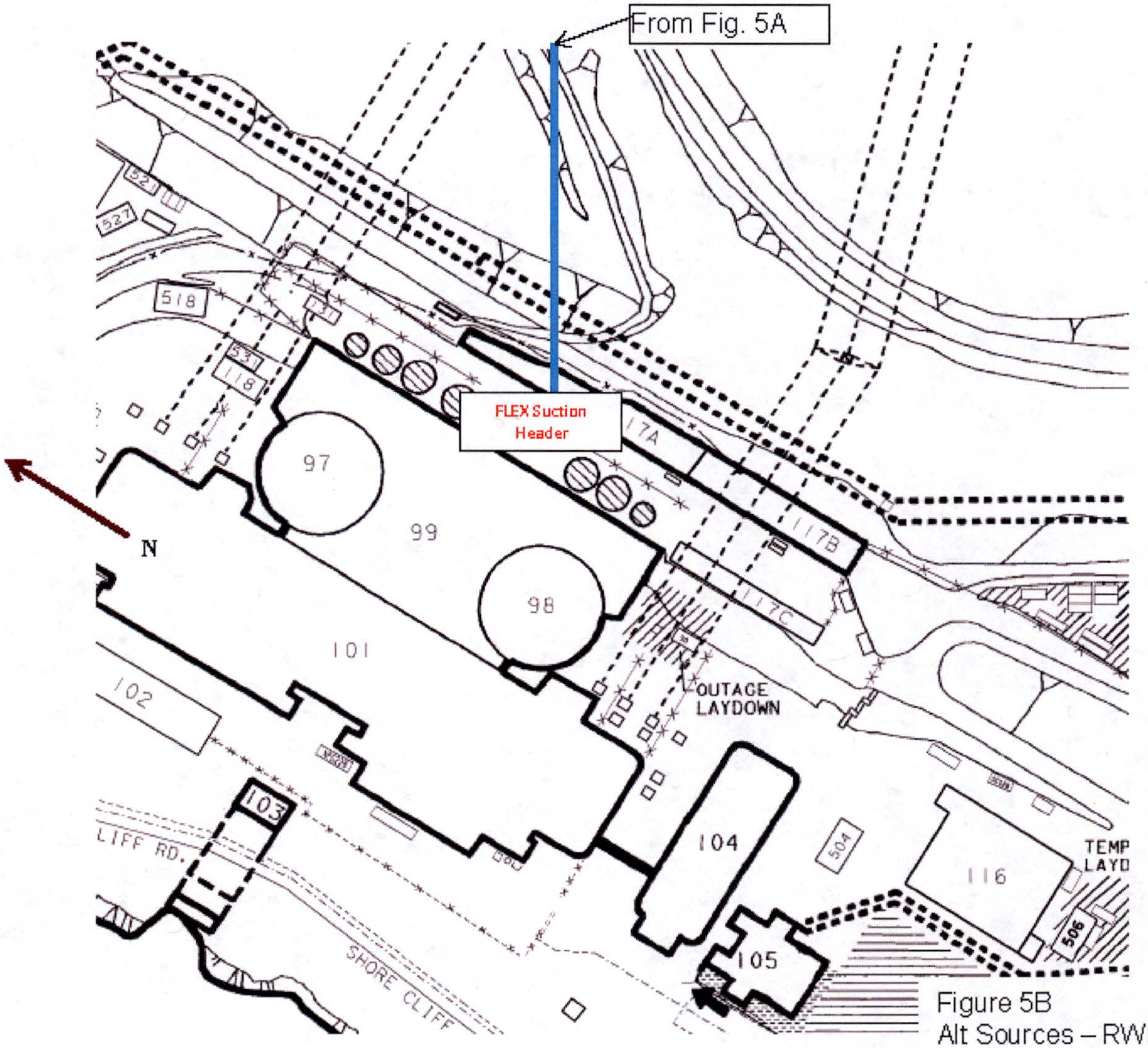
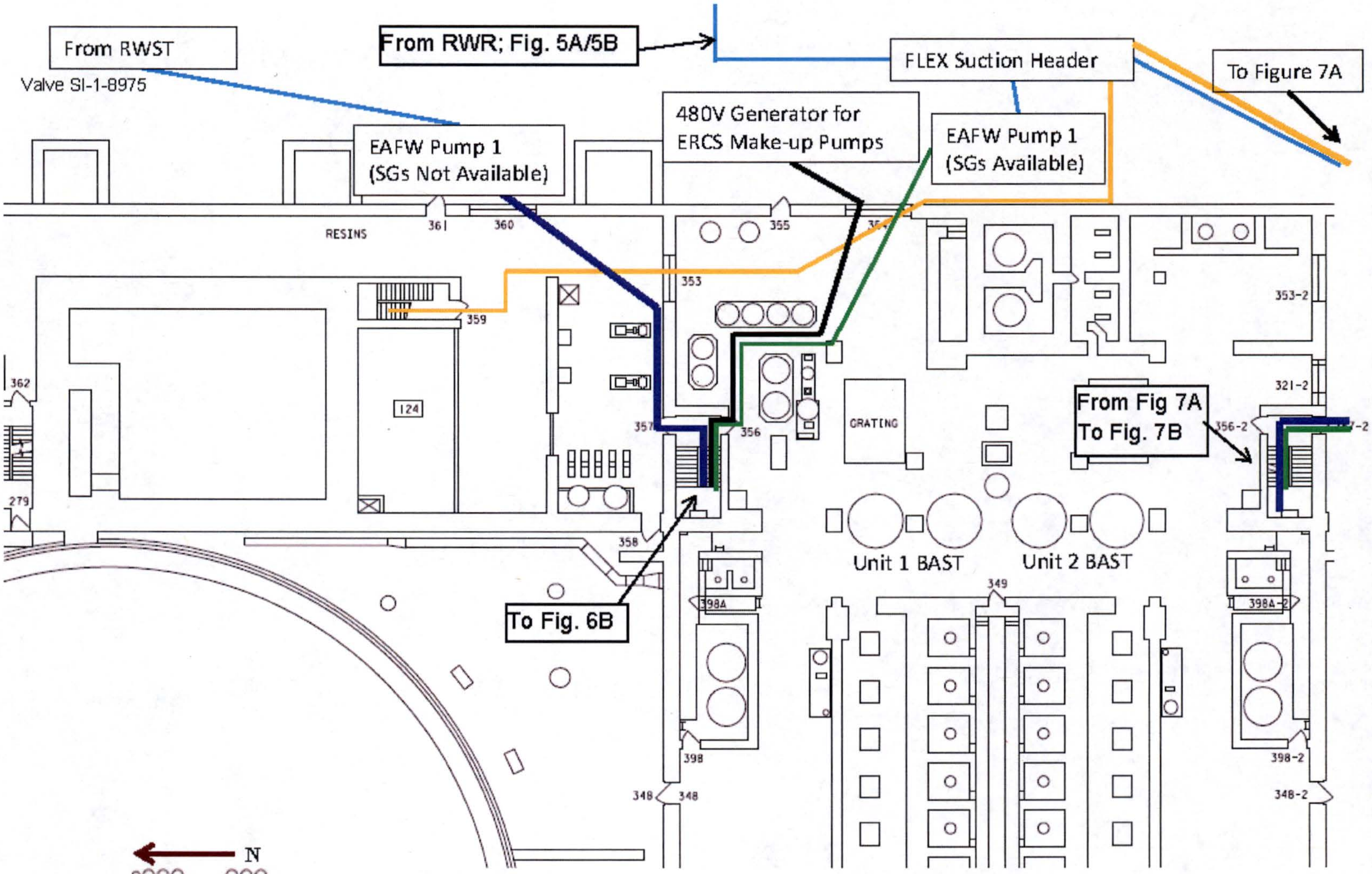
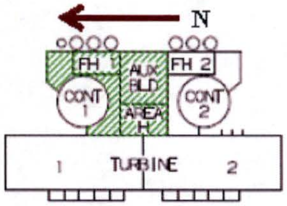


Figure 5B
Alt Sources – RWR
Unit 1 & 2





━ 480V Generator Cables
━ AFW SGs Available
━ SFP Flexible Hose
━ AFW SGs Not Available

Figure 6A
All Strategies – Primary
Unit 1 and 2
Elevation 115'

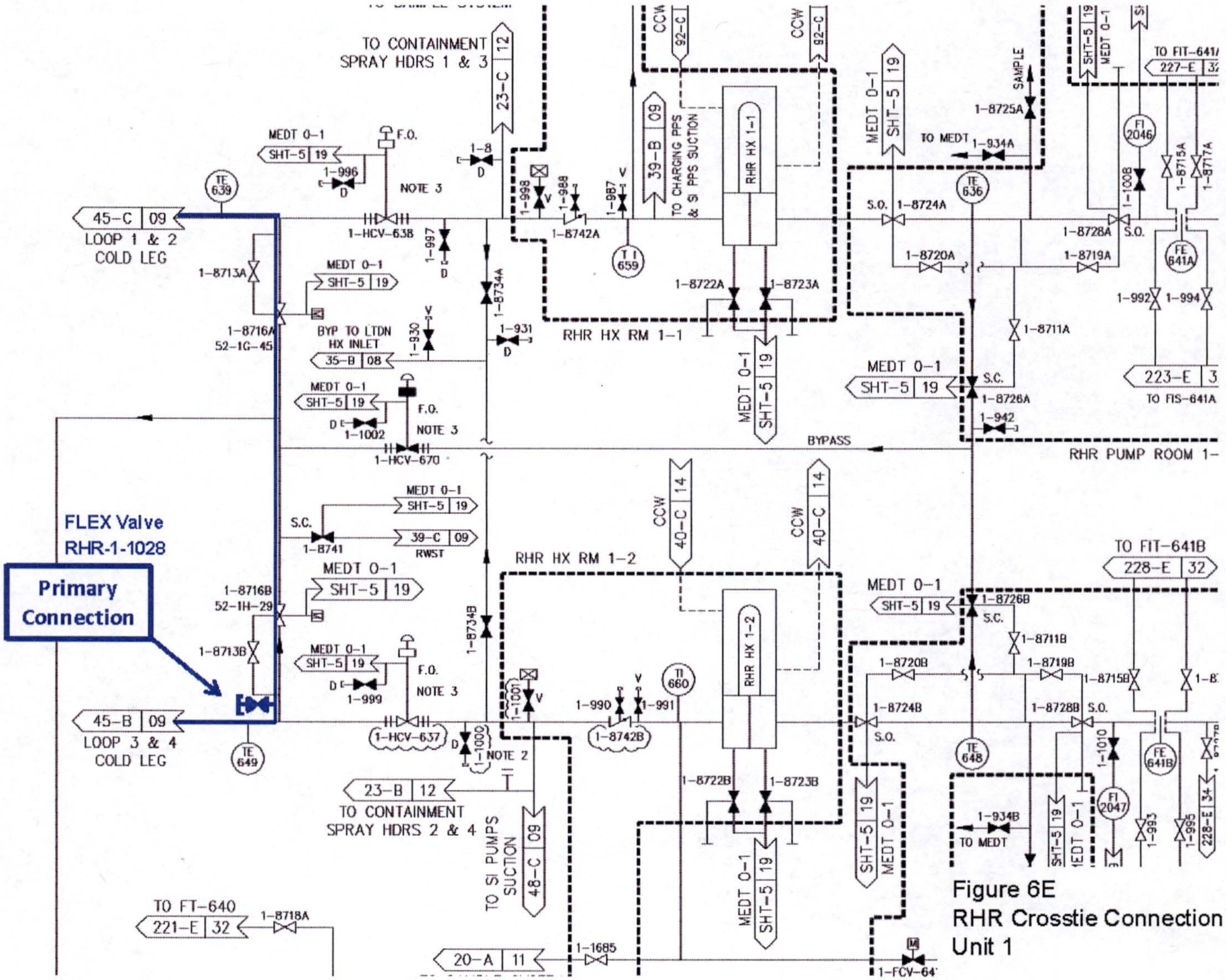


Figure 6E
RHR Crosstie Connection Point
Unit 1

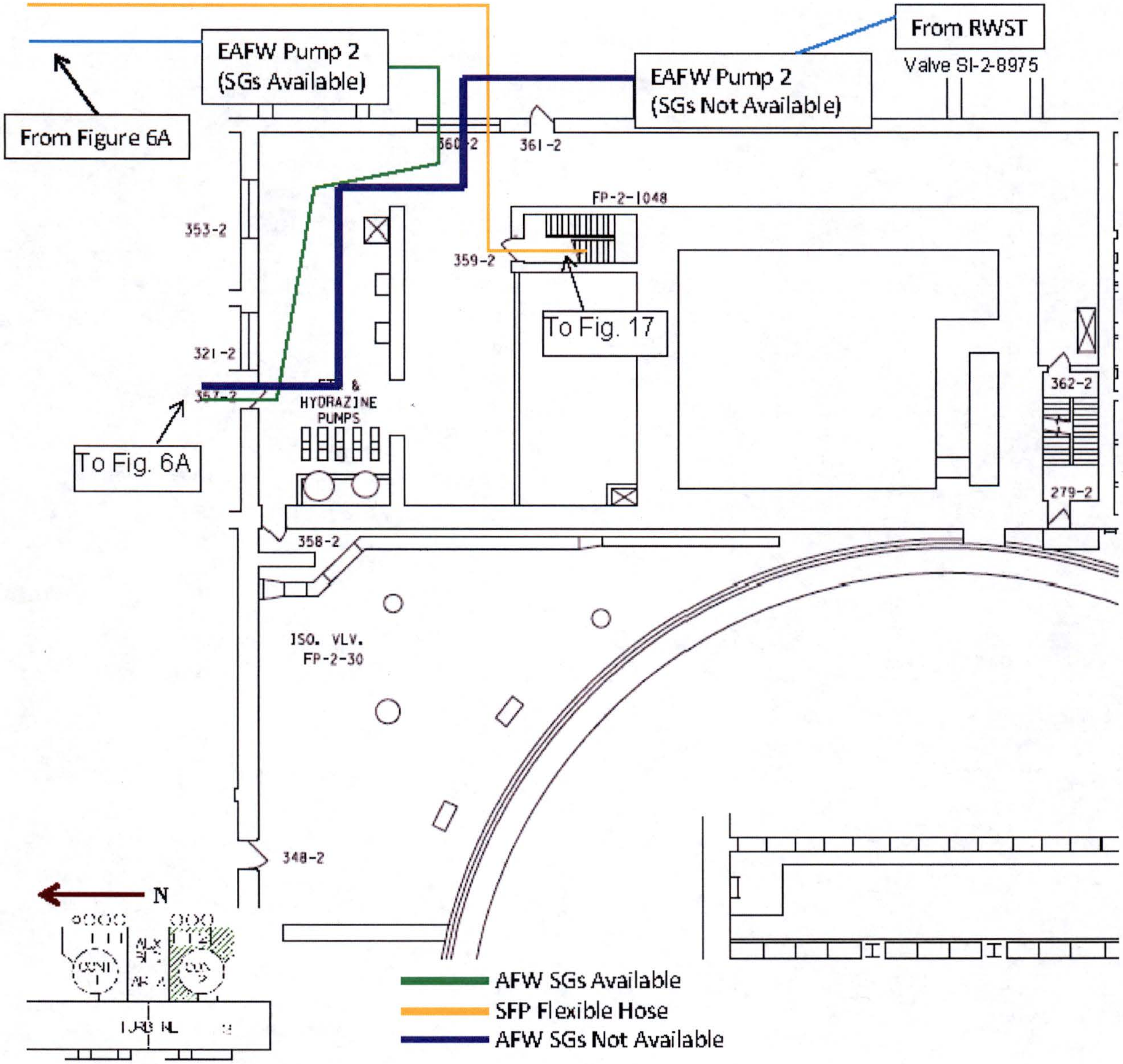


Figure 7A
All Strategies – Primary
Unit 2
Elevation 115'

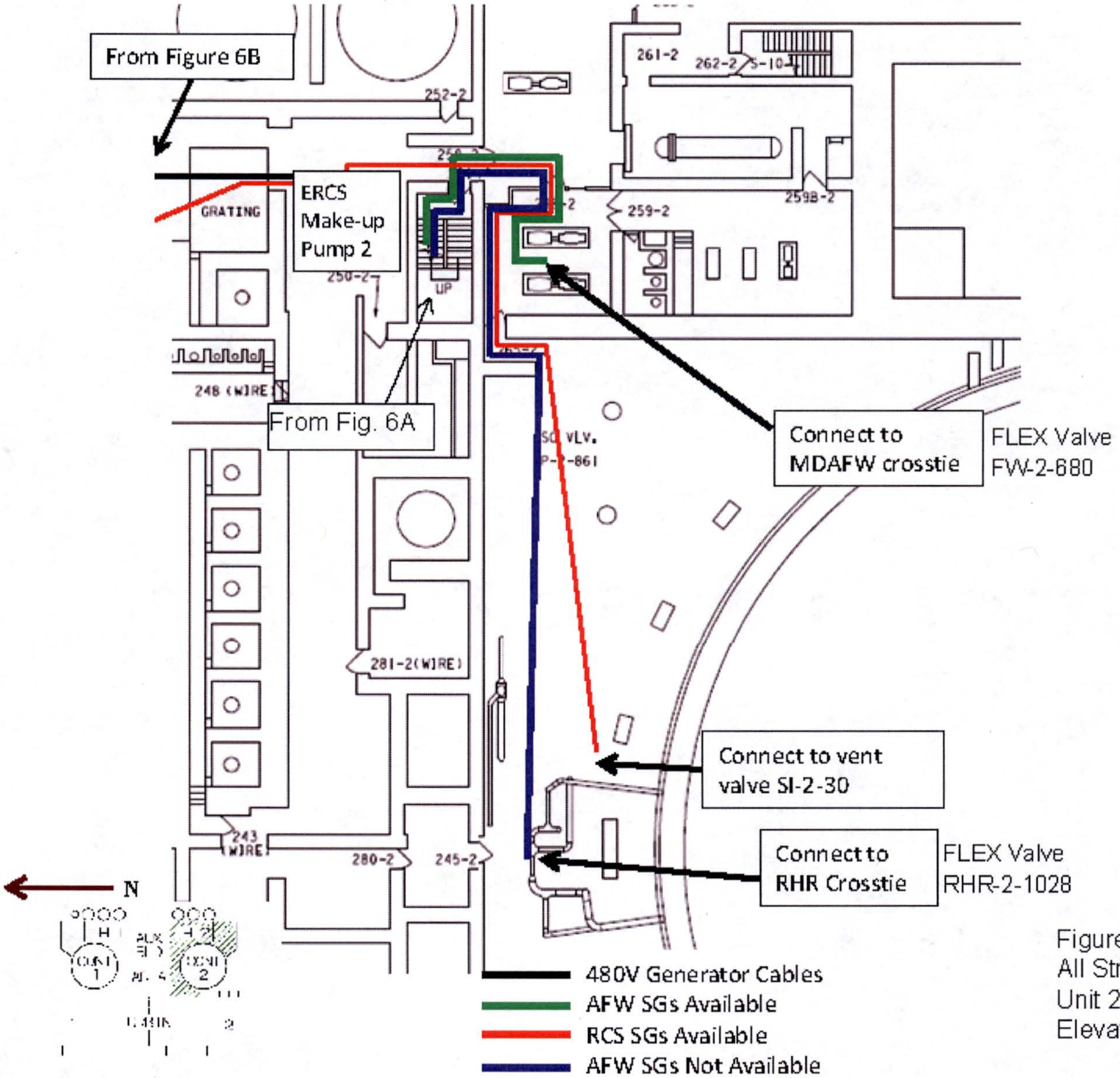
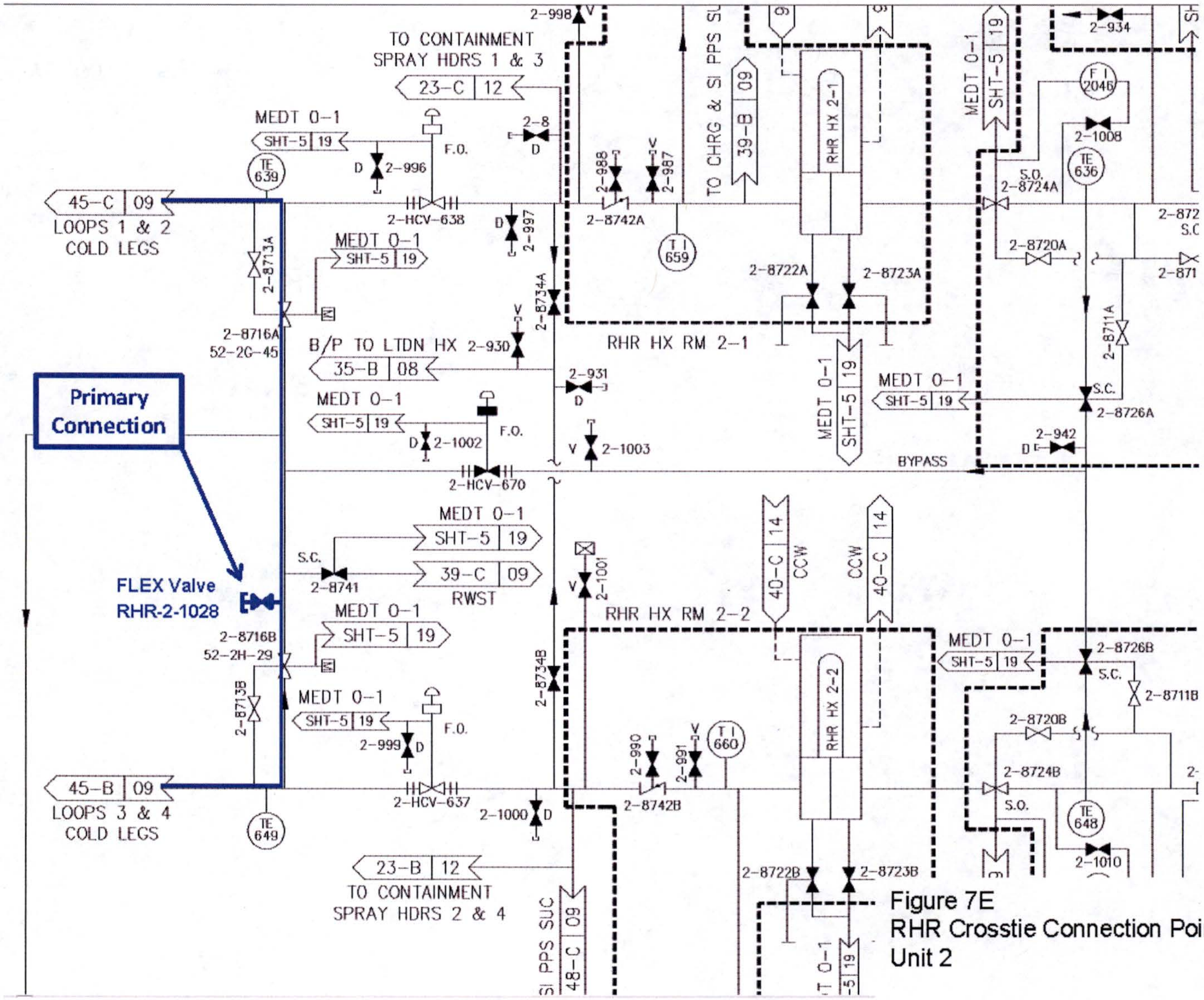


Figure 7B
All Strategies – Primary
Unit 2
Elevation 100'



Primary Connection

FLEX Valve RHR-2-1028

Figure 7E
RHR Crosstie Connection Point
Unit 2

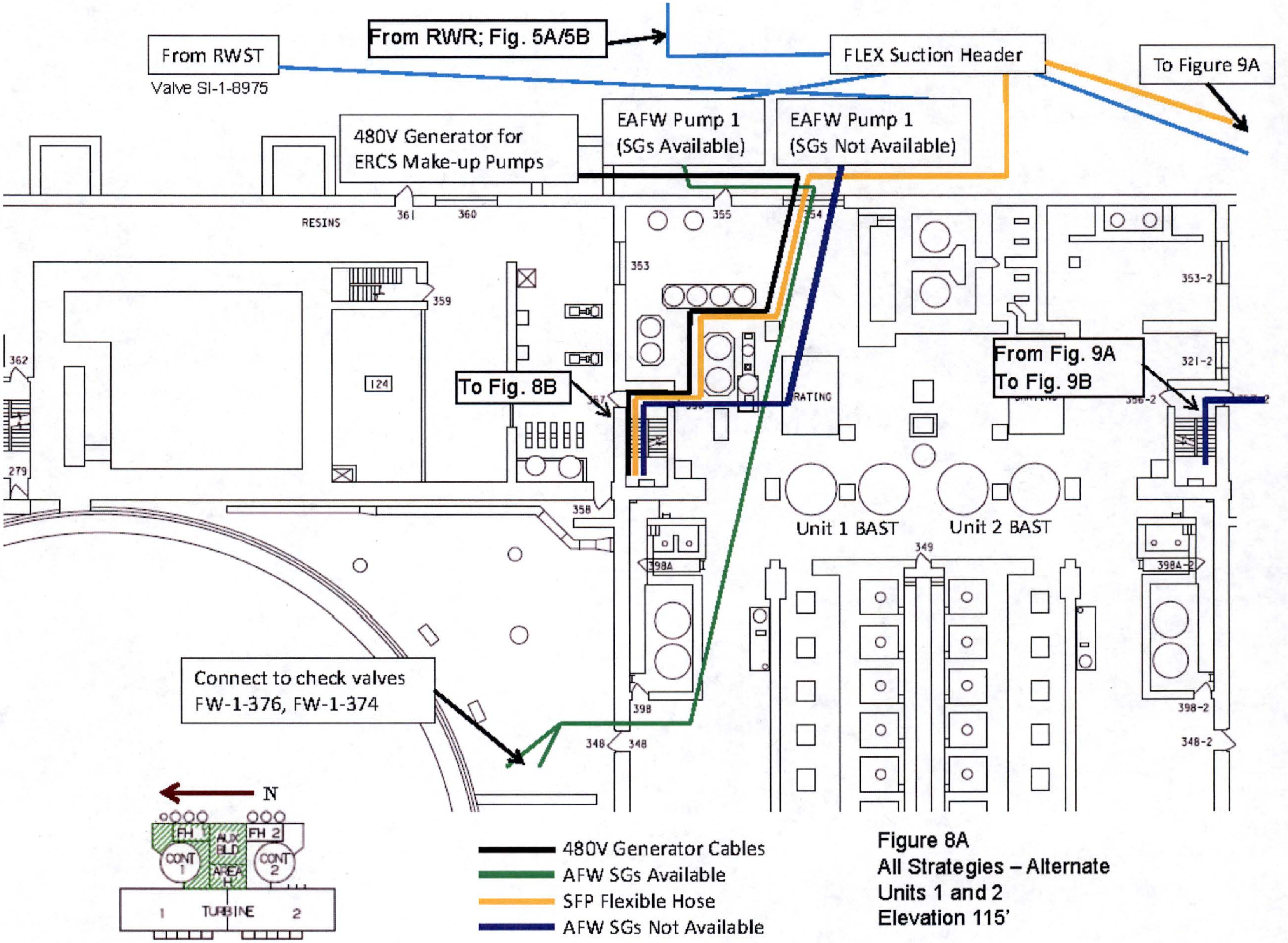
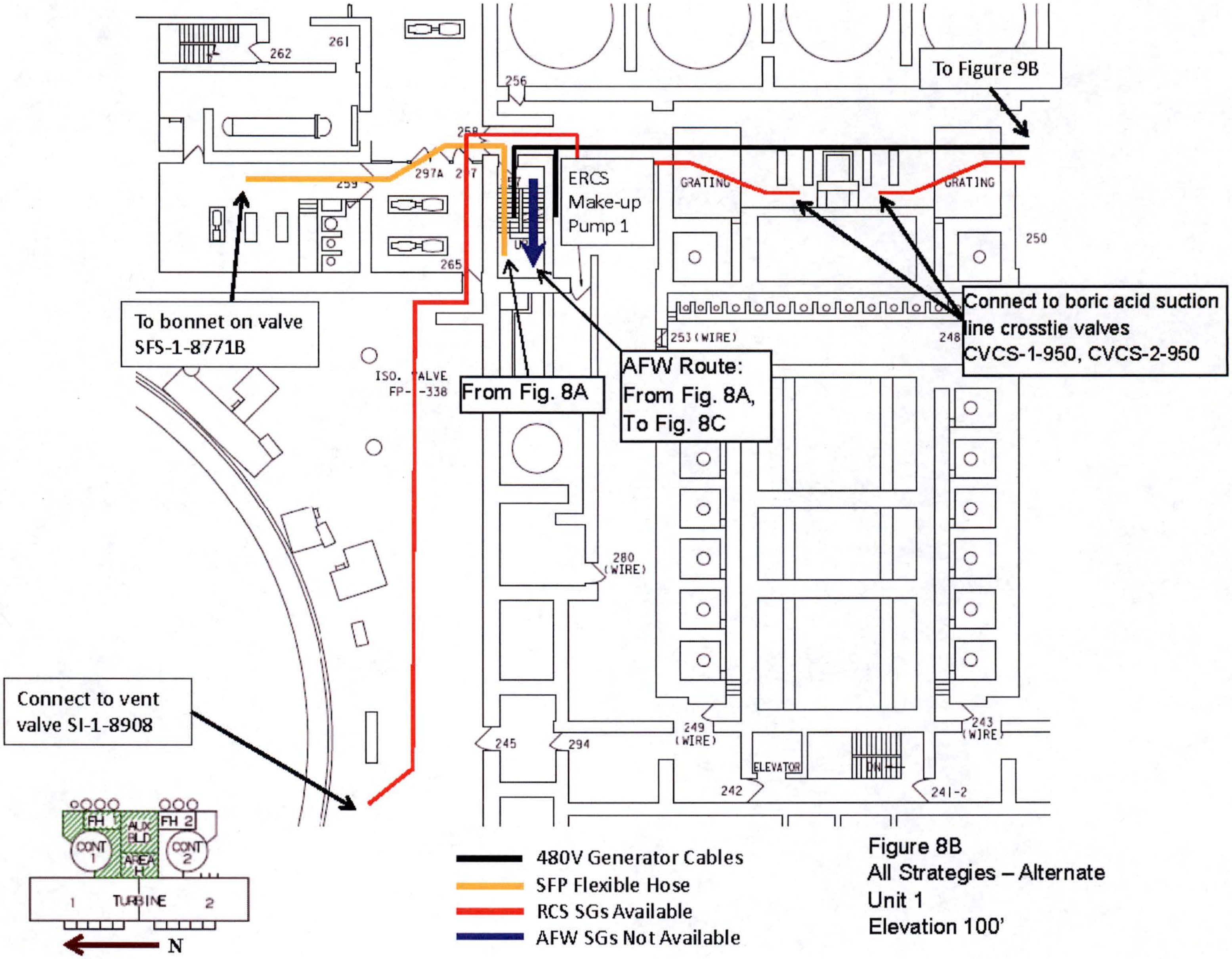


Figure 8A
All Strategies – Alternate
Units 1 and 2
Elevation 115'



To Figure 9B

To bonnet on valve SFS-1-8771B

ERCS Make-up Pump 1

Connect to boric acid suction line crosstie valves CVCS-1-950, CVCS-2-950

From Fig. 8A

AFW Route: From Fig. 8A, To Fig. 8C

Connect to vent valve SI-1-8908

Figure 8B
All Strategies – Alternate
Unit 1
Elevation 100'

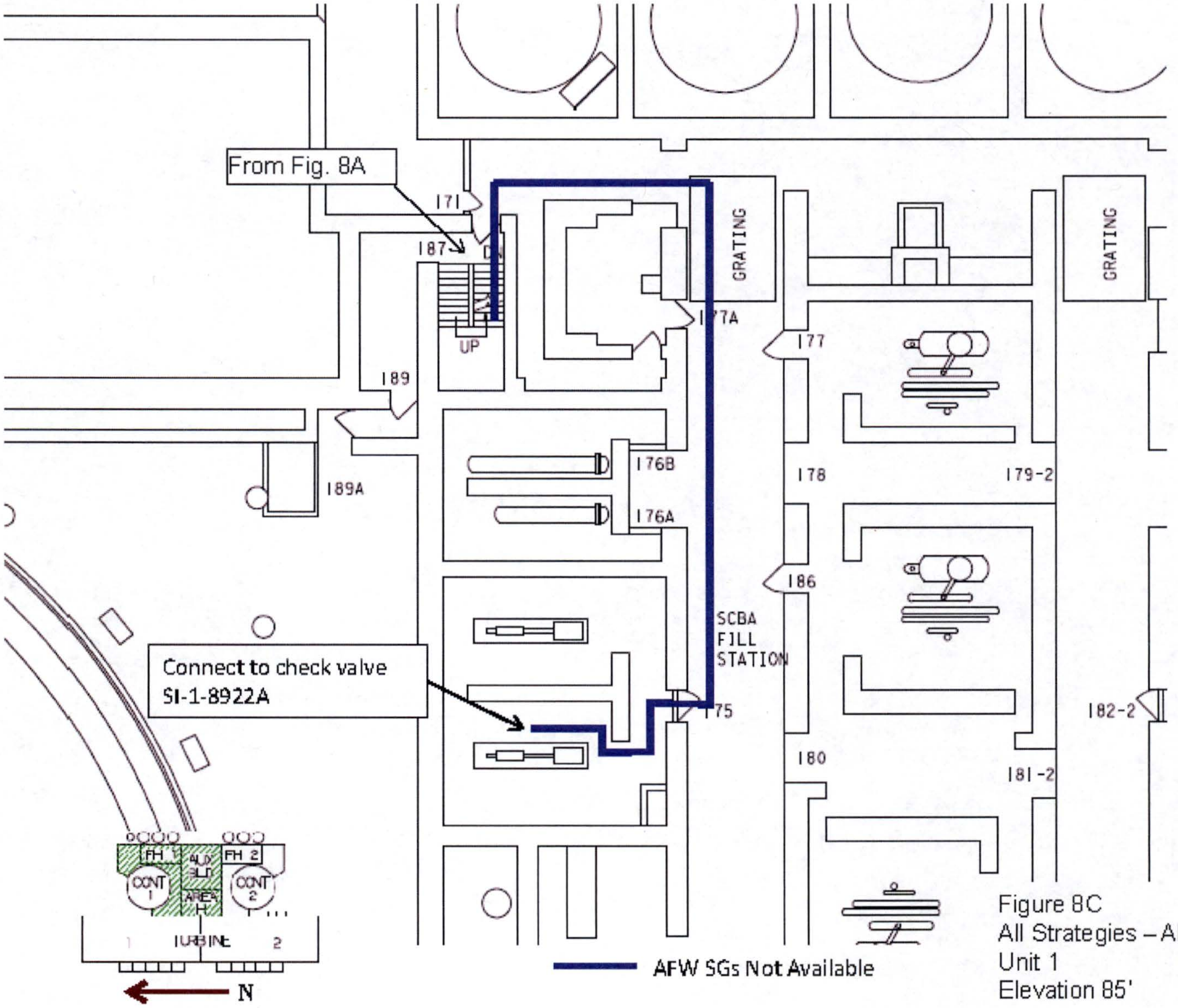


Figure 8C
All Strategies – Alternate
Unit 1
Elevation 85'

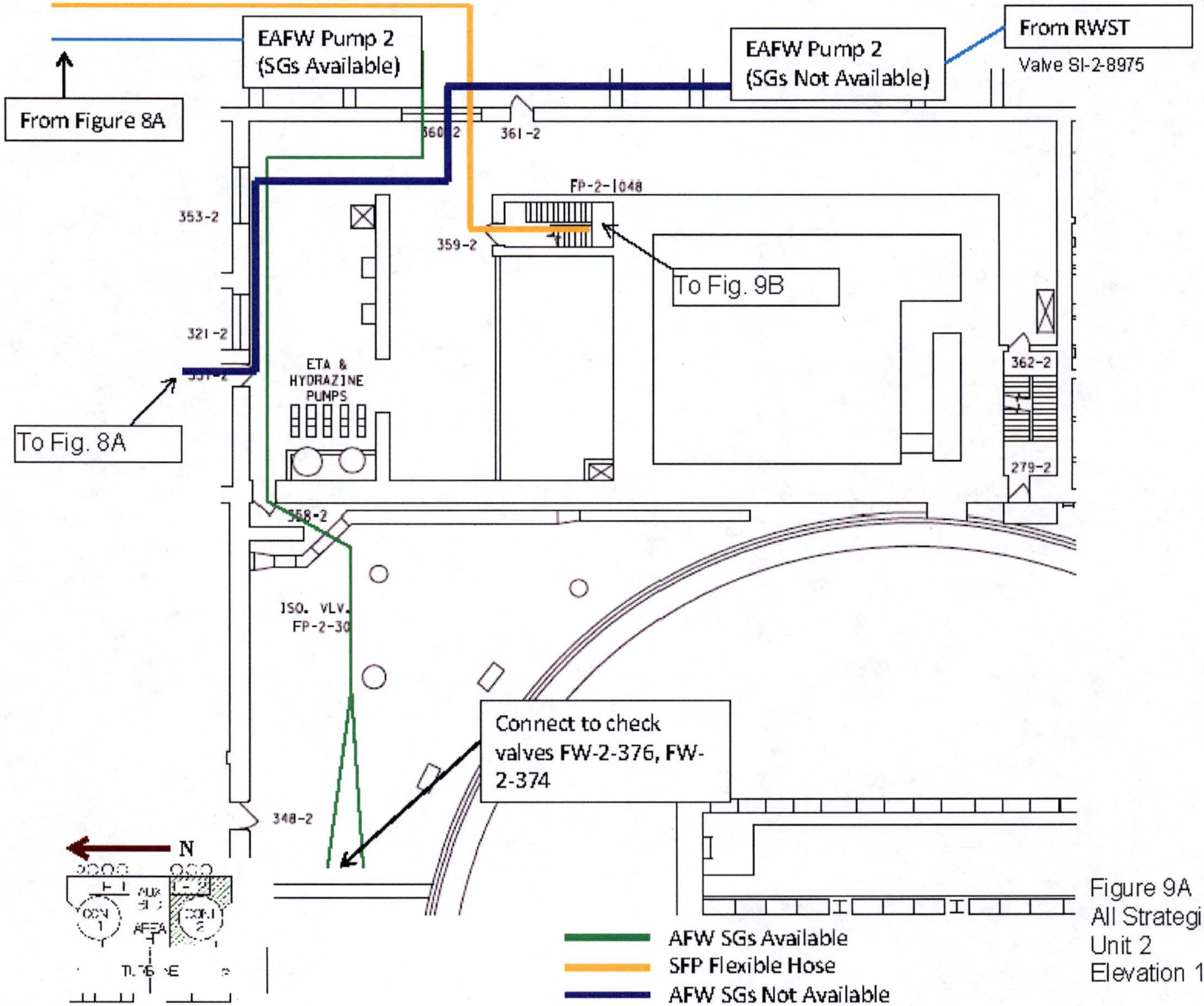


Figure 9A
All Strategies – Alternate
Unit 2
Elevation 115'

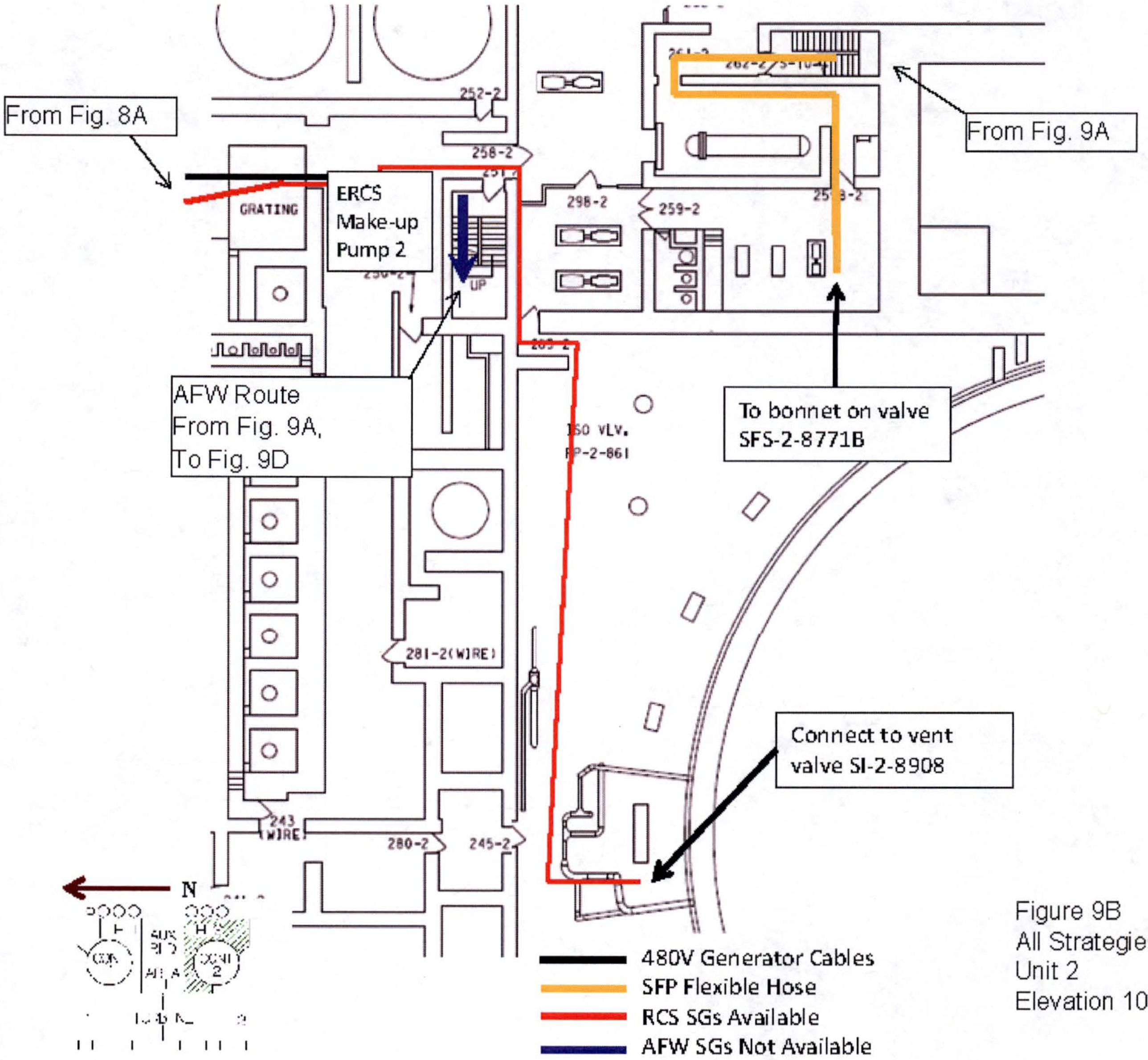
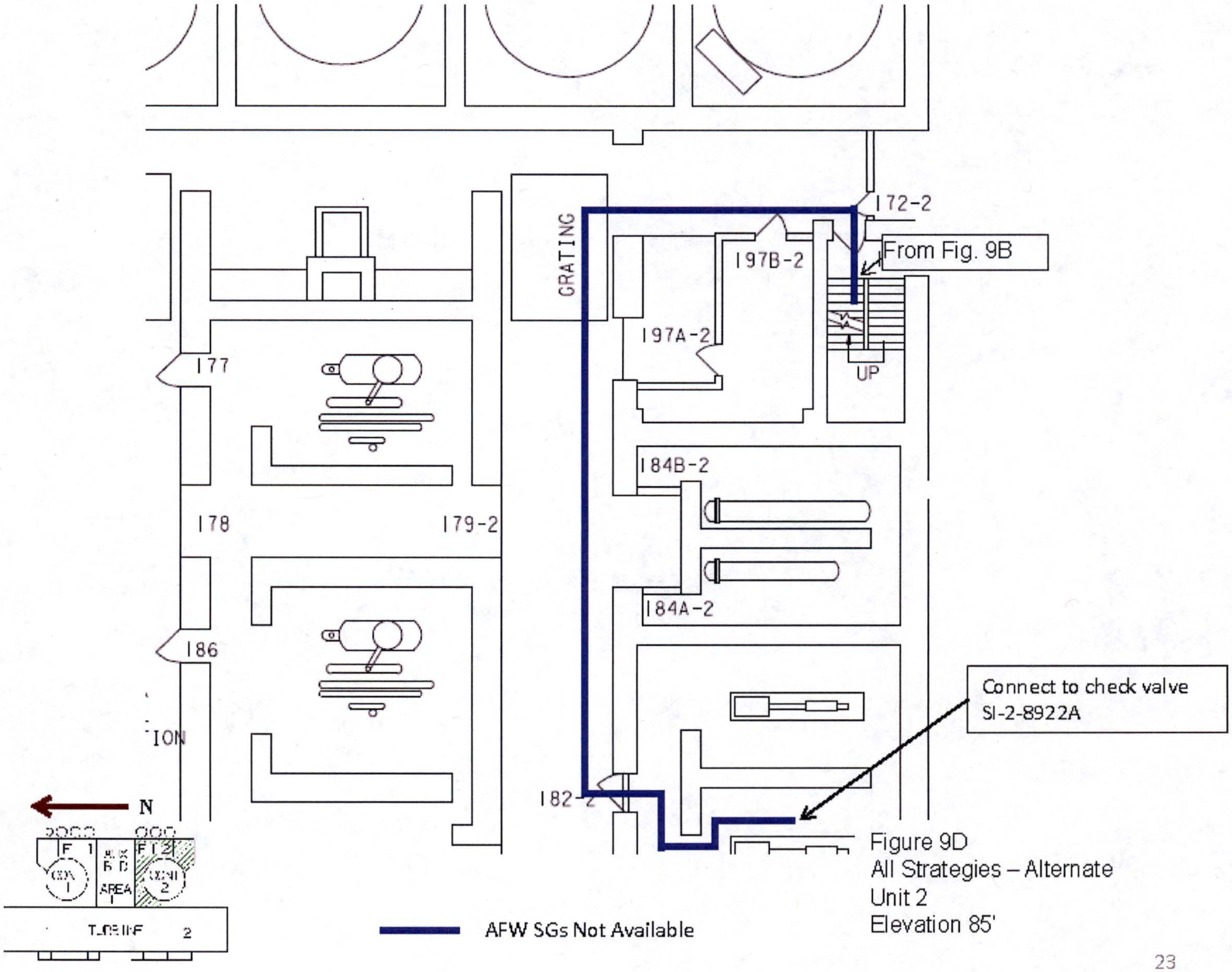


Figure 9B
All Strategies – Alternate
Unit 2
Elevation 100'



From Fig. 9B

Connect to check valve SI-2-8922A

Figure 9D
All Strategies – Alternate
Unit 2
Elevation 85'

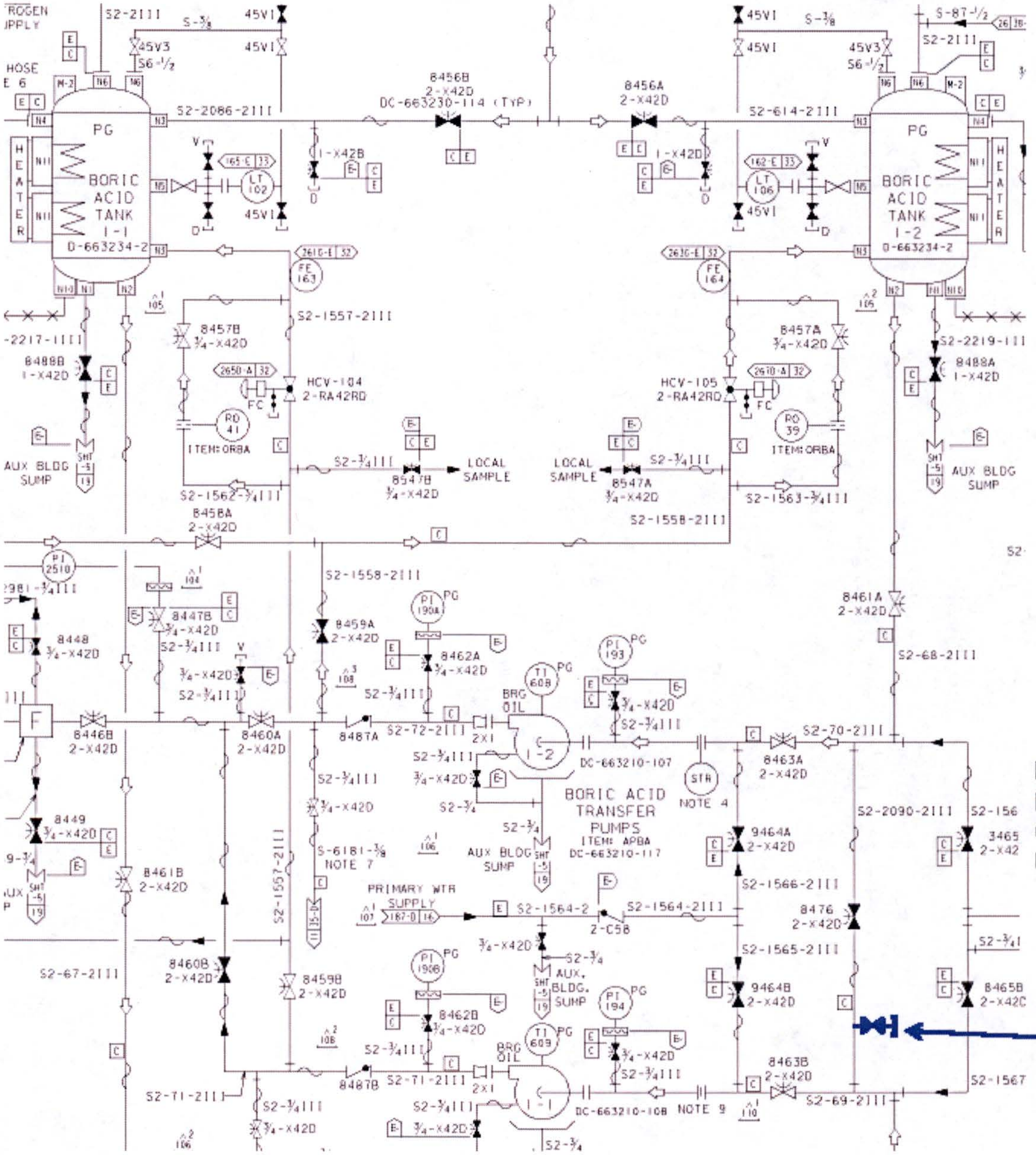


Figure 10
BAST Suction
Connection Point
Unit 1

**FLEX Valve
CVCS-1-950**

**Primary
Connection**

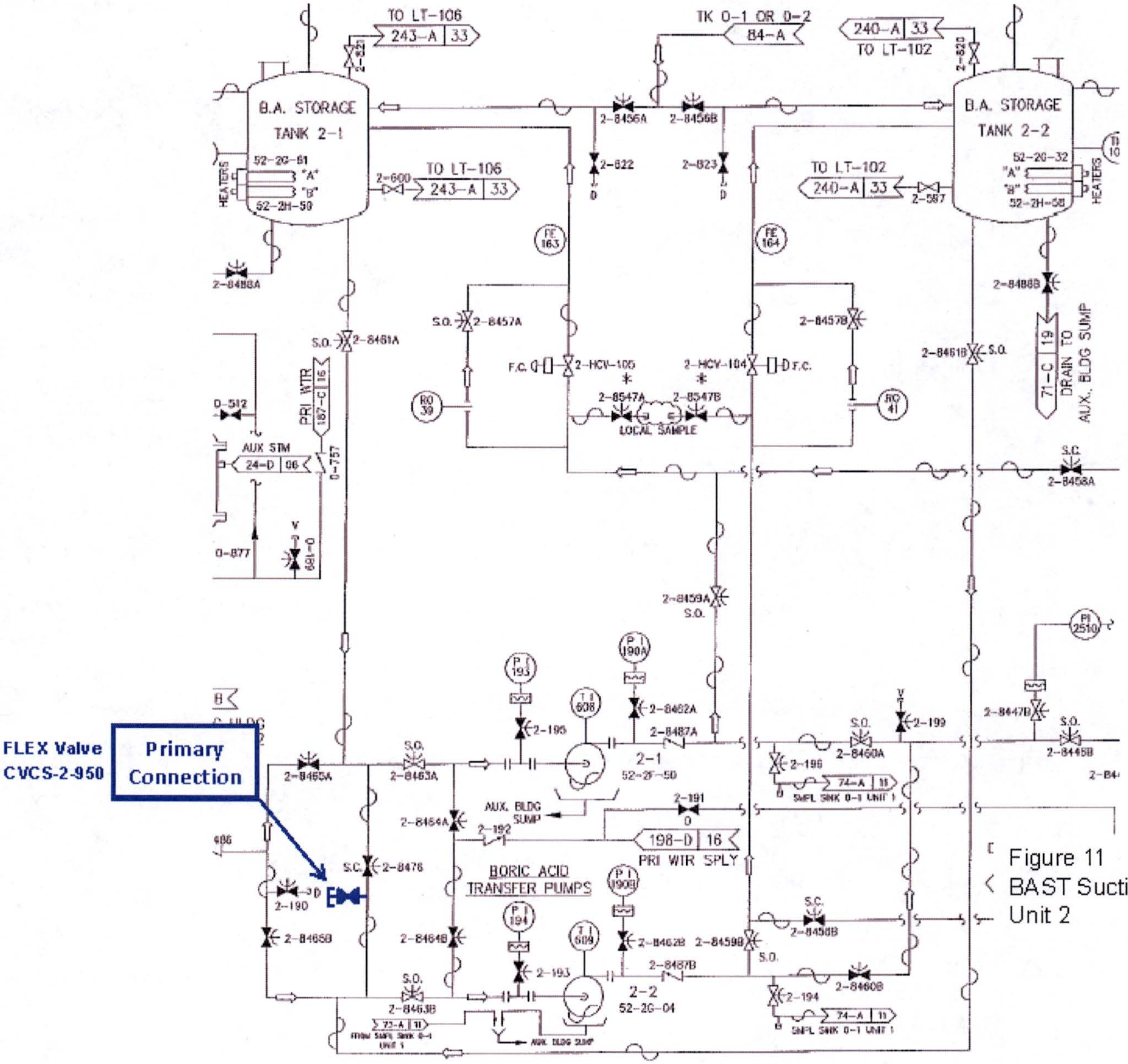
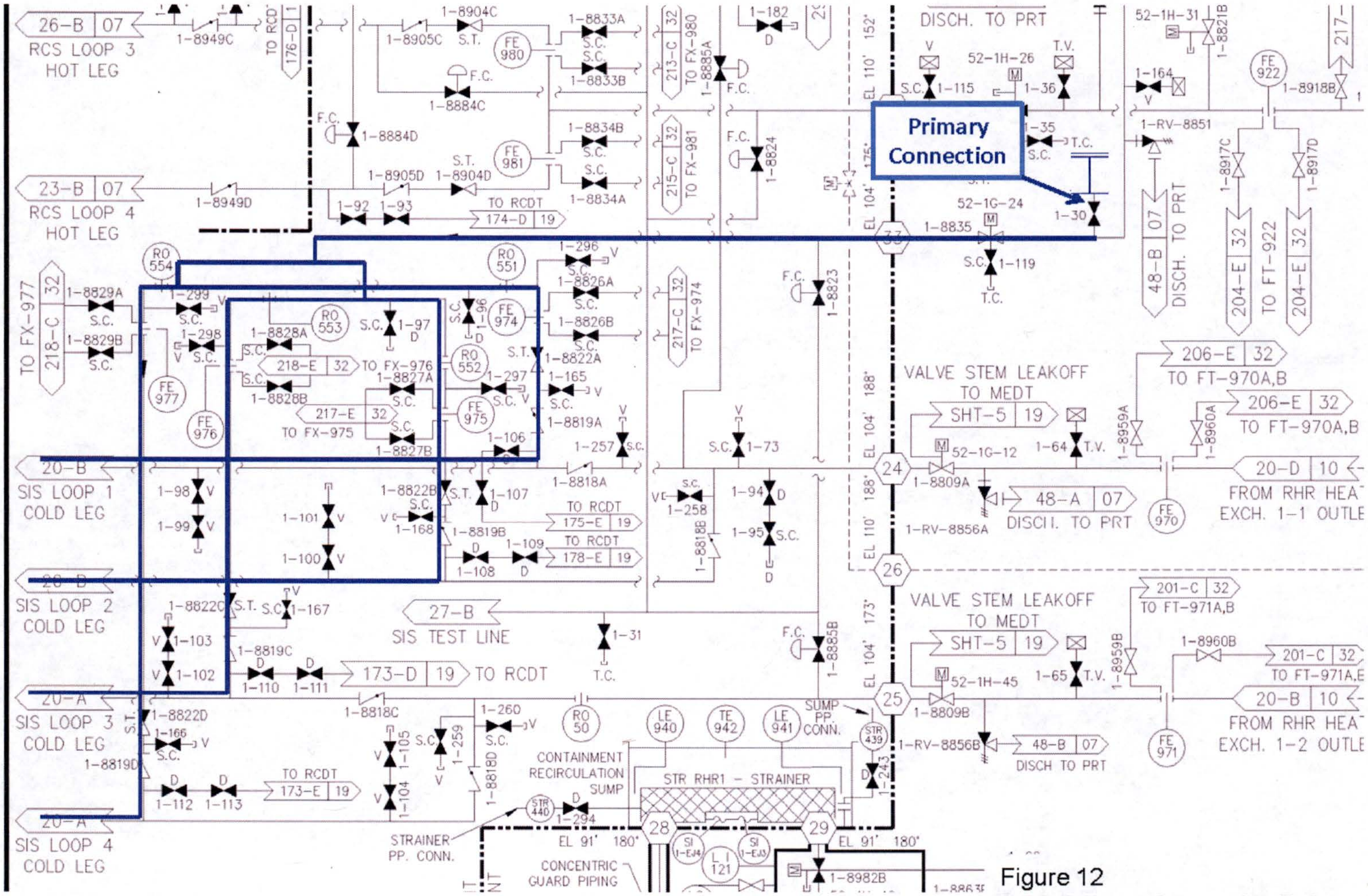


Figure 11
BAST Suction Connection Point
Unit 2



Primary Connection

Figure 12
RCS Primary Connection Point
Unit 1

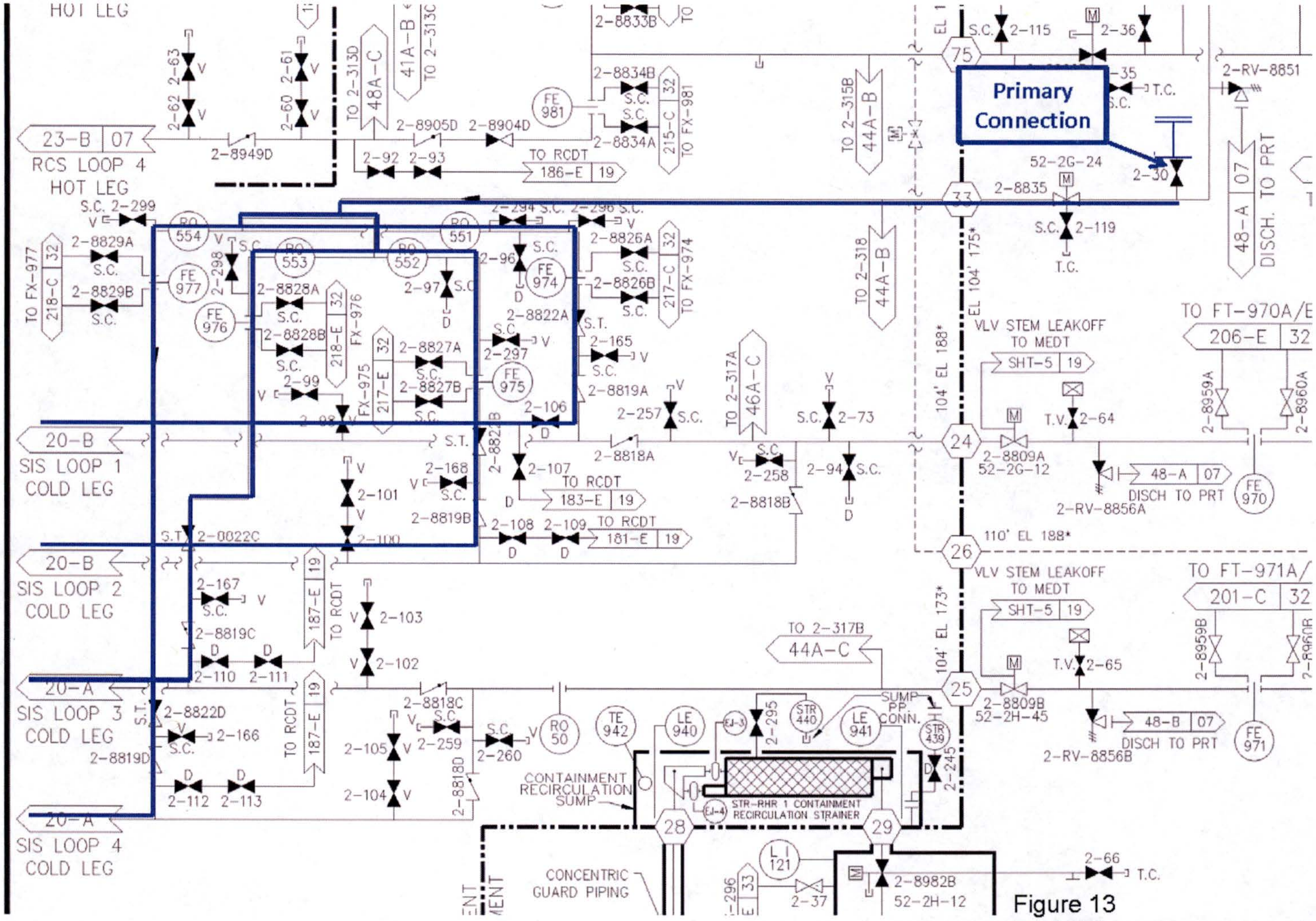


Figure 13
RCS Primary Connection Point
Unit 2

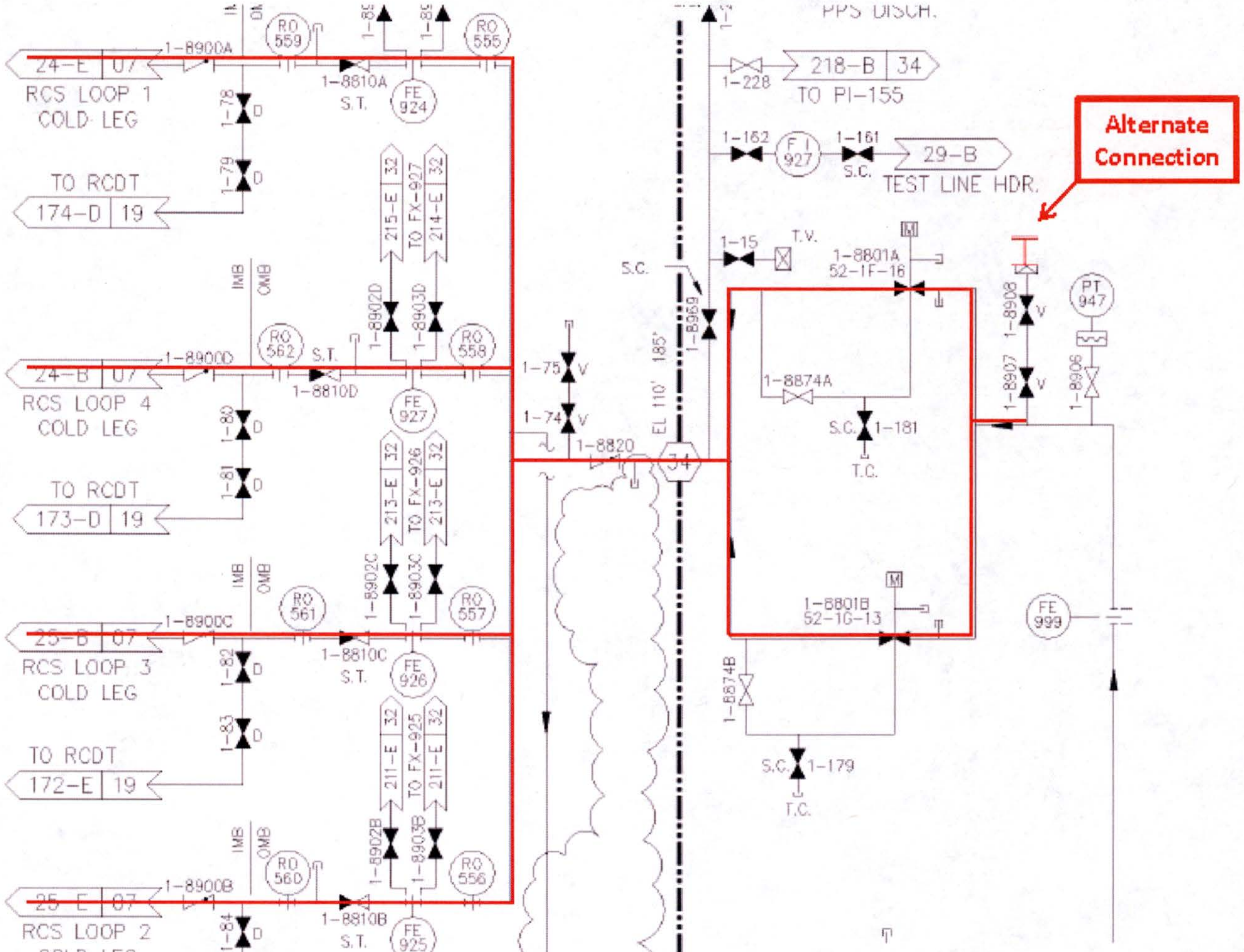


Figure 14
RCS Alternate Connection Point
Unit 1

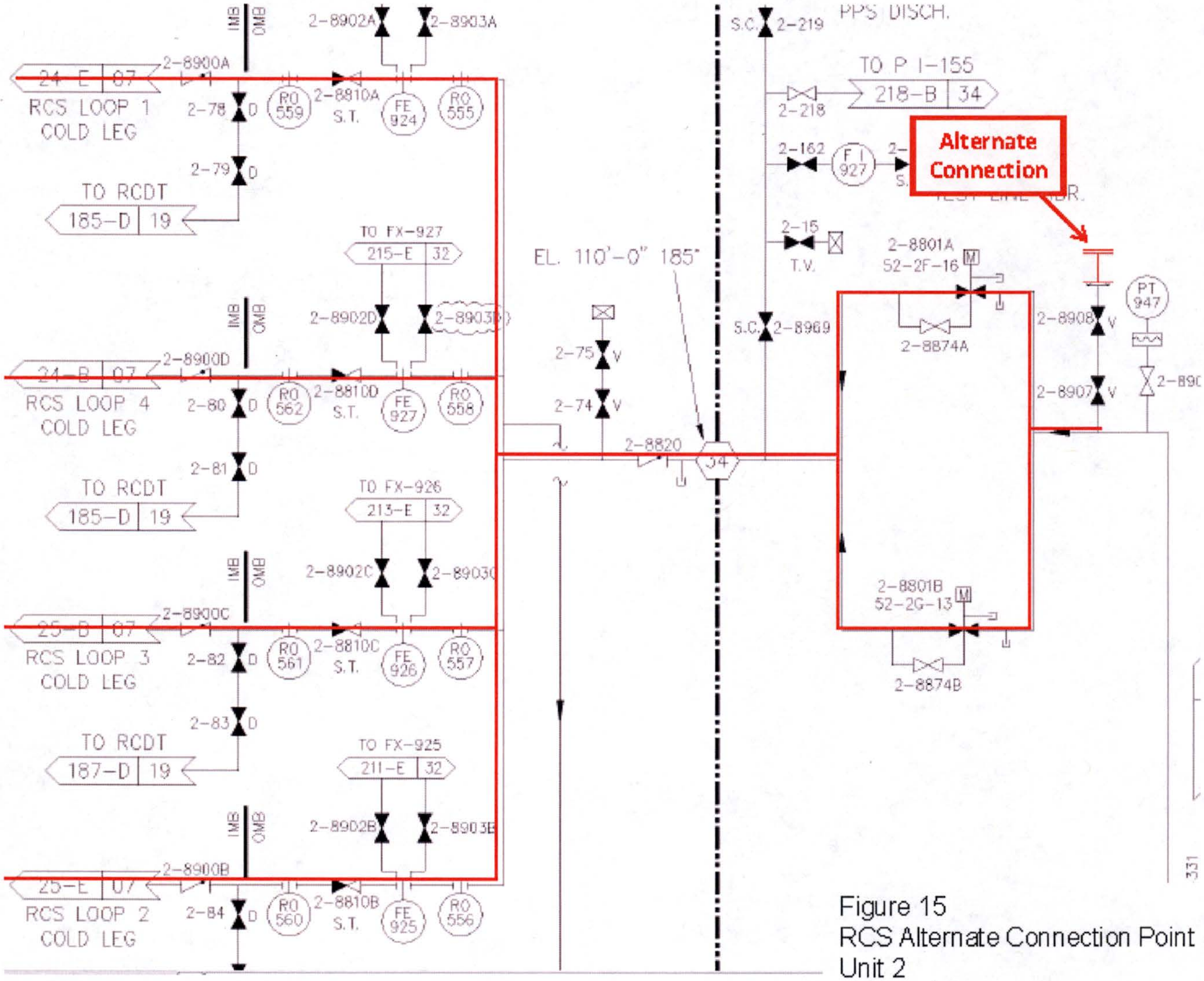
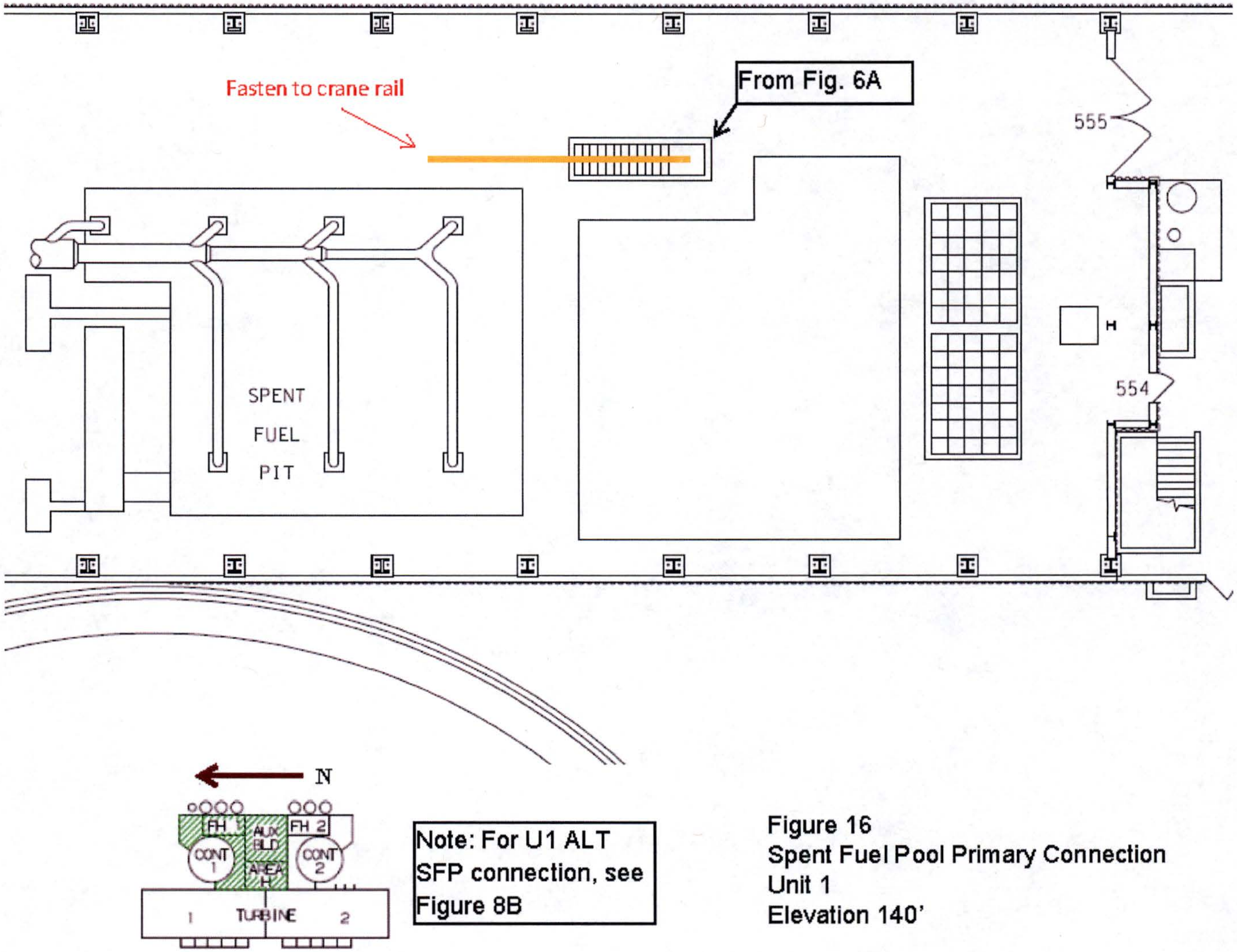
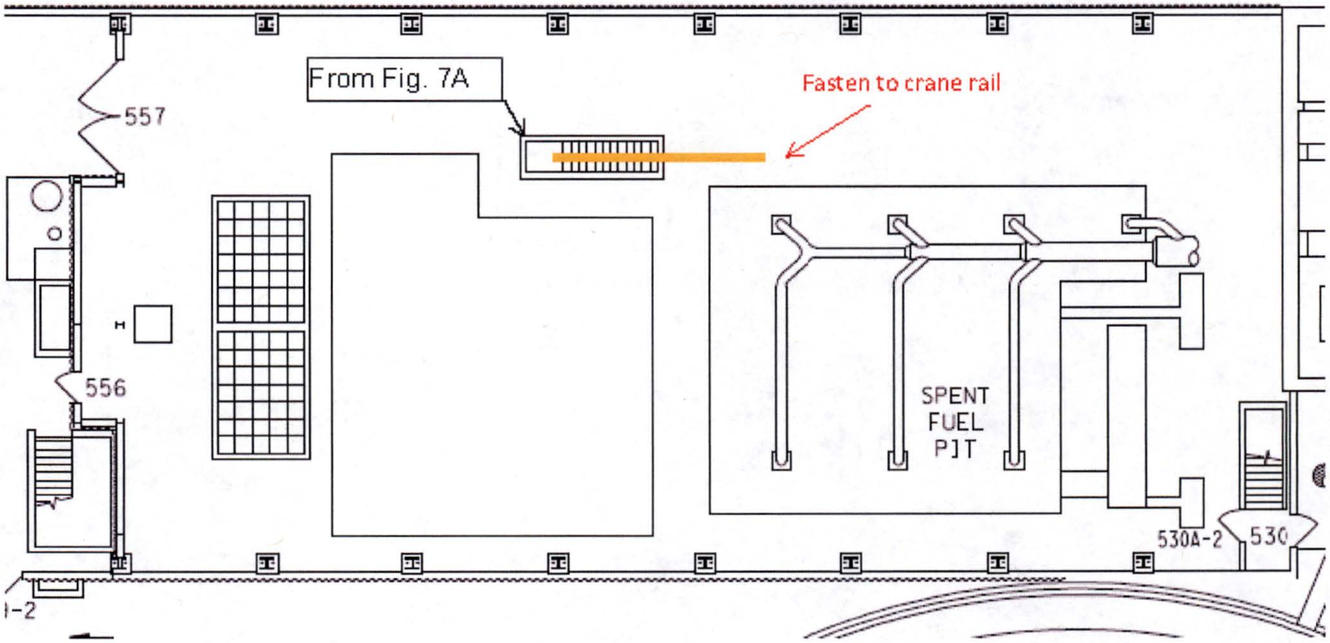


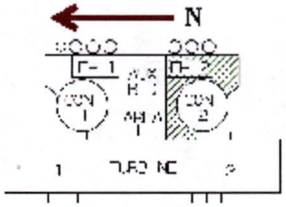
Figure 15
RCS Alternate Connection Point
Unit 2



Note: For U1 ALT SFP connection, see Figure 8B

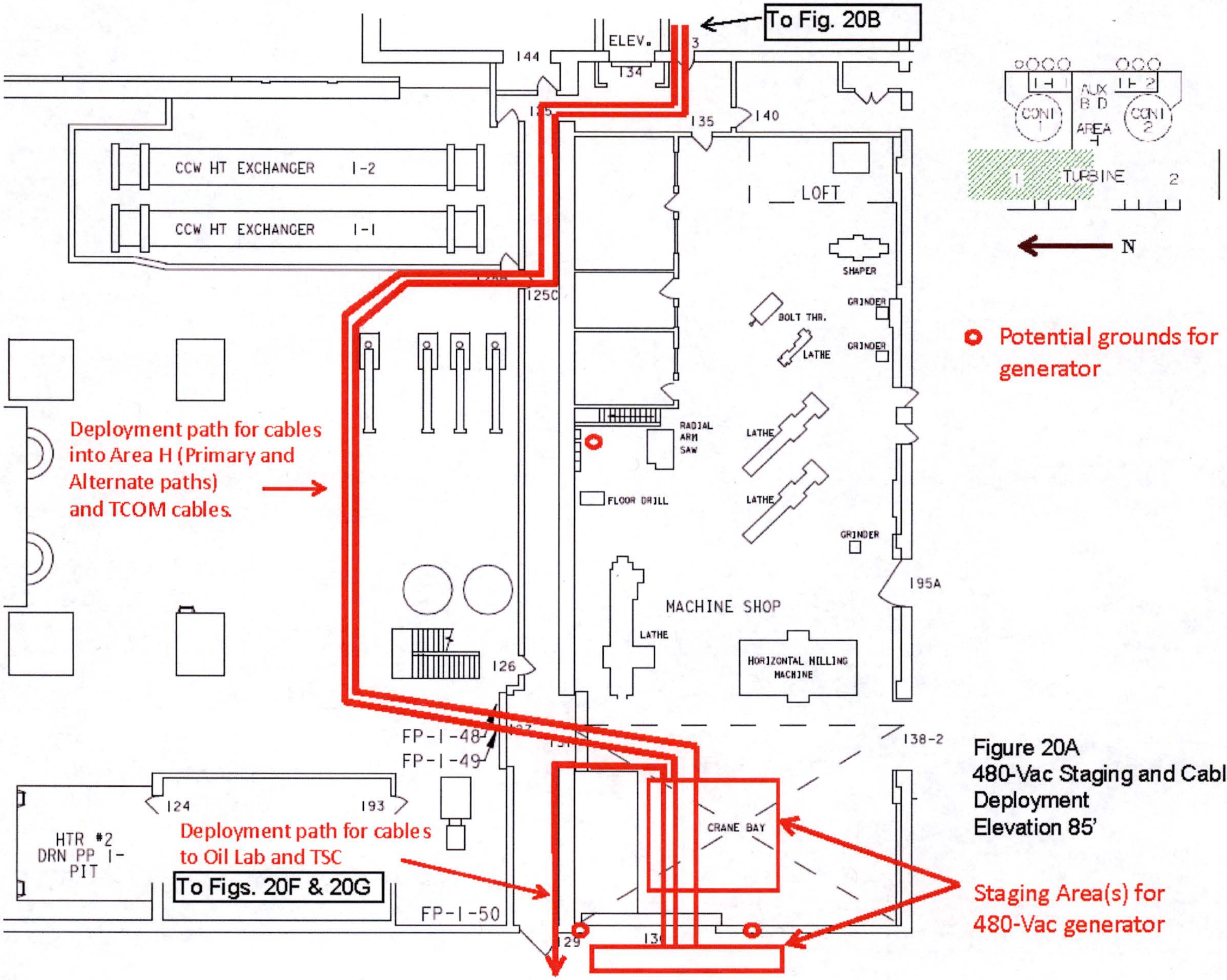
Figure 16
Spent Fuel Pool Primary Connection
Unit 1
Elevation 140'





Note: For U2 ALT SFP connection, see Figure 9B

Figure 17
Spent Fuel Pool Primary Connection
Unit 2
Elevation 140'



Potential grounds for generator

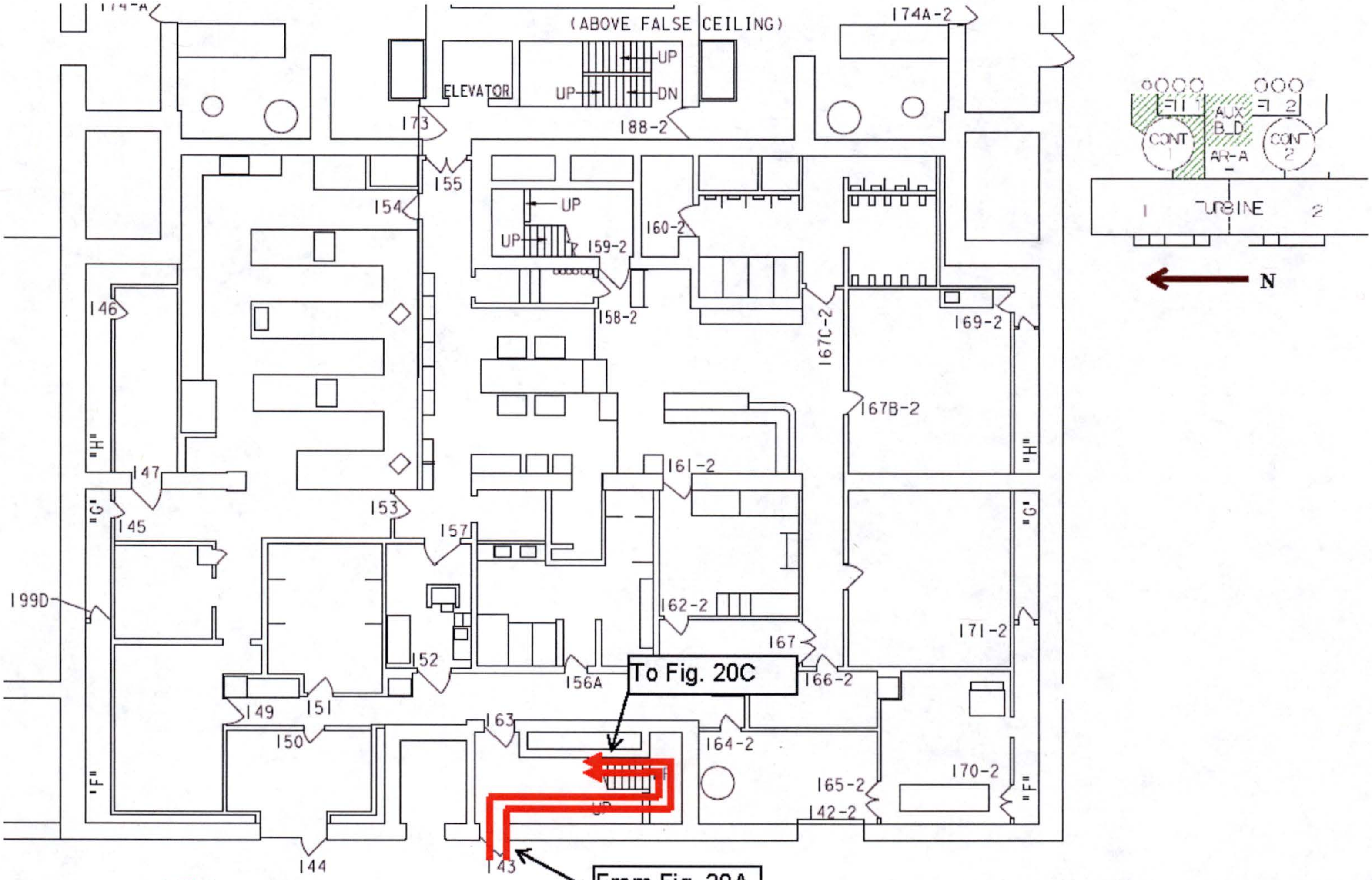
Deployment path for cables into Area H (Primary and Alternate paths) and TCOM cables.

Deployment path for cables to Oil Lab and TSC

To Figs. 20F & 20G

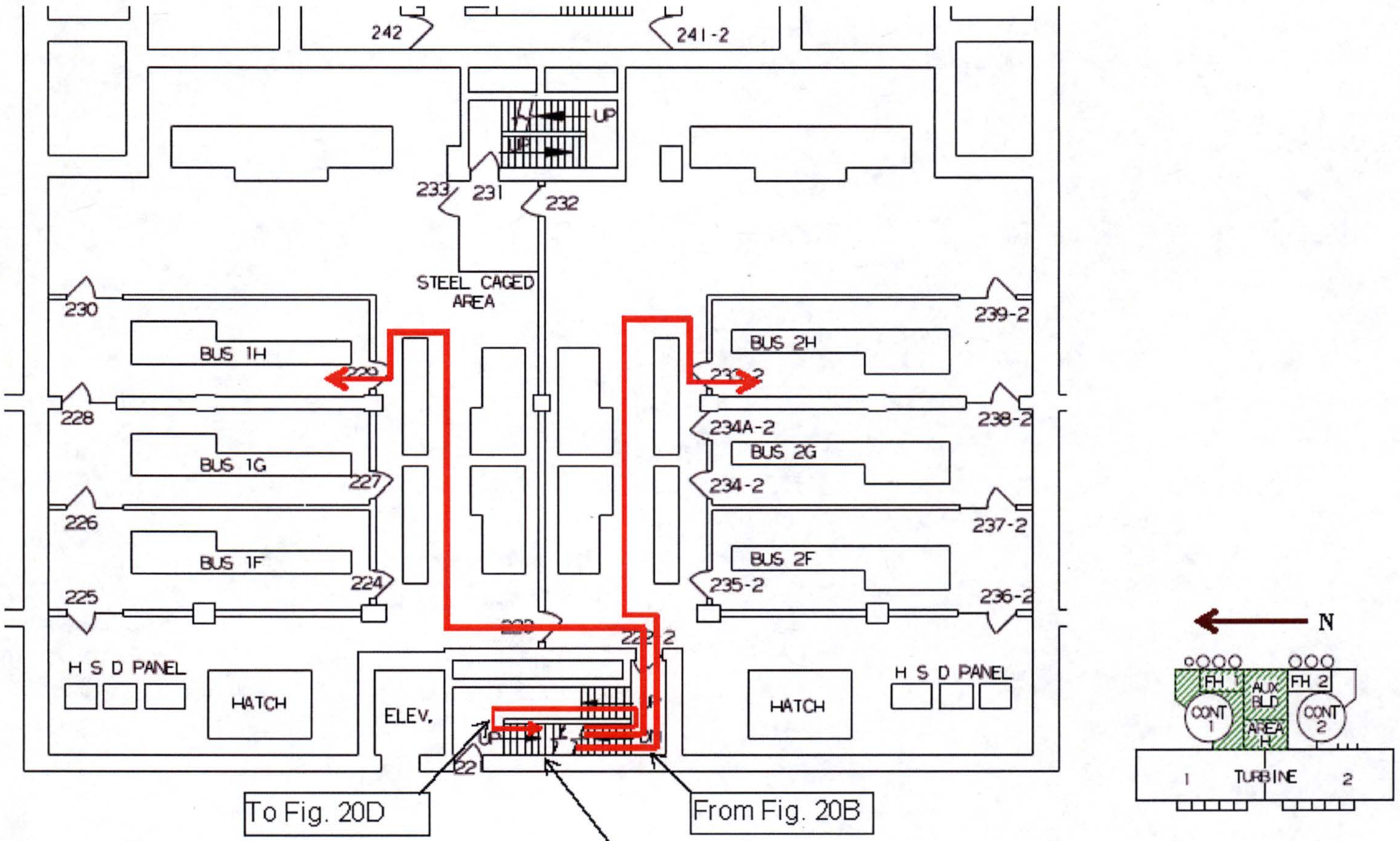
Staging Area(s) for 480-Vac generator

Figure 20A
480-Vac Staging and Cable Deployment
Elevation 85'



85' Area H
Cables routed up stairwell to 100' (primary) or 115' (alternate). TCOM cables routed to 128'.

Figure 20B
480-Vac Cable Routing
Elevation 85'



100' Area H – Primary connection. Cables routed into switchgear rooms and connected to new FLEX transfer switches for Bus 1H & 2H.

TCOM cables routed up stairwell to 128'

Figure 20C
480-Vac Cable Routing
Elevation 100'

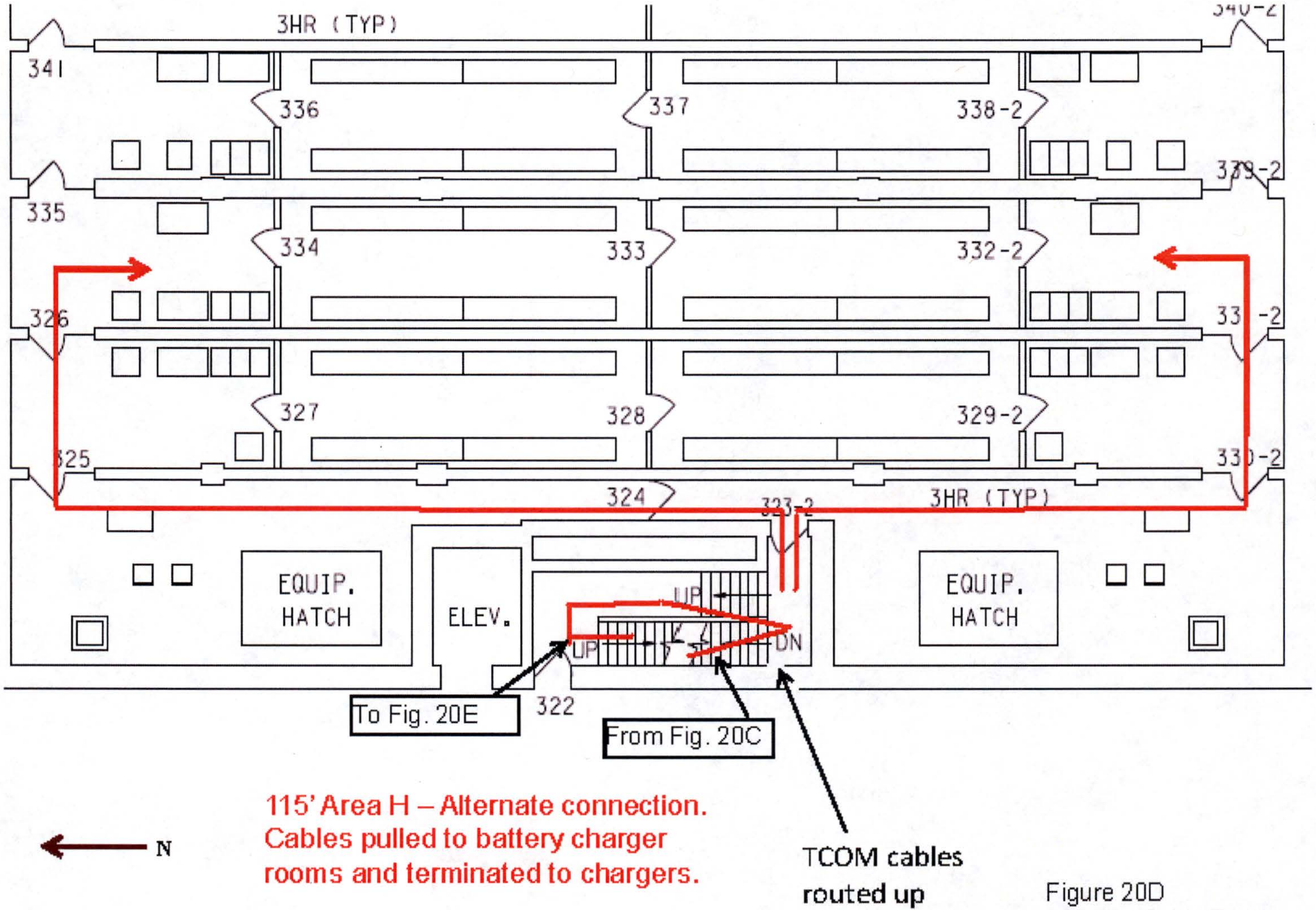
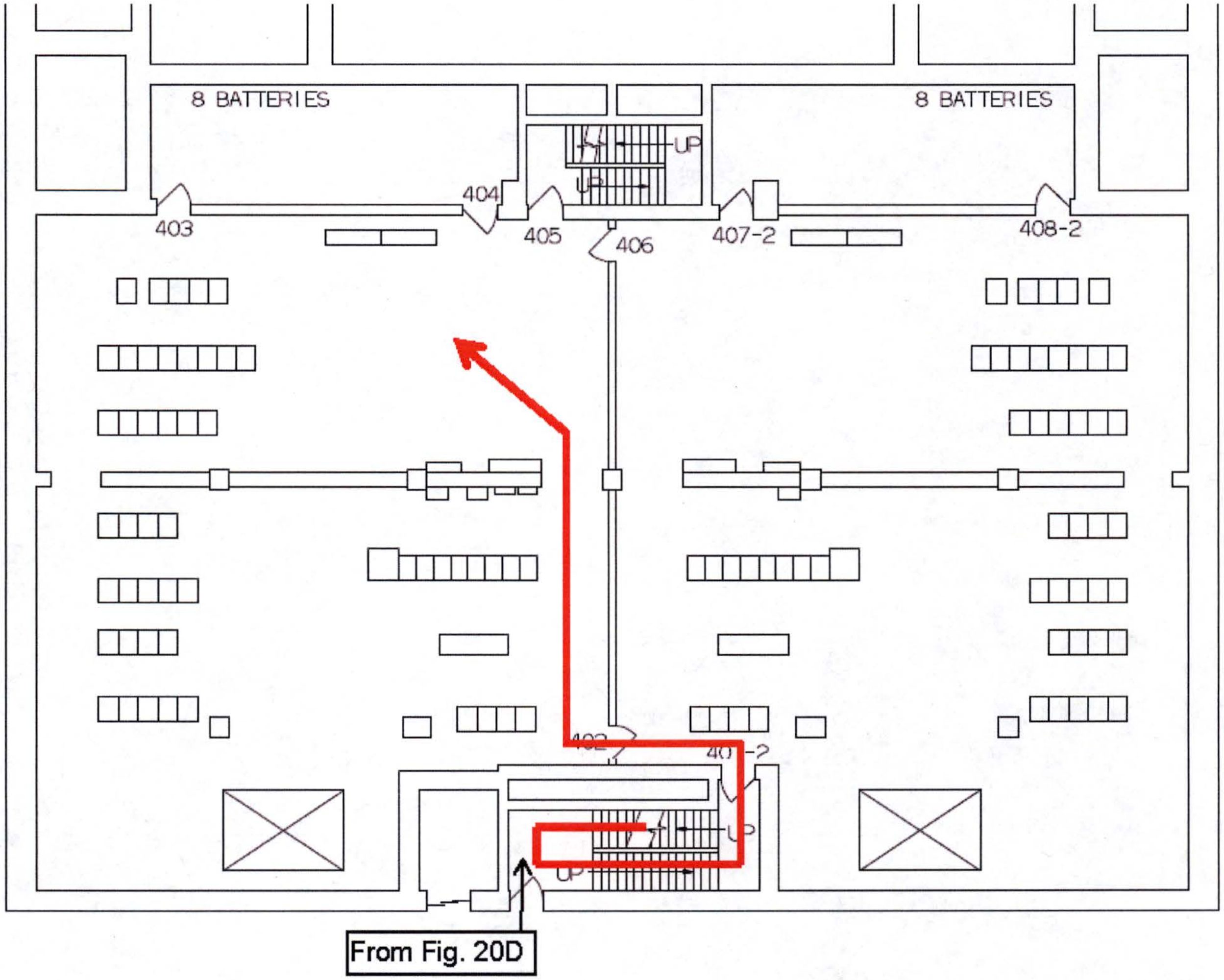


Figure 20D
480-Vac Cable Routing
Elevation 115'



128' Area H – Cable connection to TCOM system batteries

Figure 20E
480-Vac Cable Routing
Elevation 128'

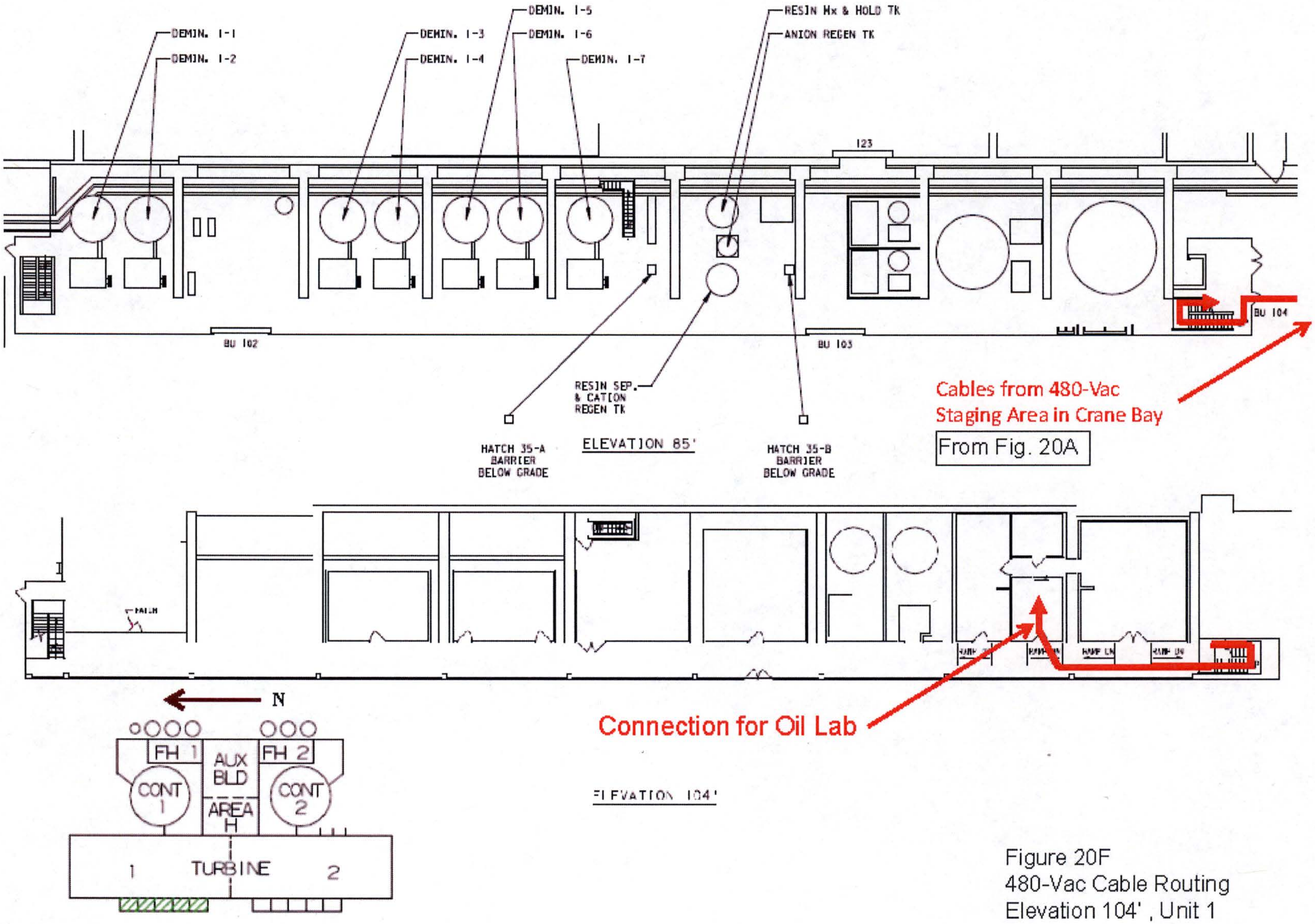


Figure 20F
480-Vac Cable Routing
Elevation 104' , Unit 1

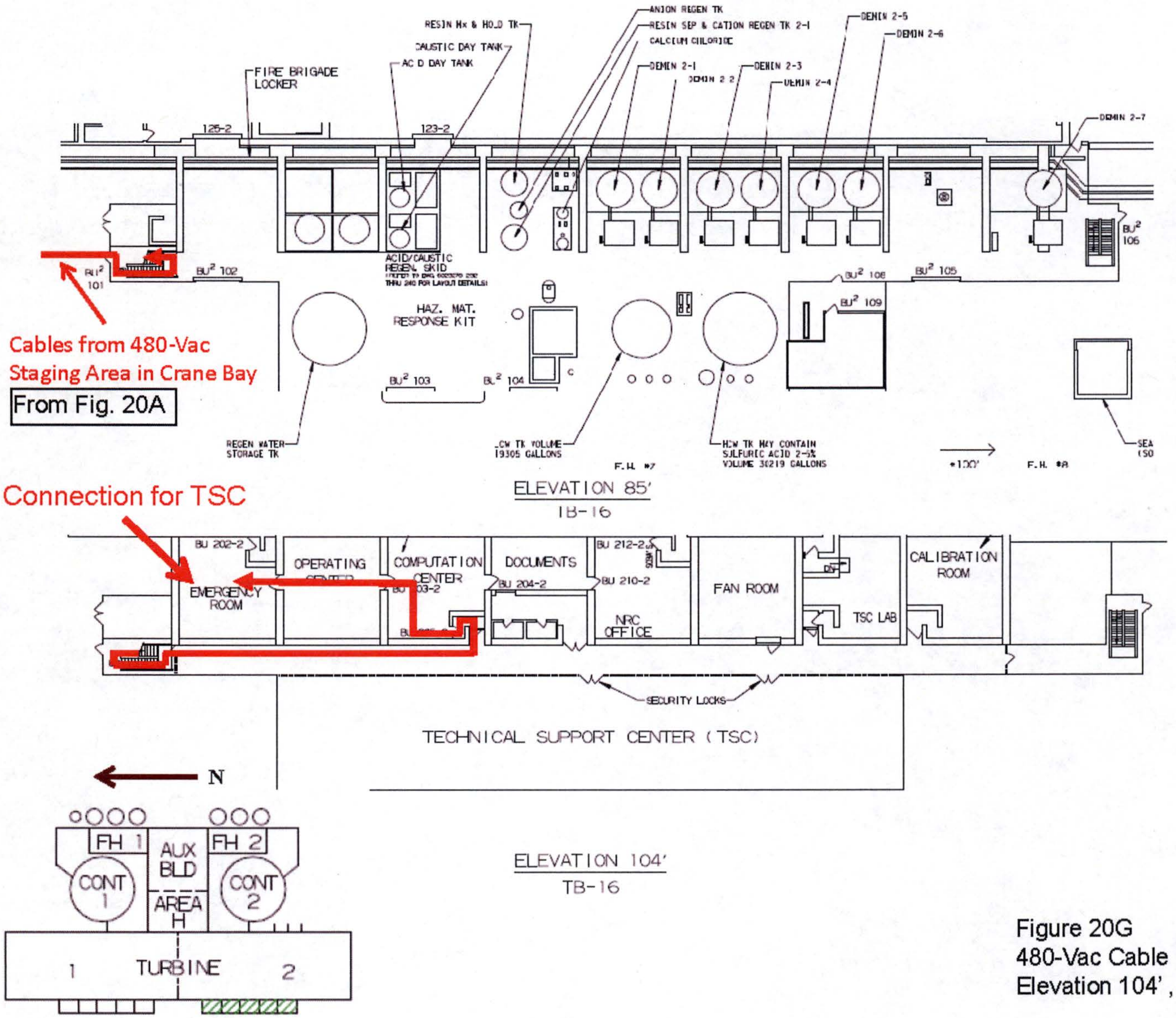
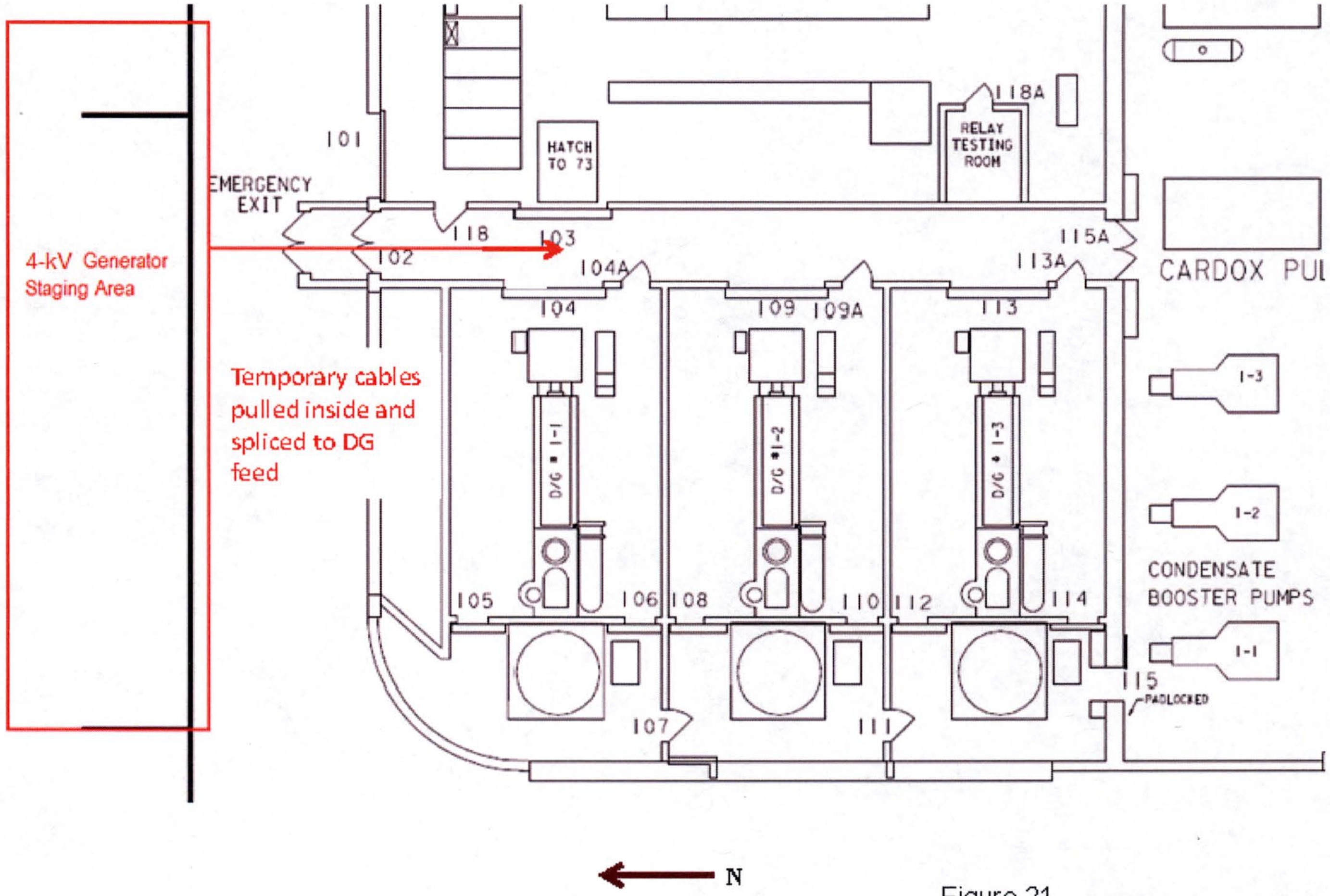


Figure 20G
480-Vac Cable Routing
Elevation 104', Unit 2



Temporary cables pulled inside and spliced to DG feed

Figure 21
4-kV Generator and Cable Routing
Unit 1 - Elevation 85'

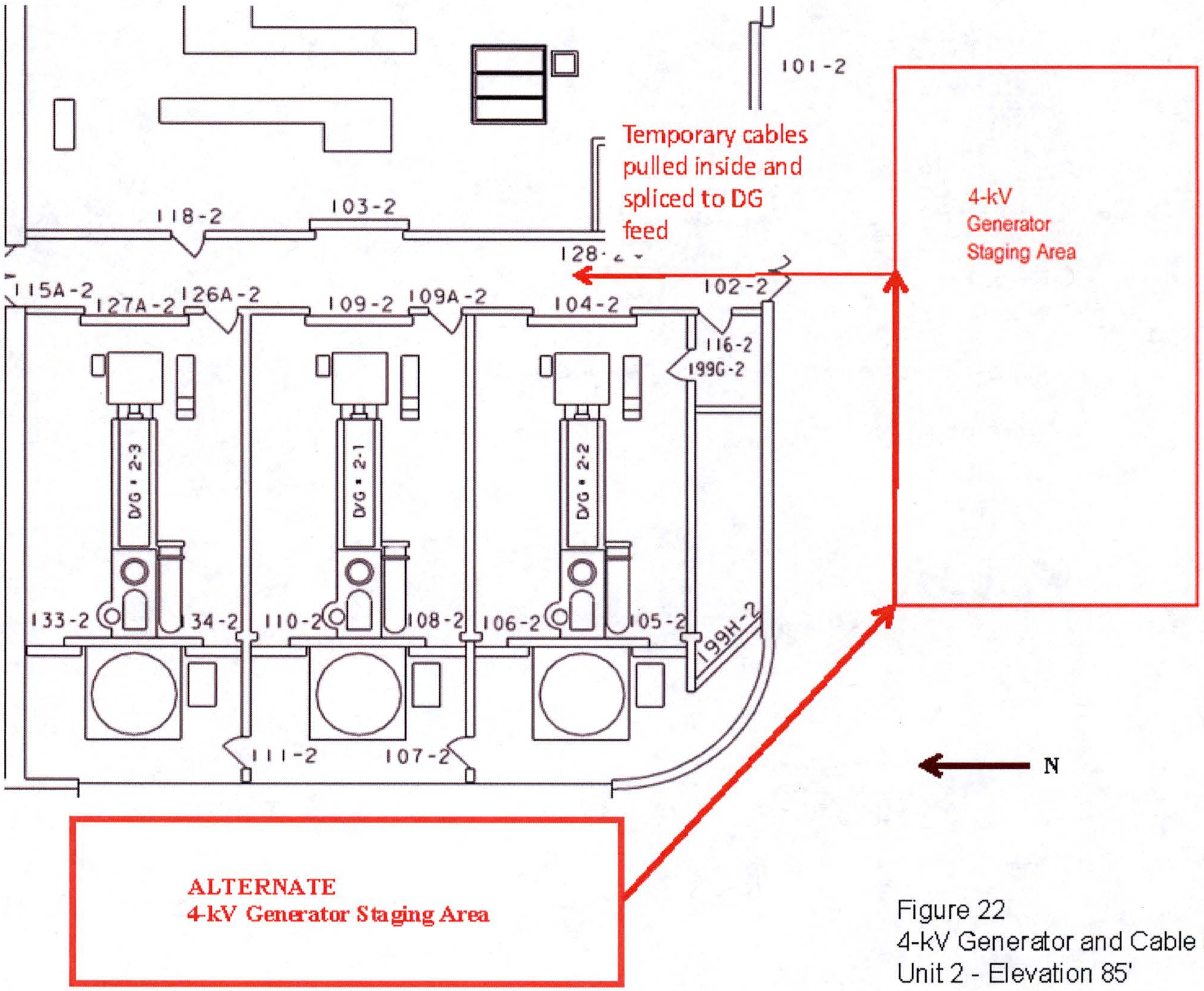


Figure 22
4-kV Generator and Cable Routing
Unit 2 - Elevation 85'