WOLF CREEK NUCLEAR OPERATING CORPORATION

January 19, 2017

Jaime H. McCoy
Vice President Engineering

ET 17-0003

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References:

1) Letter dated March 12, 2012, from E. J. Leeds and M. R. Johnson, USNRC, to M. W. Sunseri, WCNOC, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events"

2) NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0, August 29, 2012

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

4) Letter ET 12-0029, dated October 29, 2012, from J. P. Broschak, WCNOC, to USNRC

5) Letter WO 13-0014, dated February 28, 2013, from R. A. Smith, WCNOC, to USNRC

6) Letter ET 13-0027, dated August 28, 2013, from J. P. Broschak, WCNOC, to USNRC

7) Letter ET 14-0011, dated February 26, 2014, from J. P. Broschak, WCNOC, to USNRC

8) Letter ET 14-0024, dated August 28, 2014, from C. O. Reasoner, WCNOC, to USNRC

9) Letter ET 15-0005, dated February 24, 2015, from J. H. McCoy, WCNOC, to USNRC

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10) Letter ET 15-0020, dated August 25, 2015, from J. H. McCoy, WCNOC, to USNRC

11) Letter ET 16-0008, dated February 17, 2016, from J. H. McCoy, WCNOC, to USNRC

12) Letter ET 16-0018, dated August 18, 2016, from J. H. McCoy, WCNOC, to USNRC

Subject: Docket No. 50-482: Wolf Creek Nuclear Operating Corporation's Compliance Report for the Implementation of Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" and Final Integrated Plan

Gentlemen:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-049 (Reference 1) to Wolf Creek Nuclear Operating Corporation (WCNOC). Reference 1 was immediately effective and directs WCNOC to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (Reference 2) and an Overall Integrated Plan (OIP) pursuant to Section IV, Condition C. Reference 4 provided the WCNOC initial status report regarding mitigation strategies. Reference 5 provided the WCNOC OIP.

Section IV, Condition C.2 of Reference 1 requires submission of a status report at six-month intervals following submittal of the Overall Integrated Plan. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," provides direction regarding the content of the status reports (Reference 3). References 6, 7, 8, 9, 10, 11, and 12 provided WCNOC's six-month status reports.

Reference 1 requires submission of a report to the NRC when full compliance with the requirements described in Attachment 2 of Reference 1 is achieved. This letter, along with its attachment and enclosure, provides the notification required by Section IV, Condition C. 3 of Reference 1 that full compliance with the requirements described in Attachment 2 of Order EA-12-049 has been achieved by WCNOC. The attachment to this letter provides the full compliance report. The enclosure to this letter provides the Final Integrated Plan (FIP) for WCNOC.

This letter contains no commitments. If you have any questions concerning this matter, please contact me at (620) 364-4156, or Cynthia R. Hafenstine (620) 364-4204.

Sincerely,

Jaime H. McCoy

JHM/rlt

Attachment: Wolf Creek Nuclear Operating Corporation's Compliance Report in Response to Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events"

Enclosure: Wolf Creek Generating Station Diverse and Flexible Coping Mitigation Strategies (FLEX) Final Integrated Plan (FIP)

cc: K. M. Kennedy (NRC), w/a, w/e
B. K. Singal (NRC), w/a, w/e
N. H. Taylor (NRC), w/a, w/e
Senior Resident Inspector (NRC), w/a, w/e

STATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Jaime H. McCoy, of lawful age, being first duly sworn upon oath says that he is Vice President Engineering of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the contents thereof; that he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By ____________________
Jaime H. McCoy
Vice President Engineering

SUBSCRIBED and sworn to before me this 19th day of January, 2017.

GAYLE SHEPHEARD
My Appointment Expires
July 24, 2019

____
Notary Public

Expiration Date 7/24/2019

Wolf Creek Nuclear Operating Corporation's Compliance Report in Response to Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events"

INTRODUCTION

Wolf Creek Nuclear Operating Corporation (WCNOC) developed an Overall Integrated Plan (OIP) (Reference 1), documenting diverse and flexible strategies (FLEX) in response to Reference 2. The OIP for Wolf Creek Generating Station, Unit 1 was submitted to the NRC on February 28, 2013 and was supplemented by six-month status reports (References 3, 4, 5, 6, 7, 8, and 9), in accordance with Order EA-12-049.

Full compliance with Order EA-12-049 was completed on November 21, 2016. This date corresponds to the end of the second refueling outage after submittal of the OIP as required by Reference 2. The information provided herein documents full compliance with Order EA-12-049 for Wolf Creek Generating Station, Unit 1.

NRC ISE AND AUDIT ITEMS – COMPLETE

During the ongoing audit process (Reference 10), WCNOC provided responses for the following items:

- Interim Staff Evaluation (ISE) Open and Confirmatory Items (Reference 11)
- Licensee Identified Open Items (Reference 1)
- Audit Questions
- Safety Evaluation Review Items

The following Open Item remained following the Wolf Creek seventh six-month status report (Reference 9).

Open Item #	Overall Integrated Plan Open Item	Status
OI 3	The current CST and CST pipe chase are non-seismic. Therefore, WCNOC is currently pursuing two options: the qualification and hardening of the existing CST, or construction of a new 670,000 gallon seismically qualified and missile protected CST. One of these options will be completed before the volume of the CST can be credited	Closed - An evaluation was performed to show that the existing Condensate Storage Tank (CST) meets current licensing basis for seismic and tornado missile hazards (References 12, 13, 14, and 15). The CST pipe chase was evaluated and can withstand the current licensing basis for seismic and tornado missile hazards (Reference 16) Design Change Package (DCP) 14277 has been implemented to harden the CST by welding a layer of plating around the tank in order to withstand a

		Safe Shutdown Earthquake. This was completed in Refueling Outage 21. DCP 14864 was implemented to harden the CST Valve House. The Valve House was replaced with a steel structure built to withstand missile hazards and Safe Shutdown Earthquake. This was completed in Refueling Outage 21. DCP 15084 was implemented to upgrade the CST and transfer system piping and pipe supports to withstand a Safe Shutdown Earthquake. This was completed in Refueling Outage 21.

It is Wolf Creek Nuclear Operating Corporation's position that no further actions are required related to Interim Staff Evaluation (ISE) Open and Confirmatory Items, Audit Questions, Safety Evaluation Review Items, and Licensee Identified Open Items.

MILESTONE SCHEDULE – ITEMS COMPLETE

Unit 1 Milestone	Completion Date
Submit Overall Integrated Plan	Feb 2013
6-Month Status Updates	
Update 1	Aug 2013
Update 2	Feb 2014
Update 3	Aug 2014
Update 4	Feb 2015
Update 5	Aug 2015
Update 6	Feb 2016
Update 7	Aug 2016
FLEX Strategy Evaluation	Apr 2013
Walk-Throughs or Demonstrations	Sep 2016
Perform Staffing Analysis	Jan 2016
Modifications:	
Modifications Evaluation	Apr 2013
N-1 Walkdown	Apr 2014
Design Engineering	Jan. 2014

Condensate Storage Tank (CST) Reinforcement Design Engineering	Nov 2016
Implementation Outage	Nov 2016
FLEX Equipment:	
Procure On-Site Equipment	Apr 2016
Develop Strategies with Regional Response Center (RRC)	Sep 2015
Install Off-Site Delivery Station (if necessary)	Nov 2016
Procedures:	
Pressurized Water Reactor Owners Group (PWROG) issues NSSS-specific guidelines	May 2013
Create WCGS FLEX Support Guidelines (FSG)	Sep 2016
Create Maintenance Procedures	Nov 2016
Training:	
Develop Training Plan	Jul 2014
Training Complete	Sep 2016
Submit Completion Report	Jan 2017

STRATEGIES – COMPLETE

Strategy related ISE Open and Confirmatory Items, Audit Questions, and Safety Evaluation Review Items have been addressed in the Final Integrated Plan (FIP). The WCNOC strategies are in compliance with Order EA-12-049.

MODIFICATIONS – COMPLETE

The modifications required to support the FLEX strategies for Wolf Creek Generating Station (WCGS) have been completed in accordance with the station design control process. The plant modification design change packages (DCPs) implemented in support of the FLEX strategies for compliance are as follows:

NRC FLEX ORDER 12-EA-049		
MODIFICATION	**DCP**	**DCP TITLE**
HARDENED CONDENSATE STORAGE TANK (CST)	14277	Fukushima Missile Protection and Seismic Upgrade the CST
	14864	CST Valve House Missile Protection and Seismic Upgrade
	14977	Relocation of APV0022
	15057	CST Valve House Missile Protection and Seismic Upgrade – Electrical Scope
	15084	CST and Transfer System and Pipe Support FLEX Modifications
SATELLITE PHONES	14259	Satellite Telephone Battery Chargers and Antennas
REACTOR COOLANT SYSTEM (RCS) MAKEUP (including RWST)	14413	Fukushima Reactor Coolant Connections
ELECTRICAL	14414	Fukushima Electrical Modifications
ESSENTIAL SERVICE WATER (ESW)	14425	ESW FLEX Piping Modification
FLEX PRIMARY AND ALTERNATE BUILDINGS	14459	Fukushima Storage FLEX Building 1 and 2 Grounding
REACTOR WATER MAKEUP STORAGE TANK (RWMST)	14463	Fukushima Reactor Make-up Water Connections
STEAM GENERATOR MAKEUP	14495	Fukushima Auxiliary Feedwater Connections
SPENT FUEL POOL MAKEUP	14496	Fukushima Spent Fuel Pool Makeup
COMMUNICATIONS	14625	Voice Over Internet Protocol (VoIP) – Olive Ann Beech Administration Building
	14626	VoIP Power Upgrade – Dwight D. Eisenhower Bldg
	14627	VoIP Power Upgrade – Relief Area and Radio Room
	14628	VoIP Power Upgrade – Technical Support Center
	14629	VoIP Power Upgrade – Security Locations
REACTOR COOLANT PUMP (RCP) PASSIVE SHUTDOWN SEALS	14831	RCP Passive Shutdown Seal

Copies of the FLEX related design modification change packages have previously been provided to the NRC staff and are available for their review.

EQUIPMENT – PROCURED AND MAINTENANCE & TESTING – COMPLETE

The equipment required to implement the FLEX strategies for WCGS has been procured in accordance with NEI 12-06, Section 11.1 and 11.2 (Reference 17), received onsite, initially tested, performance verified as identified in NEI 12-06, Section 11.5, and is available for use.

Maintenance and testing will be conducted through the use of the WCNOC's Preventative Maintenance Program such that equipment reliability is maintained and is in compliance with Electric Power Research Institute (EPRI) guidelines where applicable to the FLEX equipment.

PROTECTED STORAGE – COMPLETE

The storage facilities required to protect FLEX equipment have been completed for WCGS. The FLEX equipment is protected from the applicable site hazards and will remain deployable to assure implementation of the FLEX strategies for WCGS.

PROCEDURES – COMPLETE

FSGs for WCGS have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been approved 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-Basis External Events at WCGS has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6.

STAFFING – COMPLETE

The staffing study for WCGS has been completed in accordance with Enclosure 5 pertaining to Recommendation 9.3 of Reference 17. Reference 18 provided the staffing assessment. Reference 19 provided the NRC acceptance of the proposed staffing. The FSG strategies can be successfully implemented using the current minimum on-shift staffing.

NATIONAL SAFER RESPONSE CENTERS – COMPLETE

WCNOC has established a contract with Pooled Equipment Inventory Company (PEICo) and has joined the Strategic Alliance for FLEX Emergency Response (SAFER) Team Equipment Committee for off-site facility coordination. It has been confirmed that PEICo is ready to support WCGS, with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site-specific SAFER Response Plan (Reference 20).

VALIDATION – COMPLETE

WCNOC has completed validation testing of the FLEX strategies for WCGS in accordance with industry developed guidance. The validations assure that required tasks, manual actions, and decisions for FLEX strategies may be executed within the constraints identified in the FIP for Order EA-12-049.

FLEX PROGRAM DOCUMENT – ESTABLISHED

The FLEX Program Document has been developed in accordance with the requirements of NEI 12-06 (Reference 21) and is in effect for WCGS.

REFERENCES

1. WCNOC Letter WO 13-0014, "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," February 28, 2013. ADAMS Accession No. ML13070A026.

2. Letter from E. J. Leeds and M. R. Johnson, USNRC, to M. W. Sunseri, WCNOC, "Issuance of Order to Modify Licenses with Regard to Requirements For Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012. ADAMS Accession No. ML12054A735.

3. WCNOC Letter ET 13-0027, "Wolf Creek Nuclear Operating Corporation's First Six-Month Status Report for the Implementation of Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events'," August 28, 2013. ADAMS Accession No. ML13247A277.

4. WCNOC Letter ET 14-0011, "Wolf Creek Nuclear Operating Corporation's Second Six-Month Status Report for the Implementation of Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events'," February 26, 2014. ADAMS Accession No. ML14064A190.

5. WCNOC Letter ET 14-0024, "Wolf Creek Nuclear Operating Corporation's Third Six-Month Status Report for the Implementation of Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events'," August 28, 2014. ADAMS Accession No. ML14246A191.

6. WCNOC Letter ET 15-0005, "Wolf Creek Nuclear Operating Corporation's Fourth Six-Month Status Report for the Implementation of Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events'," February 24, 2015. ADAMS Accession No. ML15062A033.

7. WCNOC Letter ET 15-0020, "Wolf Creek Nuclear Operating Corporation's Fifth Six-Month Status Report for the Implementation of Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events'," August 25, 2015. ADAMS Accession No. ML15244B181.

8. WCNOC Letter ET 16-0008, "Wolf Creek Nuclear Operating Corporation's Sixth Six-Month Status Report for the Implementation of Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events'," February 17, 2016. ADAMS Accession No. ML16055A113.

9. WCNOC Letter ET 16-0018, "Wolf Creek Nuclear Operating Corporation's Seventh Six-Month Status Report for the Implementation of Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events'," August 18, 2016. ADAMS Accession No. ML16239A397.

10. Letter from J. R. Davis, USNRC, to M. W. Sunseri, WNCOC, "Nuclear Regulatory Commission Audits of Licensee Responses to Mitigation Strategies Order EA-12-049," August 28, 2013. ADAMS Accession No. ML13234A503.

11. Letter from J. S. Bowen, USNRC, to A. C. Heflin, WCNOC, "Wolf Creek Generating Station, Unit 1 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies)," February 6, 2014. ADAMS Accession No. ML14002A190.

12. 020542.13.01-C-001, Revision 0, "Condensate Storage Tank and Refueling Water Storage Tanks Tornado Missile Impact Analysis," November 2013.

13. 020542.13.01-C-002, Revision 0, "Structural Analysis of Condensate Storage Tank," November 2013.

14. 020542.13.01-C-003, Revision 0, "Condensate Storage Tank Valve House and Refueling Water Storage Tank Valve House Missile Impact and Seismic Analysis," December 2013.

15. 020542.13.01-C-004, Revision 0, "Condensate Storage Tank Pipe Stress Analysis," December 2013.

16. 020542.13.01-C-009, Revision 0, "Condensate Storage Tank Pipe Tunnel Evaluation," December 2013.

17. Letter from E. J. Leeds and M. R. Johnson, USNRC, to M. W. Sunseri, WCNOC, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," March 12, 2012. ADAMS Accession No. ML 12053A340.

18. WCNOC Letter WO 16-0003, "Wolf Creek Nuclear Operating Corporation Fukushima Staffing," January 18, 2016. ADAMS Accession No. ML16028A329.

19. Letter from M. A. Brown, USNRC, to A. C. Heflin, WCNOC, "Wolf Creek Generating Station – Response Regarding Phase 2 Staffing Submittals Associated with Near-Term Task Force Recommendation 9.3 Related to the Fukushima Dai-ichi Nuclear Power Plant Accident," March 22, 2016. ADAMS Accession No. ML16075A362.

20. Letter from J. R. Davis, USNRC, to J. E. Pollock, NEI, "Staff Assessment of National SAFER Response Centers Established in Response to Order EA-12-049," September 26, 2014. ADAMS Accession No. ML14265A107.

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

FD-FIP-001
Wolf Creek Generating Station (WCGS)
Diverse and Flexible Coping Mitigation Strategies (FLEX)
Final Integrated Plan

Revision 0
January 11, 2017

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ACRONYMNS

AC	Alternating Current
AFW	Auxiliary Feedwater
ARV	Atmospheric Relief Valve
ASD	Auxiliary Shutdown
BAT	Boric Acid Tank
BDB	Beyond-Design-Basis
BDBEE	Beyond-Design-Basis External Events
BIT	Boron Injection Tank
CCW	Component Cooling Water
CFR	Code of Federal Regulations
CST	Condensate Storage Tank
DC	Direct Current
DG	Diesel Generator
EDG	Emergency Diesel Generator
ELAP	Extended Loss of AC Power
EOF	Emergency Operations Facility
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
ERO	Emergency Response Organization
ESEP	Expedited Seismic Evaluation Process
ESF	Engineering Safety Feature
ESGR	Emergency Switchgear Room
ESW	Essential Service Water
FHRR	Flood Hazard Reevaluation Report
FLEX	Diverse and Flexible Coping Mitigation Strategies
FSB	FLEX Storage Building
FSG	FLEX Support Guideline
GMRS	Ground Motion Response Spectra
INPO	Institute of Nuclear Power Operations
LIP	Local Intense Precipitation
LLL	Lawrence Livermore Laboratories
LUHS	Loss of Normal Access to the Ultimate Heat Sink
MCR	Main Control Room
MDAFWP	Motor-Driven Auxiliary Feedwater Pump
NRC	Nuclear Regulatory Commission
MSIV	Main Steam Isolation Valve
MSL	Mean Sea Level
NEI	Nuclear Energy Institute
NR	Narrow Range
NSRC	National SAFER Response Center
NSSS	Nuclear Steam Supply System
NTTF	Near-Term Task Force
OBE	Operational Basis Earthquake
OFN	Off Normal Operating Procedures

ACRONYMNS (continued)

PM	Preventive Maintenance
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PWROG	Pressurized Water Reactor Owners Group
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RO	Reactor Operator
RVLIS	Reactor Vessel Level Indication System
RWST	Refueling Water Storage Tank
SAFER	Strategic Alliance for FLEX Emergency Response
SAT	Systematic Approach to Training
SBO	Station Blackout
SDM	Shutdown Margin
SFP	Spent Fuel Pool
SG	Steam Generator
SI	Safety Injection
SOE	Sequence of Events
SSE	Safe Shutdown Earthquake
TDAFWP	Turbine Driven Auxiliary Feedwater Pump
TSC	Technical Support Center
TSS	Total Suspended Solids
USAR	Updated Safety Analysis Report
UHS	Ultimate Heat Sink
US	United States
WCGS	Wolf Creek Generating Station
WCNOC	Wolf Creek Nuclear Operating Corporation
WR	Wide Range
ZPA	Zero Period Acceleration

1 BACKGROUND

In 2011, an earthquake-induced tsunami caused Beyond Design Basis (BDB) flooding at the Fukushima Daiichi Nuclear Power Station in Japan. The flooding caused the emergency power supplies and electrical distribution systems to be inoperable, resulting in an Extended Loss of alternating current (AC) Power (ELAP)/Loss of Normal Access to the Ultimate Heat Sink (LUHS) in five of the six units on the site. The ELAP/LUHS led to (1) the loss of core cooling, (2) loss of Spent Fuel Pool (SFP) cooling capabilities, and (3) a significant challenge to maintaining containment integrity. All direct current (DC) power was lost early in the event at Units 1 and 2 and after some period of time at the other units. Core damage occurred in three of the units along with a loss of Containment integrity, resulting in a release of radioactive material to the surrounding environment.

The United States (US) Nuclear Regulatory Commission (NRC) assembled a Near Term Task Force (NTTF) to advise the NRC on actions the US nuclear industry should take to preclude core damage and a release of radioactive material after a natural disaster such as that seen at Fukushima. The NTTF report (Reference 1) contained many recommendations to fulfill this charter, including assessing Beyond Design Basis External Event (BDBEE) hazards and strengthening station capabilities for responding to BDBEEs.

Based on NTTF Recommendation 4.2, the NRC issued Order EA-12-049 (Reference 2) on March 12, 2012 to implement mitigation strategies for BDBEEs. The Order included the following requirements:

- Licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities following a BDBEE.
- Licensees shall develop strategies that are capable of mitigating an ELAP and have adequate capacity to address challenges to core cooling, containment and SFP cooling capabilities at all units on a site subject to the Order.
- Licensees must provide reasonable protection for the associated equipment from BDBEEs. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to the Order.
- Licensees must be capable of implementing the strategies in all modes.
- Full compliance shall include procedures, guidance, training, and acquisition, staging or installing of equipment needed for strategies.

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

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

NRC Order EA-12-049, Diverse and Flexible Mitigation Capability (FLEX) (Reference 2), required licensees of operating reactors to submit an overall integrated plan, including a description of how compliance with these requirements would be achieved by February 28, 2013. The Order also required licensees to complete implementation of the requirements no later than two refueling cycles after submittal of the overall integrated plan or December 31 2016, whichever came first.

The Nuclear Energy Institute (NEI) developed NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide (Reference 3), which provided guidelines for nuclear stations to assess extreme external event hazards and implement the mitigation strategies specified in NRC Order EA-12-049 (Reference 2). The NRC issued Interim Staff Guidance JLD-ISG-2012-01 (Reference 4), which endorsed NEI 12-06 (Reference 3) with clarifications on determining baseline coping capability and equipment quality.

NRC Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012 (Reference 5) required licensees to install reliable SFP instrumentation with specific design features for monitoring SFP water level. This Order was prompted by NTTF Recommendation 7.1 (Reference 1).

NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051 (Reference 6), provided guidance for compliance with NRC Order EA-12-051 (Reference 5). The NRC determined that, with the exceptions and clarifications provided in JLD-ISG-2012-03 (Reference 7), conformance with the guidance in NEI 12-02 (Reference 6) was an acceptable method for satisfying the requirements in NRC Order EA-12-051 (Reference 5).

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 potential Wolf Creek Generating Station (WCGS) ELAP event and the development of FLEX strategies are stated below

Boundary conditions consistent with NEI 12-06 (Reference 3) are established to support development of FLEX strategies as follows:

- The reactor is 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
- The reactor is successfully shut down when required (i.e., all rods inserted, no anticipated transient without scram). Steam release to maintain decay heat removal upon shutdown functions normally, and Reactor Coolant System (RCS) overpressurization valves respond normally, if required by plant conditions, and reseat.
- 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.

The following plant initial conditions and assumptions are established for the purpose of defining FLEX strategies and are consistent with NEI 12-06 (Reference 3):

- No specific initiating event is used. The initial condition is assumed to be a Loss of Offsite Power with installed sources of emergency onsite AC power and Station Blackout (SBO) alternate AC power sources unavailable with no prospect for recovery.
- Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles are available. Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles, are available. The portion of the fire protection system that is robust with respect to seismic events, floods, and high winds and associated missiles is available as a water source.
- 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 BDB equipment stored in structures with designs that are robust with respect to seismic events, floods and high winds and associated missiles, remains available.
- Installed Class 1E electrical distribution systems, including inverters and battery chargers, remain available since they are protected.
- No additional accidents, events, or failures are assumed to occur immediately prior to or during the event, including security events.
- Reactor coolant inventory loss consists of unidentified leakage at the upper limit of Technical Specifications, reactor coolant letdown flow (until isolated), and Reactor Coolant Pump (RCP) seal leak-off at normal maximum rate.
- For the SFP, the heat load is assumed to be the maximum design basis heat load. In addition, inventory loss from sloshing during a seismic event does not preclude access to the pool area.

Additionally, key assumptions associated with implementation of FLEX strategies are as follows:

- Exceptions for the site security plan or other requirements of Title 10 of the Code of Federal Regulations (CFR) may be required.
- Deployment resources are assumed to begin arriving at hour 6 and unlimited resources available after 24 hours.
- This plan defines strategies capable of mitigating an ELAP resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions to protect the public health and safety.

The Emergency Operating Procedures (EOP) have been revised, per established EOP change processes, to clearly reference and identify appropriate entry and exit conditions for these pre-planned strategies. The EOPs retain overall command and control of the actions responding to a BDBEE. Also, the impact of these strategies on the design basis capabilities of the unit has been evaluated under 10CFR50.59.

- The WCGS Technical Specifications (Reference 11) contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the BDBEE may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security Plan, and, as such, may warrant invocation of 10CFR50.54(x) and/or 10CFR73.55(p). This position is consistent with the previously documented TIA 2004 04 (Reference 8).

2.2 STRATEGIES

The objective of the FLEX strategies is to establish an indefinite coping capability in order to 1) prevent damage to the fuel in the reactor, 2) maintain the containment function and 3) maintain cooling and prevent damage to fuel in the SFP using installed equipment, onsite portable equipment, and pre-staged offsite resources. This indefinite coping capability will address an ELAP (loss of offsite power, Emergency Diesel Generators (EDG), and any alternate AC source but not the loss of AC power to buses fed by Class 1E batteries through inverters) with a simultaneous loss of normal access to the UHS. This condition could arise following BDBEEs that are within the existing design basis with additional failures and conditions that could arise from a BDBEE.

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

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

- Phase 1 – Initially cope by relying on installed plant equipment and onsite resources.
- Phase 2 – Transition from installed plant equipment to onsite BDB equipment.
- Phase 3 – Obtain additional capability and redundancy from offsite equipment 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 strategies described below are capable of mitigating an ELAP resulting from a BDBEE by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at WCGS.

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 WCGS EOPs per established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10CFR50.59.

2.3 REACTOR CORE COOLING STRATEGY

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 steam from the steam generators (SGs) using the SG atmospheric relief valves (ARVs) and the addition of a corresponding amount of auxiliary feedwater to the SGs via the Turbine Driven Auxiliary Feedwater Pump (TDAFWP). The Auxiliary Feedwater (AFW) System includes the Condensate Storage Tank (CST) as the initial water supply to the TDAFWP. Operator actions to verify, to potentially re-align, and to throttle AFW flow is required by the EOPs following an ELAP to prevent SG dryout and/or overfill.

RCS cooldown will be initiated within the first 2 hours following a BDBEE that initiates an ELAP (Reference 9).

DC bus load stripping will be completed by the end of the first hour following the declaration of an ELAP to ensure Class 1E battery life is extended to 8 hours (Reference 44). Portable generators will be used to repower instrumentation prior to battery depletion.

RCS makeup and boron addition from the boric acid tank (BAT) will be initiated before 13 hours following the declaration of an ELAP to ensure natural circulation heat removal and to ensure shutdown margin (refer to Table 4 - Phase 2 Timeline).

2.3.1 Phase 1 Strategy

The loss of AC power will cause the reactor to trip and the plant will initially stabilize at no-load RCS temperature and pressure conditions, with reactor decay heat removal via steam release through the Main Steam Isolation Valves (MSIV) and/or the SG ARVs. Natural circulation of the RCS will develop to provide core cooling. Heat from the RCS will be removed from the core/RCS though the SGs as long as the TDAFWP provides flow from the CST to the SGs for secondary makeup due to steam release.

Operators will respond to the ELAP per EOPs to confirm RCS, secondary system, and containment conditions. A transition to Procedure EMG C-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 (load shedding) on the station Class 1E batteries, and establishes electrical equipment alignment in preparation for eventual power restoration. The operators ensure AFW flow to all SG, establish manual control of the SG ARVs, and initiate a rapid cooldown of the RCS to minimize inventory loss through the RCP seals. Procedure EMG C-0 also directs local manual control of AFW flow to the SGs and manual control of the ARV to maintain the RCS cooldown rate, as necessary.

Secondary Side - 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 AFW System is located in the Auxiliary Building, except for the TDAFWP exhaust pipe and the section of pump recirculation piping. The Auxiliary Building is designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other appropriate natural phenomena

The TDAFWP automatically starts on the loss of offsite power condition to provide AFW to the SGs. The TDAFWP is a horizontal centrifugal pump. The pump bearings are cooled by the pumped fluid. The pump design capacity includes continuous minimum flow recirculation. Power for all controls, valve operators, and other support systems is independent of AC power sources. Steam supply piping to the turbine driver is taken from two of the four main steam lines between the containment penetrations and the MSIVs. Each of the steam supply lines to the turbine is equipped with a locked-open gate valve, normally closed air-operated globe valve with air-operated globe bypass to keep the line warm, and two non-return valves. Air-operated globe valves are equipped with DC-powered solenoid valves. These steam supply lines join to form a header that leads to the turbine through a normally closed, DC motor-operated mechanical trip and throttle valve. The turbine is designed to operate with steam inlet pressures ranging from 92 to 1,290 psia. Exhaust steam from the turbine is vented to atmosphere above the Auxiliary Building roof (Updated Safety Analysis Report (USAR) Section 10.4.9.2.2).

According to Procedure EMG C-0, in the event that the TDAFWP does not start on demand or trips after start, an operator will open steam supply valves and the trip throttle valve as well as starting the non-safety related AFW pump per Procedure SYS AP-122, Non-Safety Aux Feed Pump Operation. The AFW System is normally aligned for the TDAFWP to deliver flow to all four SGs. Manual control of TDAFWP flowrate to the SGs to establish and maintain proper water levels in the SGs will be performed in the Main Control Room (MCR).

Steam release from the SGs will be controlled remotely from the MCR (or the auxiliary shutdown panel) using air-operated SG ARVs. Local manual operation of SG B and C ARVs, using the installed manual control handwheel, can be performed in the event that compressed air or the nitrogen backup is unavailable. The nitrogen backup through an accumulator for each line is designed to allow for 8 hours of usage after the loss of compressed air. Per Procedure EMG C-0, an RCS cooldown will be initiated at a maximum rate of 100°F/hour to a minimum SG pressure of 310 psig (Reference 41). 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 in the event that the TDAFWP becomes unavailable. The minimum established SG pressure is high enough to prevent nitrogen gas from the safety injection accumulators from entering the RCS.

To avoid pump damage due to overheating while operating with no delivered flow, the TDAFWP requires a minimum flow 120 gpm (USAR Section 10.4.9.3). To satisfy this requirement, the pump has a recirculation line that joins to a common header and returns to the CST. The common recirculation line transitions from safety-related to non-safety-related in the AFW System to CST pipe chase. The CST pipe chase and the CST have been upgraded so that they are seismically qualified and qualified for tornados/airborne missiles.

Initially, AFW supply is provided by the installed CST. The tank has a capacity of approximately 385,646 gallons. This usable volume is defined as the nominal CST volume (407,318 gallons) minus the volume below the FLEX suction connection (21,672 gallons) or 385,646 gallons. This volume will provide a suction source to the TDAFWP for a minimum of 31.10 hours of RCS decay heat removal (Reference 12) concurrent with a 100°F/hour RCS cooldown to a minimum SG pressure of 310 psig per Procedure EMG C-0. This minimum time is for the CST only supplying feedwater to the SG. Therefore, CST makeup is not necessary until Phase 2.

Primary Side – The RCS will be cooled down and depressurized until SG pressure reaches 310 psig per Procedure EMG C-0 (Reference 41). RCS isolation will be verified to have occurred automatically and RCS leakage will be assumed to be through the RCP seals (see Section 2.3.8). Without additional RCS inventory, natural circulation will continue until at least the assumed onset of reflux cooling. Reference 9 indicates that reflux cooling will occur in excess of 72 hours (see Section 2.3.7.2). K_{eff} is calculated to be less than 0.99 at the RCS conditions (average RCS temperature of 415°F at saturated pressure) for approximately 14.1 hours (for the worst case: beginning of life, middle of life, or end of life) (Reference 32). This duration factors into establishing the latest time when FLEX RCS makeup needs to be established (see Section 2.3.9).

Electrical/Instrumentation - Load stripping of all non-essential loads would begin within 1 hour after the declaration of an ELAP and completed within the next 30 minutes. With load stripping, the useable station Class 1E battery life has been calculated to be eight (8) hours (see Section 2.3.11).

2.3.2 Phase 2 Strategy

The Phase 2 FLEX strategy for reactor core cooling and heat removal provides an indefinite supply of water for feeding the SGs while continuing to utilize the TDAFW pump as it is available. In Phase 1, the CST will be used as the supply of water. Before the complete depletion of the usable CST inventory, FSG-06, Alternate CST Makeup, will be invoked assuming no other coolant sources are available. This guideline provides actions for makeup to the CST from the UHS (see Section 2.3.10).

RCS makeup will be initiated within 13 hours of the ELAP using a portable pump to replenish RCS inventory, maintain shutdown margin, and re-establish RCS level in the pressurizer (refer to Table 4 –Phase 2 Timeline). FSG-01, Long Term RCS Inventory Control, indicates that one of the FLEX RCS Makeup Pumps is stored at Elevation 1974' in the Auxiliary Building while the other is stored at Elevation 2000' in the Auxiliary Building (one of the pumps is stored at a higher elevation due to potentially worst-case flooding concerns during a seismic event). The Phase 2 FLEX strategy also includes re-powering of Class 1E 480 VAC Buses for FLEX loads within eight (8) hours using a portable FLEX 480 VAC/500 kW Diesel Generator (DG) stored onsite (one in each FLEX Storage Building (FSB)

Preparation of the FLEX 480 VAC/500 kW DG for service will commence immediately after the declaration of an ELAP. Placing the FLEX 480 VAC/500 kW DG into service can be completed within 6 hours (this includes time for debris removal, transport/setup time, and time for bus switching). It is therefore reasonable to expect the FLEX 480 VAC/500 kW DG to be supplying power to the key Class 1E loads and capable of supplying an RCS Makeup Pump and a FLEX Air Compressor no later than eight (8) hours of a BDBEE which initiates an ELAP.

2.3.3 Phase 3 Strategy

Phase 3 actions include those that can be performed once offsite FLEX equipment arrives from the NSRC. Phase 3 strategies result in an expected condition of indefinite coping with respect to the required safety functions. It should be noted that precursor tasks may be required to enable application of required FLEX strategies. For example, in order to receive equipment not deployable via helicopter, major debris removal or alternate plant access strategies may be required.

In Phase 3, core cooling is continued to be maintained through natural circulation heat removal from the RCS via the SGs. Reactor level and subcriticality are adequately maintained via the Phase 2 strategy; however, borated water sources are limited to some extent. Phase 3 deployment of a unit capable of generating borated coolant when used in conjunction with the mobile filtration system can further extend coping times with respect to RCS inventory management. Heat rejection through the SGs is continued to be maintained via either the TDAFWP or the FLEX Core Cooling Pump; however, use of non-standard coolant in the SG cannot be maintained indefinitely. Phase 3 deployment of a unit capable of generating SG quality coolant for use in the SGs will be used to extend the coping time further. However, to conserve water, RCS cooling can be transferred from SG cooling to residual heat removal (RHR) cooling. Phase 3 deployment of a large pump capable of providing water the Essential Service Water (ESW) System to cool the Component Cooling Water (CCW) System and subsequently the RHR system

Support to the safety functions is continued by observation of conditions by operators using specific instruments and coordinating activities from the MCR. Maintaining indications and control requires maintenance of battery power, through the generator installed during Phase 2. Electrical needs for other equipment, including the CCW and RHR System as described above will be supplied from 4160 VAC DG and distribution bus supplied from the National SAFER Response Center (NSRC) and tied into one of the 4160 VAC Class 1E buses.

2.3.4 Systems, Structures, Components

2.3.4.1 Turbine Driven Auxiliary Feedwater Pump

The TDAFWP is a horizontal centrifugal pump. The pump bearings are cooled by the pumped fluid. The pump design capacity includes continuous minimum flow recirculation (USAR Section 10.4.9.2.2). Power for all controls, valve operators, and other support systems is independent of ac power sources. Steam supply piping to the turbine driver is taken from two of the four main steam lines between the containment penetrations and the MSIVs. Each of the steam supply lines to the turbine is equipped with a locked-open gate valve, normally closed air-operated globe valve with air-operated globe bypass to keep the line warm, and two non-return valves. Air-operated globe valves are equipped with DC-powered solenoid valves. These steam supply lines join to form a header that leads to the turbine through a normally closed, DC motor operated mechanical trip and throttle valve. The steam lines contain provisions to prevent the accumulation of condensate. The turbine driver is designed to operate with steam inlet pressures ranging from 92 to 1,290 psia. Exhaust steam from the turbine driver is vented to atmosphere above the Auxiliary Boiler Building roof.

2.3.4.2 Steam Generator Atmospheric Relief Valves (ARV)

A power-operated ARV is installed on the outlet piping from each SG. The four ARVs are installed to provide for controlled removal of reactor decay heat during normal reactor cooldown when MSIVs are closed or the Turbine Bypass System is not available (USAR Section 10.3.2.2). The ARVs will pass sufficient flow at all pressures to achieve a 50°F per hour plant cooldown rate. Therefore, during ELAP per Procedure EMG C-0, operators are directed to use ARV's and control total feedwater flow in order to establish and maintain a 100°F per hour plant cooldown rate. The ARVs are air operated, carbon steel, 8-inch 1,500-pound globe valves, supplied by a safety-related nitrogen supply (as described in Section 9.3.1 of Reference 4, and controlled from Class 1E sources). A non-safety-related air supply is available during normal operating conditions. The capability for remote manual valve operation is provided in the MCR, the Auxiliary Shutdown Panel, and locally at AB-PV-2 and AB-PV-3. The ARVs are opened by pneumatic pressure and closed by spring action.

As part of the FLEX response, WCGS will deploy FLEX Air Compressors that will allow for continued operation, locally or remotely, of the ARVs and Feedwater Control Valve(s) for the TDAFWP throughout the event.

2.3.4.3 Class 1E Electrical

The safety-related Class 1E 480 VAC Buses, 125 VDC Batteries and associated 125 VDC 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 has been conservatively calculated to provide a total service time of 8 hours of operations.

2.3.4.4 Condensate Storage Tank

The CST provides an AFW water source at the initial onset of the event. The tank has been upgraded to be a seismic, tornado missile protected structure and is, therefore, designed to withstand the applicable design basis external hazards stated in NEI 12-06 (Reference 3). The nominal CST volume is 407,318 gallons (Reference 12) and is normally aligned to provide emergency makeup to the SGs. The CST minimum usable volume is approximately nominal CST volume (407,318 gallons) minus the volume below the FLEX suction connection (21,672 gallons) or 385,646 gallons.

2.3.4.5 Ultimate Heat Sink

The UHS is assumed to be the only large water source available for the WCGS after a BDB seismic event. It consists of a normally submerged Seismic Category I cooling pond. The UHS provides a volume of 455 acre-feet with no sedimentation behind a Seismic Category I dam built in one finger of the cooling lake. This water source serves as an available water source for AFW, RCS and SFP Cooling (USAR Section 9.2.5.2.1).

2.3.4.6 Cooling Lake

The cooling lake, main dam, saddle dams, and control structures are designed for stability under drawdown, Operational Basis Earthquake (OBE), and Probable Maximum Flood (PMF) conditions. The cooling lake is the largest volume of water on site (USAR Figure 2.4-20) with a nominal volume of 111,280 acre-feet. This water source serves as an available water source for AFW, RCS and SFP Cooling and is assumed available for all BDBEEs except a BDB seismic event.

2.3.5 FLEX Strategy Connections

2.3.5.1 Primary FLEX Core Cooling Pump Connection

The primary suction flow path for the FLEX Core Cooling Pump (one stored in each FSB) is from the CST. A non-collapsible suction hose is connected between the CST isolation valve connection in the CST Building and a gated wye adapter. A second section of non-collapsible suction hose is then connected between the FLEX Core Cooling Pump suction and the gated wye adapter. The primary discharge flow path for the FLEX Core Cooling Pump is from the pump discharge to the Emergency Water to TDAFWP Discharge Line Hose Connection in Room 1207 on the 2000' elevation of the Auxiliary Building. A flexible hose is connected between the FLEX Core Cooling Pump discharge connection and the FLEX Pump Discharge to Emergency Supply Header connection in the CST Building. The FLEX Pump Discharge to Emergency Supply Header is a hard pipe running from the CST Building through a pipe chase into Room 1207. A second flexible hose is then connected between the FLEX Pump Discharge to Emergency Supply Header and the Emergency Water to TDAFWP Discharge Line Hose Connection in Room 1207 (see Figures 2a, 2b, and 2c).

2.3.5.2 Alternate FLEX Core Cooling Pump Connection

The alternate suction flow path for the FLEX Core Cooling Pump suction is the same path as the primary flow path or by supplying the pump suction directly from the CST Makeup Pump discharge. The alternate discharge flow path for the FLEX Core Cooling Pump is from the FLEX Core Cooling Pump discharge to the Emergency Water to Motor Driven Auxiliary Feedwater Pump (MDAFWP) B Discharge Line Hose Connection in Room 1206 on the 2000' elevation of the Auxiliary Building. A flexible hose is connected between the FLEX Core Cooling Pump discharge connection and the FLEX Pump Discharge to Emergency Supply Header connection in the CST Building. A second flexible hose is then connected between the FLEX Pump Discharge to Emergency Supply Header and the Emergency Water to MDAFWP B Discharge Line Hose Connection in Room 1206 (see Figure 2a, 2b, and 2d).

2.3.5.3 FLEX CST Makeup Pump Connection

The primary path for the FLEX CST Makeup Pump (one stored in each FSB) is from the ESW Pumphouse to the CST. A flexible hose (one stored on each pump cart in the FSBs) is connected between the discharge of the submersible pump and a 90° elbow. The pump is lowered into one of the ESW bays downstream of the traveling screens. The hose connected to the 90° elbow is then routed out of the ESW Pumphouse and connected to a wye adapter in the ESW Pumphouse area. Additional flexible hose sections (stored on trailers in each FSB) are then connected between the wye at the ESW Pumphouse and a wye in the CST area.

An additional piece of flexible hose (stored on trailer in each FSB) is connected between the wye in the CST area and the CST isolation valve connection or directly to the FLEX Core Cooling Pump suction for diversity. Two pumps are stored and either pump can be placed in either the A or B ESW Pump Room for diversity (see Figures 3a, 3b, 3c, and 3d).

2.3.5.4 Primary FLEX Air Compressors

The primary air supply to the ARV accumulators is from one of two Electric FLEX Air Compressors stored on the Auxiliary Building 1974' elevation. A section of hose (stored in the Auxiliary Building 1974' elevation) is connected between one of the Electrical FLEX Air Compressor Receiver outlet connections and a manifold (one stored in each FSB). This section of hose is routed through Hatch 1207A, Emergency Escape Hatch to 1974' Auxiliary Building, to the Auxiliary Building 2000' elevation. Additional hoses (4 stored in each FSB) are then connected between the manifold and an adapter on the ARV accumulators in Room 1329, Aux Feedwater Pump Vestibule 2000' elevations. A second Electric FLEX Air Compressor is stored in the Auxiliary Building 1974' elevation and is a backup to the first compressor using the same hose route (see Figures 4a, 4b, and 4d).

2.3.5.5 Alternate FLEX Air Compressors

An alternate air supply to the ARV accumulators is the use of FLEX Diesel Powered Air Compressors stored in the FSBs that would be staged at the East Turbine Building rollup door. A section of hose (stored in each of the FSBs) is connected between one of the FLEX Diesel Powered Air Compressor outlet connections and a manifold (one stored in each FSB). This section of hose is routed from the Turbine Building rollup door through Turbine Building Door 13921. Additional hoses (4) are then connected between the manifold and an adapter on the ARV accumulator in Room 1329, Aux Feedwater Pump Vestibule 2000' elevation (see Figures 2a, 4b, 4c, and 4d).

2.3.5.6 Primary FLEX RCS Makeup Pump Connection

The primary suction flow path for the FLEX RCS Makeup Pump on the 1974' elevation of the Auxiliary Building is from the BAT A or B on the 1974' elevation of the Auxiliary Building. A non-collapsible suction hose is connected between the BAT isolation valve connection and the pump suction, staged near the BAT. The primary discharge flow path for the FLEX RCS Makeup Pump on the 1974' elevation of the Auxiliary Building is from the pump discharge to the EM System isolation valve in Pipe Penetration Room A on the 2000' elevation of the Auxiliary Building. A flexible hose is connected between the FLEX RCS Makeup Pump discharge connection and the FLEX Intermediate Pipe from 1974' elevation to 2000' elevation connection. The FLEX Intermediate Pipe from 1974' elevation to 2000' elevation is a hard pipe running from the 1974' elevation to the 2000' elevation of the Auxiliary Building. A second flexible hose is then connected between the FLEX Intermediate Pipe from 1974' elevation to 2000' elevation and the primary EM System isolation (see Figures 5a, 5b, 5c and 5d).

2.3.5.7 Alternate FLEX RCS Makeup Pump Connection

The alternate suction flow path for the FLEX RCS Makeup Pump on the 1974' elevation of the Auxiliary Building is from the RWST via the EJ A System minimum flow line isolation valve connection on the 1974' elevation of the Auxiliary Building. A non-collapsible suction hose is connected between the EJ System connection and the pump suction.

The alternate discharge flow path for the RCS Makeup Pump on the 1974' elevation of the Auxiliary Building is from the RCS Makeup Pump discharge to the EM System Boron Injection Tank (BIT) inlet isolation valve connection on the 1974' elevation of the Auxiliary Building. A flexible hose is connected between the RCS Makeup Pump discharge connection and the BIT inlet isolation valve connection (see Figures 5e and 5f).

2.3.5.8 FLEX RCS Makeup Pump RWST Suction Connection

The suction flow path for the FLEX RCS Makeup Pump on the 2000' elevation of the Auxiliary Building is from the RWST. A non-collapsible suction hose is connected between the RWST isolation valve connection in the RWST Building and a gated wye. A second hose is connected to the gate wye and the RCS Makeup Pump suction. The discharge flow path for the RCS Makeup Pump on the 2000' elevation of the Auxiliary Building is from the RCS Makeup Pump discharge to the EM System isolation valve in Pipe Penetration Room A on the 2000' elevation of the Auxiliary Building (see Figure 5h).

2.3.5.9 Primary FLEX 480 VAC/500 kW Electrical Connection

The primary electrical connections points are between a FLEX Connection Panel (located in the Control Building 2000' elevation on the west wall of the NB02 Switchgear Room) and the FLEX 480 VAC/500 kW DG (staged in Area 3 near Control Building 2000' elevation southwest door). There are two FLEX 480 VAC/500 kW DGs for diversity (one stored in each FSB). Cables mounted on a cable cart (one in each FSB) are installed to color code connection points on the FLEX 480 VAC/500 kW DG and the FLEX Connection Panel. The FLEX Connection Panel is hard wired directly to 480 VAC Class 1E Buses NG01 and NG02 (see Figures 6a and 6b).

2.3.5.10 Alternate FLEX 480 VAC/500 kW Electrical Connection

The alternate electrical connections points are between a FLEX Connection Panel (located in the Auxiliary Building 2000' elevation southwest corridor) and the FLEX 480 VAC/500 kW DG (staged in Area 2 near Auxiliary Building 2000' elevation southwest door). Cables mounted on a cable cart (one in each FSB) are installed to color code connection points on the FLEX 480 VAC/500 kW DG and the FLEX Connection Panel. The FLEX Connection Panel is hard wired directly to the FLEX Distribution Panel (see Figures 6c and 6d).

2.3.5.11 FLEX 120/240 VAC/15kW Electrical Connection

A cable attached to the FLEX 120/240 VAC/15kW DG (one stored in each FSB) is connected to the FLEX Connection in the Control Building Southwest Stairwell 2000' elevation (see Figure 6a).

2.3.5.12 FLEX 4160 VAC Electrical Connection

Three 1-MW 4160 VAC generators delivered to the site from NSRC will be connected to a distribution panel (also delivered from NSRC) in order to meet the required Phase 3 4160 VAC load requirements. Due to the size of the equipment, the 4160 VAC generators will be deployed to Staging Area 3 outside the west wall of the Control Building (see Figure 7).

2.3.5.13 FLEX ESW Connection

Three submersible pumps (supplied by NSRC) will have flexible hoses (stored on a trailer in the Alternate FSB) connected to their discharge. The submersible pumps will be lowered into the UHS outside of the ESW Pumphouse. The hoses from the submersible pumps are then connected to the FLEX ESW Supply Pump (stored in the Alternate FSB). Hoses are connected between the ESW Supply Pump discharge connections and connections on a manifold (stored on trailer in the Alternate FSB). Additional hoses (stored on trailer in the Alternate FSB) are then connected between the manifold and the ESW FLEX connections in the ESW Pump Rooms A and B. NSRC will also provide a backup low-pressure /high flow pump (5,000 gpm) (see Figure 8).

2.3.6 Key Reactor Parameters

All the instrumentation listed below is seismically robust and fed from Class 1E power. They are located within seismic Category 1 structures protected from all applicable BDBEEs. Instrumentation providing the following key parameters is credited for all phases of the reactor core cooling and decay heat removal strategy:

- AFW Flowrate - AFW flowrate indication will be available in the MCR. AFW flowrate indication will be available for SG A, B, C, and D throughout the event.
- SG Water level – SG wide range (WR) and narrow range (NR) level indication will be available from the MCR, Auxiliary Shutdown (ASD) Panel, and locally within the AFW Pump House. SG narrow-range (NR) level indication will be available from the MCR and ASD Panel. SG WR and NR level indication will be available for SG A, B, C, and D throughout the event.
- SG Pressure - SG pressure indication will be available from the MCR. SG pressure indication will be available for SG A, B, C, and D throughout the event.
- RCS Temperature - RCS hot-leg and cold-leg temperature indication will be available from the MCR. RCS hot-leg and cold-leg temperature indication will be available throughout the event.
- RCS Pressure- RCS wide range pressure indication will be available for the MCR. RCS pressure indication will be available throughout the event.
- Core Exit Thermocouple Temperature - Core exit thermocouple temperature indication will be available in the MCR. This temperature indication will be available throughout the event.
- CST Level - CST water level indication will be available from the MCR and will be available throughout the event. This includes AFW suction pressure indication.
- Pressurizer Level: Pressurizer level indication will be available from the MCR. Pressurizer level indication will be available throughout the event.
- Reactor Vessel Level Indication System (RVLIS): RCS level indication from the RVLIS will be available from the MCR. RVLIS will be available throughout the event.
- Excore Nuclear Instruments: Indication of nuclear source range activity will be available from the MCR. Indication will be available throughout the event.
- Containment Pressure – Wide Range containment pressure will be available from the MCR. Wide Range containment pressure will be available throughout the event.

- Class 1E DC Bus Voltage – Class 1E DC bus voltage indication will be available from the MCR. Class 1E bus voltage indication will be available throughout the event.
- SFP Level – SFP wide range level indication is available in the Auxiliary Building. SFP level indication will be available throughout the event

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

In the unlikely event that 125 VDC and 120 VAC Vital Bus infrastructure is damaged, FLEX strategy guidelines for alternately obtaining the critical parameters locally is provided in FSG-07, Loss of Vital Instrumentation or Control Power.

2.3.7 Thermal Hydraulic Analyses

2.3.7.1 Secondary Makeup Water Requirements

Calculations were performed to determine the inventory makeup required for core decay heat removal and to maintain SG levels. In addition, dryout times associated with the volumes of various onsite AFW water sources were determined. The conclusions from this analysis showed that the existing CST, which has been hardened against seismic and high winds, contains a usable volume of approximately 385,646 gallons would be depleted in approximately 31.1 hours (Reference 12) at which time another source of water would be required:

The additional water source at WCGS is the cooling lake or UHS (see Section 2.3.10). This additional volume of water will be sufficient for several weeks of decay heat removal. NSRC equipment will be available for core cooling prior to this time. Among the NSRC equipment will be a mobile water purification unit to make SG quality water.

2.3.7.2 RCS Response

The numerical model used for the determination of RCS response for the WCGS was the same model used in the generic analysis of WCAP-17601 (Reference 13). 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 T_{cold} upper head, at 3723 MWt, with Model F SGs and Model 93A/A-1 RCPs. WCGS has installed the Westinghouse low-leakage Generation III SHIELD® RCP seals which significantly reduce the leakage through these seals. The numerical model was adjusted to account for this reduced seal leakage. Reference 32 indicates that reflux cooling begins at a time in excess of 72 hours after the ELAP when using the low-leakage seals. This is a much longer time than the initiation time for reflux cooling (17 hours) found in PWROG-14064 (Reference 14).

Since RCS inventory makeup will begin within 13 hours (refer to Table 4 – Phase 2 Timeline) following the onset of the ELAP condition at 10 gpm makeup capacity, the reflux cooling condition will be avoided.

2.3.8 Reactor Coolant Pump Seals

WCGS is a Westinghouse 4-loop plant with Westinghouse RCP pumps. Recently, WCGS has installed the Westinghouse low-leakage Generation III SHIELD® RCP seals which significantly reduce the leakage through these seals. As stated in Section 2.3.7, an evaluation was performed comparing the integrated leakage for the current WCGS configuration with the analyzed values used in WCAP-17792 (Reference 15). A result from this comparison shows significantly extended coping time to avoid reflux cooling when using the low-leakage seals.

2.3.9 Shutdown Margin Analysis

A Shutdown Margin (SDM) Analysis was performed for the reactor core of WCGS, Cycle 19 (which was determined to be representative of a typical WCGS reload core) and determined that at least 1% SDM (K_{eff} <0.99) is available up to 14 hours following a reactor trip from full power assuming no injection of borated coolant (Reference 32). Calculations show that injection of approximately 10 gpm of borated coolant from either BAT will be adequate to meet shutdown reactivity requirements at the limiting End-of-Cycle condition and the core inlet temperature as low as 366°F.

Since the RCS inventory makeup is initiated no later than 13 hours following an ELAP (refer to Table 4 – Phase 2 Timeline), the borated water injected into the RCS for inventory makeup is adequate to maintain core reactivity shutdown margin of 1% following an ELAP.

The SDM calculation assumes a 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 16) 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 17 is the NRC endorsement of the PWROG position paper.). Since RCS makeup will be initiated within 13 hours (refer to Table 4 – Phase 2 Timeline), and the pump capacity of 10 gpm is greater than the maximum RCS leakage at 16 hours, the NRC clarification regarding single-phase flow has been addressed and a one hour mixing time is acceptable. This one hour for mixing was applied to reduce the RCS boration injection time to 13 hours. Since additional boron is being injected from the BAT via FLEX RCS makeup, the SDM of at least 1% is maintained. There is adequate redundancy (two FLEX RCS Makeup Pumps and three potential sources of borated coolant) to ensure an adequate SDM.

2.3.10 FLEX Pumps and Water Supplies

2.3.10.1 FLEX Core Cooling Pump

Consistent with NEI 12-06 (Reference 3), SG water injection capability is provided using a portable AFW pump through a primary and alternate connection. The FLEX Core Cooling Pump is specified to have a design flowrate of 500 gpm and a head of 1155 feet. The FLEX Core Cooling Pump is a trailer-mounted, diesel engine driven centrifugal pump that is stored in the FSB (one in each building). The portable, diesel-driven FLEX Core Cooling Pump will provide a back-up method for SG injection in the event that the TDAFWP can no longer perform its function due to insufficient turbine inlet steam flow from the SGs. Hydraulic analyses have determined the FLEX Core Cooling Pump minimum required SG injection flowrate to support reactor core cooling and decay heat removal.

This analysis indicates that the FLEX Core Cooling Pump is required to provide a nominal 365 gpm (Reference 33). Therefore, the specification for the selected FLEX Core Cooling Pump provides significant margin. Two FLEX Core Cooling pumps are available to satisfy the N+1 requirement.

2.3.10.2 FLEX RCS Makeup Pump

The PWROG Core Cooling Position Paper (issued in conjunction with WCAP-17601) recommends that the FLEX RCS Makeup Pump required delivery pressure be established at the saturation pressure of the reactor vessel head + 100 psi driving head to allow RCS injection. Following the formula in the position paper, the required delivery pressure for the FLEX RCS Makeup Pump at WCGS is approximately 1500 psia. Analysis has shown that the FLEX RCS Makeup Pump must be capable of delivering a minimum flow of 10 gpm (Reference 32). Hydraulic analysis of the FLEX RCS Makeup Pump with the associated hoses and installed piping systems confirm that the FLEX RCS Makeup Pump minimum flow rate and head capabilities exceed the FLEX strategy requirements for maintaining RCS inventory (Reference 35). The specified FLEX RCS Makeup Pumps have a design flow rate of 36 gpm thus providing a significant margin. Two RCS Makeup Pumps are available with one being stored at elevation 1974' in the Auxiliary Building and the second being stored on the 2000' elevation of the Auxiliary Building.

2.3.10.3 AFW Water Supplies

Condensate Storage Tank

Initially, AFW supply is provided by the installed CST. The tank has been modified to be a seismically designed, tornado missile protected structure and will, therefore, withstand applicable BDBEEs. The tank has a capacity of approximately 385,646 gallons. This usable volume is defined as the nominal CST volume (407,318 gallons) minus the volume below the FLEX suction connection (21,672 gallons). This volume will provide a suction source to the TDAFWP for a minimum of 31.10 hours of RCS decay heat removal (Reference 12) concurrent with a 100°F/hour RCS cooldown to a minimum SG pressure of 310 psig per Procedure EMG C-0. This minimum time is for the CST only supplying feedwater to the SG

Ultimate Heat Sink

The UHS is assumed to be the only large water source available for the WCGS after a BDB seismic event. It consists of a normally submerged Seismic Category I cooling pond. The UHS provides a volume of 455 acre-feet with no sedimentation behind a Seismic Category I dam built in one finger of the cooling lake. This water source serves as an available water source for AFW, RCS and SFP Cooling (USAR Section 9.2.5.2.1).

Cooling Lake

The cooling lake, main dam, saddle dams, and control structures are designed for stability under drawdown, Operational Basis Earthquake (OBE), and Probable Maximum Flood (PMF) conditions. The cooling lake is the largest volume of water on site (USAR Figure 2.4-20) with a nominal volume of 111,280 acre-feet. This water source serves as an available water source for AFW, RCS and SFP Cooling and is assumed available for all BDBEEs except a BDB seismic event.

2.3.10.4 Borated Water Supplies

Boric Acid Tanks (BAT)

Two BATs are available to provide a suction source for the FLEX RCS Makeup Pumps. The combined BAT volume is 28,000 gallons with a minimum volume of 17,658 gallons with boron concentration between 7000 and 7700 ppm. The BAT(s) is the preferred borated water source for the RCS injection strategies and are fully protected for all applicable external events.

Refueling Water Storage Tank (RWST)

The RWST is located at grade level just outside of the Control Building. The tank is a stainless steel, safety-related, seismically qualified storage tank, but is not protected from missiles. During "at power" operations, the RWST borated volume is maintained greater than 394,000 gallons at a boron concentration no less than 2400 ppm

Safety Injection Accumulators

There are 4 Safety Injection Accumulators each with a capacity of 6,122 gallons – 6594 gallons that are passive devices and will inject borated water into the RCS when pressure drops below approximately 600 psig. The accumulators provide RCS makeup capability to ensure natural circulation is maintained within the RCS as well as negative reactivity insertion to the RCS during Phase 1. The accumulators are provided with a nitrogen cover gas that will be vented before RCS pressure falls below cover gas pressure to prevent nitrogen gas intrusion into the RCS. The accumulators are Seismic Category 1 tanks located in containment; therefore, they are fully protected for all applicable BDBEEs.

NSRC Mobile Boration Skid

A mobile boration skid will be available from NSRC for the Phase 3 strategy.

2.3.11 Electrical Analysis

Batteries

The installed Class 1E batteries maintain power for up to 4 hours (coping time) to critical instrumentation, controls and lighting following of a loss of AC power. A duty cycle of eight (8) hours for WCGS was calculated (Reference 36) per 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 18). An ELAP will be declared within 1 hour after an evident when it becomes clear that AC power will not be restored from onsite or off-site sources. 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 four (4) hours.

FLEX Diesel Generators

The strategy to re-power the stations Vital AC/DC buses during Phase 2 (or Phase 3 as appropriate) requires the use of a DG. For this purpose, one of the two FLEX 480 VAC/500 kW DGs is used to power the 480 VAC Class 1E Safety Related Buses, Class 1E Battery Chargers, FLEX RCS Makeup Pump, and a FLEX Electric Air Compressor as the primary re-powering option. The 480VAC/500 kW DG has sufficient capacity to also supply one electric FLEX 45kW heater (one stored in each FSB Conex). The FLEX 480 VAC/500 kW DGS are trailer mounted with a 500 gallon double walled diesel fuel tank built into the trailer.

NSRC Generators

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

2.4 SPENT FUEL POOL COOLING/INVENTORY

The basic FLEX strategy for maintaining SFP cooling is to monitor SFP level and provide sufficient makeup water to the SFP to maintain the normal SFP level.

2.4.1 Phase 1 Strategy

WCGS document CN-SEE-II-12-35 (Reference 37) estimates that with no operator action following a loss of SFP cooling with normal SFP heat load assuming initial SFP temperature is 140°F, the SFP temperature reaches 212°F in approximately 5.59 hours. The SFP inventory boils off to reach the top of the fuel racks in approximately 34.93 hours from initiation of the event (Reference 9, Table 5-2-2).

Under maximum design SFP heat load (core off-load) with initial SFP temperature of 140°F, the SFP temperature reaches 212°F in approximately 2.4 hours. The SFP boils off to reach the top of the fuel racks in 15.43 hours from initiation of the event (Reference 9, Table 5-2-2, and Reference 37).

The Phase 1 coping strategy for SFP cooling is to monitor SFP level using instrumentation installed as required by NRC Order EA-12-051 (Reference 5) and to pre-stage equipment in the Fuel Building required to perform SFP Spray strategy early in the event. In addition, during Modes 5 and 6, the FLEX Core Cooling Pump is pre-staged at Staging Area A2 to expedite SFP/RCS makeup from the RWST. Access to the SFP area as part of the Phase 2 response could be challenged by environmental conditions. Action is required to vent the Fuel Building by opening the roll-up door, run hose for alternate SFP Make-up and staging SFP Spray equipment in the first 5.59 hours of the event during Modes 1-5, and 2.38 hours in Mode 6 (if defueled). Refer to Section 2.11.1 for more information regarding ELAP impact on ventilation of Fuel Building and actions that are taken. The time margin from declaration of an ELAP and completion of these actions is 4.18 hours.

2.4.2 Phase 2 Strategy

The Phase 2 strategy is to initiate SFP makeup using the FLEX Spent Fuel Pool Pump through the FLEX SFP makeup connection. The FLEX Spent Fuel Pool Pump would be deployed from the FSB to a staging area directed by FSG-05, Initial Assessment and FLEX Equipment Staging. Makeup to the SFP would be from the RWST (if available) or the CST.

The discharge of the pump would be connected to the FLEX SFP makeup hose connection inside of the Fuel Building near the north side of the roll-up door on the east side of the Fuel Building.

WCGS is implementing an alternate approach from NEI 12-06 (Reference 3). The SFP cooling strategy utilizes a portable pump to discharge through hoses that connect to permanently installed piping to provide the required makeup flow. This alternate method meets the requirements for performance attributes of NEI 12-06 (Reference 3). WCGS considers the seismically robust piping to provide make-up to the SFP an improvement over the minimal requirements of NEI 12-06 (Reference 3) which only requires make-up via hoses to the SFP.

JLD-ISG-2012-01 (Reference 7) requires a SFP Spray strategy in addition to the SFP make-up capabilities required by NEI 12-06 (Reference 3). WCGS utilizes hoses run from the FLEX Spent Fuel Pool Pump to spray nozzles placed on the operating floor of the Fuel Building. This is the same strategy utilized in the WCGS B.5.b strategy.

The FLEX Spent Fuel Pool Pump is trailer mounted and will be towed to the staging area, along with the necessary hoses and fittings, by tow vehicles also located within the FSBs.

Additionally, as required by NEI 12-06 (Reference 3), spray monitors and sufficient hose length required for the SFP spray option are located in the Fuel Building.

It should be noted that WCGS document CN-SEE-II-12-35 (Reference 37) indicates that SFP makeup is not required until 34.93 hours after the onset of the ELAP during Modes 1 through 4. Current procedures will align the FLEX Spent Fuel Pool Pump 15 hours after the declaration of an ELAP leaving a margin of 19.93 hours. During full core off-load, makeup to the SFP is required before 15.43 hours (Reference 9, Table 5-2-2, and Reference 37), therefore in Modes 5 and 6, the FLEX Core Cooling Pump is pre-staged in Staging Area A2 to expedite initiation of SFP/RCS makeup from the RWST.

2.4.3 Phase 3 Strategy

The Phase 3 coping capabilities continue to utilize the Phase 2 strategies. Additional Low Pressure/High Flow pumps will be available from NSRC as a backup to the onsite FLEX Spent Fuel Pool Pumps.

2.4.4 Structures, Systems, and Components

2.4.4.1 Primary Spent Fuel Pool Makeup Connection

The primary suction flow path for the FLEX Spent Fuel Pool Pump is from the RWST. A non-collapsible suction hose (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB) is connected between the RWST isolation valve connection in the RWST Building and a gated wye adapter (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB). A second non-collapsible hose (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB) is connected between the gated wye adapter and the pump suction. The FLEX Spent Fuel Pool Pump is staged in Area A2 near the RWST. The primary discharge flow path for the FLEX Spent Fuel Pool Pump is a flexible hose (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB) connected between the FLEX Spent Fuel Pool Pump discharge connection and the primary spent fuel makeup connection just inside the Fuel Building rollup door.

The primary SFP makeup line is a hard pipe from the 2000' elevation of the Fuel Building to nozzles on the 2047' elevation of the Fuel Building that direct makeup water into the SFP. For diversity, the primary discharge flow path can be used with the alternate suction flow path (see Figure 9a).

2.4.4.2 Alternate Spent Fuel Pool Makeup Connection

The alternate suction flow path for the FLEX Spent Fuel Pool Pump is from the CST. A non-collapsible suction hose (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB) is connected between the CST isolation valve connection in the CST Building and a gated wye adapter (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB). A second non-collapsible hose (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB) is connected between the gated wye adapter and the pump suction. The FLEX Spent Fuel Pool Pump is staged in Area A1 near the CST. The alternate discharge flow path for the FLEX Spent Fuel Pool Pump is a flexible hose (stored on the FLEX Spent Fuel Pool Pump trailer in each FSB) connected between the FLEX Spent Fuel Pool Pump discharge connection and the alternate spent fuel makeup connection just inside the Fuel Building rollup door. The alternate SFP makeup line is a hard pipe from the 2000' elevation of the Fuel Building to a connection on the 2026' elevation of the Fuel Building. A second flexible hose (stored in Room 6203 on the 2026 elevation of the Fuel Building) is connected between the 2026' elevation alternate SFP makeup line connection and the EC isolation valve connection in Room 6203. Manual valves are then opened and the alternate spent fuel discharge flow path is through the A SFP Cooling Train. For diversity, the alternate discharge flow path can be used with the primary suction flow path (see Figures 9a and 9b).

2.4.4.3 Spent Fuel Pool Spray Option Connection

WCGS has a SFP that is above ground, meaning it is not surrounded on four sides by earth and therefore, could potentially drain. However, WCGS performed a spent fuel pool seismic integrity evaluation. Refer to Section 2.4.7. The evaluation concluded that the SFP is seismically adequate and can retain adequate water inventory for 72 hours in accordance with NTTF 2.1, Seismic Evaluation Criteria. The spray strategy is required by NEI 12-06 (Reference 3) for providing spray at 250 gpm. The SFP spray option will utilize the FLEX Spent Fuel Pool Pump using either the primary or alternate suction flow paths described above. The SFP spray option discharge paths are flexible hoses (stored in the Fuel Building) connected between the FLEX Spent Fuel Pool Pump discharge connection and spray nozzles (stored in the Fuel Building) staged on the 2047' elevation of the Fuel Building (see Figures 9a, and 9c).

2.4.4.4 Fuel Building Ventilation

Ventilation requirements to prevent excessive steam accumulation in the Fuel Building are included in FSG-11, Alternate SFP Makeup and Cooling. This FSG directs operators to open the rollup door on the 2000' elevation of the Fuel Building to establish a natural circulation flow path. Airflow through this door provides adequate vent pathways through which steam generated by SFP boiling can exit the Fuel Building.

2.4.5 Key Reactor 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 NRC Order EA-12-051 (Reference 5).

2.4.6 Thermal-Hydraulic Analyses

An analyses was performed that determined, with the normal expected SFP heat load and a SFP initial temperature of 140°F, the SFP will reach a bulk boiling temperature of 212°F in approximately 5.6 hours and boil off to a level 10 ft above the top of fuel in 34.9 hours unless additional water is supplied to the SFP (Reference 9, Table 5-2-2, and Reference 37). A flow of 56.5 gpm will replenish the water lost due to boiling. Deployment of the SFP hose connection from the FLEX Spent Fuel Pump within 24 hours with a design flow of 250 gpm for the SFP will provide for adequate makeup to restore the SFP level and maintain an acceptable level of water for shielding purposes. This same analysis determined with the maximum design SFP heat load (core off-load) and with initial SFP temperature of 140°F, the SFP temperature reaches 212°F in approximately 2.4 hours and boils off to reach the top of the fuel racks in 15.43 hours (Reference 9, Table 5-2-2, and Reference 37). A minimum flowrate of 132 gpm will replenish the water lost due to boiling. Pre-staging of the FLEX Core Cooling Pump in Staging Area A2 will provide SFP/RCS makeup from the RWST in Modes 5 and 6 that will maintain an acceptable level of water for shielding purposes.

2.4.7 SFP Seismic Evaluation

WCGS performed a spent fuel pool seismic integrity evaluation utilizing EPRI 3002007148, Seismic Evaluation Guidance Spent Fuel Pool Integrity Evaluation, endorsed by the NRC in ADAMS Accession No ML15350A158 (Reference 45). The evaluation concluded that the SFP is seismically adequate and can retain adequate water inventory for 72 hours per NTTF 2.1, Seismic Evaluation Criteria.

2.4.8 FLEX Pump and Water Supplies

2.4.8.1 FLEX Spent Fuel Pool Pump

The FLEX Spent Fuel Pool Pump is specified to have a nominal 250 gpm flow rate with 235 feet of head. The pump is sized to provide a minimum of 125 gpm SFP makeup via the SFP sprays. Hydraulic analysis of the flow path from each water source to the SFP or to the FLEX Spent Fuel Pool Pump suction has confirmed that applicable performance requirements are met (Reference 34).

The FLEX Spent Fuel Pool Pump is a trailer-mounted, diesel driven centrifugal pump that is stored in the FSBs. The pump is deployed by towing the trailer to a designated location near the selected water source. Two high capacity pumps are available to satisfy the N+1 requirement.

2.4.8.2 Refueling Water Storage Tank

The RWST is primary source of water to the SFP. The tank is a stainless steel, safety-related, seismically qualified storage tank, but is not protected from missiles. During "at power" operations, the RWST borated volume is maintained greater than 394,000 gallons at a boron concentration no less than 2400 ppm.

2.4.8.3 Condensate Storage Tank

The CST provides an alternate source of makeup or spray water to the SFP. The tank has been upgraded to be a seismic, tornado missile protected structure and is, therefore, designed to withstand the applicable design basis external hazards stated in NEI 12-06 (Reference 3).

The nominal CST volume is 407,318 gallons (Reference 12) and is normally aligned to provide emergency makeup to the SGs. The CST minimum usable volume is approximately nominal CST volume (407,318 gallons) minus the volume below the FLEX suction connection (21,672 gallons) or 385,646 gallons.

2.4.8.4 Ultimate Heat Sink

The UHS is assumed to be the only large available water source for WCGS after a BDB seismic event. It consists of a normally submerged Seismic Category I cooling pond. The UHS provides a volume of 455 acre-feet with no sedimentation behind a Seismic Category I dam built in one finger of the main cooling lake. This water source serves as an available water source for AFW, RCS and SFP Cooling (USAR Section 9.2.5.2.1).

2.4.8.5 Cooling Lake

The cooling lake, main dam, saddle dams, and control structures are designed for stability under drawdown, OBE, and PMF conditions. The cooling lake is the largest volume of water on site (USAR Figure 2.4-20) with a nominal volume of 111,280 acre-feet. This water source serves as an available water source for AFW, RCS and SFP Cooling and is assumed available for all BDBEEs except a BDB seismic event.

2.4.9 Electrical Analysis

The SFP will be monitored by instrumentation installed in response to NRC Order EA-12-051 (Reference 5). The power for this equipment has backup battery capacity for 72 hours. Alternative power will be provided within 72 hours using onsite portable generators, if necessary, to provide power to the instrumentation and display panels and to recharge the backup battery.

2.5 CONTAINMENT INTEGRITY

2.5.1 Modes 1 - 4

Containment pressure and temperature are expected to increase during an ELAP due to loss of Containment cooling and RCS leakage into Containment. With the installation of the low leakage RCP shutdown seals, the pressure and temperature are not expected to rise to levels which could challenge the Containment structure. However, with no cooling in the Containment, temperatures in the Containment are expected to rise and could reach a point where continued reliable operation of key instrumentation might be challenged.

Containment evaluation (Reference 39), using GOTHIC, was performed based on the boundary conditions described in Section 2 of NEI 12-06 (Reference 3). Conservative evaluations have concluded that Containment temperature and pressure will remain below the Containment design limits and that key parameter instruments subject to the Containment environment will remain functional for a minimum of seven days. Therefore, actions to reduce Containment temperature and pressure and to ensure continued functionality of the key parameters will not be required immediately.

Actions are provided in Procedure EMG C-0 to support isolation of Containment without available AC power. This procedure will be used to provide Containment isolation in support of FLEX strategies to ensure containment integrity is maintained during Phase 1.

Phase 1

The Phase 1 coping strategy for Containment involves verifying Containment isolation per Procedure EMG C-0 and monitoring Containment temperature and pressure using installed instrumentation. MCR indication for Containment wide range pressure and Containment temperature will be available for the duration of the ELAP.

Phase 2

The Phase 2 coping strategy is to continue monitoring Containment temperature and pressure using installed instrumentation. Phase 2 activities to repower key instrumentation (Section 2.3.11) are required to continue Containment monitoring.

Phase 3

The Phase 3 strategy is to continue the monitoring of Containment temperature and pressure using installed instrumentation. Actions to reduce Containment temperature are not required to ensure continued functionality of the key parameters. Reduction of the RCS heat load indirectly reduces containment temperature and pressure. Restoration of the CCW, ESW and RHR Systems is performed in Phase 3 to support core cooling. Conditions in containment will improve with no further actions.

2.5.2 Modes 5 - 6

With an ELAP initiated while in Modes 5 - 6, containment pressure and temperature will quickly increase due to steam that is released into Containment. The Containment pressure response is more pronounced for the ELAP event initiating from either Modes 5 or 6 when compared to an ELAP event starting from Mode 1 through 4 conditions. If Containment is not vented, the Containment structure would eventually exceed design pressure. WCGS has analyzed Containment response for an ELAP in Modes 5 – 6 using the same system as used for the integrated leak rate test which is capable of relieving air flow with a pressure differential of 50 psia (Reference 39). As a result, WCGS pre-stages the local leak rate test vent path during Modes 5 and 6 to ensure Containment vent is established to preclude overpressurization.

Phase I

The Phase 1 coping strategy for Containment involves verifying Containment isolation per Procedure OFN NB-034 and monitoring Containment temperature and pressure using installed instrumentation. MCR indication for Containment pressure and temperature will be available for the duration of the ELAP.

Phase 2

The Phase 2 coping strategy is to continue monitoring Containment temperature and pressure using installed instrumentation. Phase 2 activities to repower key instrumentation (Section 2.9.4) are required to continue Containment monitoring. Using a conservative GOTHIC model, Reference 39 has shown that the containment vent needs to be opened 12.66 hours after event initiation for the Mode 5 and 24.89 hours for the Mode 6 to allow steam to exit containment.

During Phase 2 in Modes 5 and 6, operators will monitor containment pressure to determine if venting utilizing the LLRT vent path should be stopped due to offsite dose limits, containment radiation levels or reduced containment pressure.

Phase 3

No additional specific Phase 3 strategy is required for maintaining Containment integrity. With the initiation of RHR to remove core heat in Phase 3, the Containment will depressurize without further action.

2.5.3 Structures, Systems, Components

2.5.3.1 Ventilation Cooling Strategy

No mechanical equipment connections are required for the Containment ventilation.

2.5.4 Key Containment Parameters

Instrumentation providing the following key parameters is credited for all phases of the Containment Integrity strategy:

- Containment Pressure: Containment pressure indication is available in the MCR throughout the event.
- Containment Wide Range Temperature: Containment wide range temperature indication is available in the MCR throughout the event.
- Containment Radiation: Containment radiation indication in MCR is not available until the FLEX 480 VAC/500 kW DG is placed in service within eight hours after the declaration of an ELAP. Containment radiation monitors provide containment radiation levels required in FSG-12, Alternate Containment Cooling in Mode 5 and 6, to support the Containment venting strategy. Containment radiation instruments are repowered concurrently when the FLEX 480 VAC/500 kW DG is placed in service, well before Containment venting is required.

2.5.5 Thermal-Hydraulic Analyses

Conservative evaluations (Reference 39) have 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 for a minimum of seven days. The Containment temperature will be procedurally monitored and, if necessary, the Containment temperature will be reduced using the options available to ensure that key Containment instruments will remain within their analyzed limits for equipment qualification.

2.5.6 FLEX Pump and Water Supplies

The NSRC is providing a Low Pressure/High Flow pump (nominal 5,000 gpm) which will be used if required to provide cooling flow to the ESW System. Water supplies are as described in Section 2.3.10.

2.5.7 Electrical Analysis

One (1) of the two (2) Class 1E 4160 VAC Buses is required to repower the Containment cooling options described above. The 4160 VAC equipment being supplied from the NSRC will provide adequate power to perform the Phase 3 Containment cooling strategies. The necessary components to implement the various Containment cooling options have been included in the calculations to support the sizing of the 4160 VAC generators being provided by the NSRC. Accordingly, three 1 MW 4160 VAC DGs and a distribution panel (including cable and connectors) are provided from the NSRC.

2.6 CHARACTERIZATION OF EXTERNAL HAZZARDS

2.6.1 Seismic

Per NEI 12-06 (Reference 3), seismic hazards must be considered for all nuclear sites. As a result, the credited FLEX equipment has been assessed based on the current WCGS seismic licensing basis to ensure that at a minimum, N set of credited BDB equipment remains accessible and functional after a BDBEE. The WCGS seismic hazard is considered to be the earthquake magnitude associated with the design-basis seismic event

The seismic criteria for WCGS include two design basis earthquake spectra: OBE and Safe Shutdown Earthquake (SSE) (USAR Section 2.5).

The site seismic design response spectra define the vibratory ground motion of the OBE and SSE. The maximum horizontal acceleration for the SSE is 0.20g (USAR Section 3.7B). The OBE has a maximum horizontal and vertical acceleration of 0.06g (USAR Section 2.5.2.7).

WCGS is part of the Standard Nuclear Unit Power Plant System, which was developed with envelope seismic loads for several sites; all the sites utilized Regulatory Guide 1.60 response spectra anchored at 0.20g Zero Period Acceleration (ZPA) (USAR Appendix 3C, Section 3C.1.2). All standard plant, safety-related, power block structures were designed and analyzed using this original value. These structures include:

- Reactor Building
- Auxiliary Building
- Control Building
- EDG Building
- Fuel Building
- Safety-related Tanks
- ESW Vertical Loop Chase
- Refueling Water Storage Tank
- Buried ESW piping
- Safety-Related Duct Banks

For the remainder of the structures and structural components in the plant, WCGS evaluated a new free-field response spectrum. This spectrum was prepared by Lawrence Livermore Laboratories (LLL) and is enveloped by a Regulatory Guide 1.60 spectrum anchored at 0.15 ZPA. All the safety-related structures were deemed acceptable with regard to the LLL spectra (USAR Appendix 3C, Section 3C.1.2). These structures include:

- ESW Pumphouse
- Electrical Manholes
- Circulating and Warming Water Pipe Encasements
- UHS Dam
- ESW Caissons

Per the FLEX guidance, seismic impact must be considered for all nuclear plant sites. As a result, the credited FLEX equipment has been assessed based on the current WCGS seismic licensing basis to ensure that the equipment remains accessible and available after a BDBEE and that the FLEX equipment does not become a target or source of a seismic interaction from other systems, structures, or components. This assessment includes documentation ensuring that any storage location and deployment routes meet the FLEX criteria.

In addition to the NEI 12-06 (Reference 3) guidance, NTTF Recommendation 2.1, Seismic, required that facilities re-evaluate the site's seismic hazard. WCGS subsequently re-evaluated the seismic hazard and developed a Ground Motion Response Spectra (GMRS) for the site based upon the most recent seismic data and methodologies, and has found that the existing SSE does not envelop the new GMRS over the entire frequency range. This reevaluated seismic hazard is being addressed in the industry initiative referred to as the Augmented Approach (Electrical Power Research Institute (EPRI) Report 3002000704). The Augmented Approach requires plants to address the GMRS by performing the Expedited Seismic Evaluation Process (ESEP) as an interim measure while completing the long-term seismic risk evaluation. The Augmented Approach evaluates the seismic capability of a subset of FLEX-credited installed plant equipment to provide confidence that the equipment would retain function during and after a BDB seismic event using seismic margins assessment to a Review Level Ground Motion capped at 2 times SSE from 1 to 10 Hz. NRC endorsement of use of the EPRI Augmented Approach was provided in Reference 19.

For FLEX strategies, the earthquake is assumed to occur without warning and result in damage to non-seismically designed structures and equipment. Non-seismic structures and equipment may fail in a manner that would prevent accomplishment of FLEX-related activities (normal access to plant equipment, functionality of non-seismic plant equipment, deployment of FLEX equipment, restoration of normal plant services, etc.). The diverse nature of the FLEX strategies has been discussed. The ability to clear haul routes from seismic debris to facilitate the deployment of the FLEX Phase 2 equipment is addressed in Section 2.8.

2.6.2 External Flooding

The types of events reevaluated to determine the worst potential flood included: (1) LIP induced flooding, (2) flooding in rivers and streams, (3) flooding due to upstream dam failures, (4) storm surges, (5) Seiches, (6) tsunami, (7) ice-Induced floods, and (8) flooding resulting from channel migration or diversion.

Specific analysis of flood levels resulting from ocean storm front surges and tsunamis is not required because of the inland location of the plant. Seiches pose no flood threats because of the size and configuration of the cooling lake and that its topographic and geologic features are not conducive to landslide formation.

The maximum design basis power block flood level from any cause is Elevation 1099.92 ft Mean Sea Level (MSL). The site has an elevation of 1099.5 ft MSL and the floor level of all safety-related structures is 1,100.0 ft MSL (USAR Section 2.4.2.3.2).

WCGS is located on its own cooling lake. The release of any upstream body of impounded water, due to a seismic event or dam failure, would not have a significant impact on the cooling lake level and thus would not cause flooding at the site (USAR Section 2.4.4). A potential cause of flooding at the site would be from high cooling lake level due to runoff from an extreme precipitation event in the watershed. However, reevaluation has determined that WCGS is not susceptible to flooding from the Neosho River due to any combination of reservoir failure upstream of the confluence with WCGS, including the John Redmond Reservoir

A design basis evaluation (Reference 20) was performed to determine the highest potential cooling lake level due to runoff of precipitation in the WCGS watershed. The PMF was generated and applied over the design watershed (27.4 mi^2) using the combined effects of a single Probable Maximum Precipitation (PMP) event preceded by a Standard Project Flood (which is 50% of the PMP) with a sustained overland wind speed of 40 mph. The cumulative 48-hr duration PMP is 32.80 inches with the peak occurring at approximately 34 hours (Reference 20). The maximum water surface elevation in the cooling lake (i.e., the pool elevation) due to the PMF event is 1,095 ft MSL at the site, which assumes a starting pool elevation of 1,088 ft MSL (corresponding to the crest elevation of the service spillway for the Cooling Lake Dam). The coincident wave activity of the PMF resulted in a maximum run-up of 0.8 ft at the site shore. The resulting run-up elevation was 1,095.8 ft MSL when added to the PMF pool elevation.

The maximum wave run-up elevation on the vertical wall of the intake structure of the ESWS is 1,100.2 ft. However, the intake structure for the ESWS is designed to withstand a high water elevation of 1,102.5 ft. The only openings below elevation 1,102.5 ft are the pressure doors and the pump structure forebay opening (USAR Section 2.4.10). The pressure doors are located at elevation 1,100.0 ft. These doors are normally closed and under administrative control.

A potential source of flooding is a Local Intense Precipitation (LIP). Analysis has been performed (Reference 20) for a LIP with the most intense rainfall occurring in the first hour. The cumulative LIP rainfall depth for the 6-hr LIP is 28.79 inches, including 19 inches that falls in the first hour. The reevaluated BDB on-site LIP ponding levels range from 1,100.03 ft MSL to 1,100.38 ft MSL adjacent to safety-related SSCs.

Since the original submittal of the Overall Integrated Plan, WCGS has completed and submitted the Flood Hazard Reevaluation Report (FHRR) (Reference 20) for WCGS as requested by the 10CFR50.54(f) letter dated March 12, 2012. The reevaluation represents the most current BDB flooding analysis for WCGS. The reevaluation results were mostly bounded by the original WCGS BDB site flooding vulnerabilities and characteristics (USAR Section 2.4.2.3.2), in that the non-events such as seiche and dam failures continued to be non-events. Based on the updated analysis, the current design LIP flood level at safety-related buildings on the powerblock is now established at 1,099.92 ft MSL (USAR Section 2.4.2.3.2).

The only significant difference identified between USAR Section 2.4.10 and the FHRR (Reference 20) was the LIP event. Using BDB state of the art analysis methods some areas of the site were identified to be subject to short term flooding which required minimal protective actions. Details of the LIP event are provided in Section 4.2 of the FHRR (Reference 20). Consistent with Enclosure 2 of Reference 1, WCGS has implemented actions to address the higher LIP event levels relative to the current licensing basis.

2.6.3 Severe Storms with High Wind

The current plant design basis addresses the storm hazards of high winds and tornados.

NEI 12-06 (Reference 3) was used for this assessment. It was determined the WCGS site has the potential for damaging winds caused by a tornado exceeding 130 mph. NEI 12-06 (Reference 3) indicates a maximum wind speed of 200 mph for Region 1 plants, including WCGS. Therefore, high wind hazards are applicable to the WCGS site.

For extreme straight winds -the extreme 1-mile wind speed is defined as the 1-mile passage of wind with the highest speed for the day. The extreme 1-mile wind speed, which is predicted to occur once in 100 years, is 86 mph. The fastest wind speed recorded at Topeka, based on the 1955-1967 period, was 81 mph from the north.

For tornados and tornado missiles, the USAR indicates that between 1916 and 1950, there were a total of 618 tornadoes reported within the state of Kansas (USAR Table 2.3-6). The tornado model used for design purposes has a 290 mph rotational velocity and a 70 mph translational velocity (USAR Section 3.3.2.1). This metrological information (along with more current data) is used to determine wind born missile impact probabilities at WCGS.

2.6.4 Ice, Cold and Extreme Cold

The region averages about 10 and 20 inches of snow a year. The extreme 24 hour snowfall was 26 inches and the snow usually only remains on the ground for a few weeks (USAR Section 2.3.1.2.2).

An accumulation of 0.25 inches of ice due to ice storms will occur once a year and an accumulation of 0.50 inches of ice every two years. The mean duration of glaze ice on utility wires if an ice storm occurs is 53 hours for the state of Kansas (USAR Section 2.3.1.2.4).

Temperatures in the site region are below freezing approximately 120 days per year. The lowest temperature recorded in the site region (Burlington, Kansas) was minus 27°F (USAR Section 2.3.2.1.1).

Such low temperatures could adversely affect access to and the flowpath from the cooling lake. Ice could form on the surface of the cooling lake and impact FLEX strategies. However, capabilities are available to break through the ice, if needed, to provide access and a flowpath.

2.6.5 High Temperatures

Temperatures in the site region (Burlington Kansas) exceed 90°F approximately 60 to 70 days per year (USAR Section 2.3.2.1.1). The peak temperature recorded in Burlington was 117°F.

2.7 PROTECTION OF FLEX EQUIPMENT

WCGS FLEX equipment is stored in two (2) 7,200 sq. ft robust FSBs constructed to the ASCE 7-10, Minimum Design Loads for Buildings and Other Structures standard to meet the requirements of NEI 12-06 (Reference 3) for seismic, flooding, high winds, snow, ice, extreme cold and high temperature for the protection of the FLEX equipment. The WCGS SSE was utilized as the design input for the building's design requirements. The locations of the FSBs are shown in Figure 1. Each of the FSBs has a common set of equipment capable of supporting each FLEX function/strategy. This ensures we meet our N+1 requirement.

The FSBs were evaluated for the effect of local seismic ground motions consistent with the WCGS GMRS developed for the site as a result of the seismic hazard reevaluation (see Section 2.6.1) and found to have adequate structural margin to remain functional (i.e., collapse is not expected and access to the interior retained).

The primary FSB is located in in the southeast part of the site. The alternate FSB is located to the west of the SBO DG building. These locations are above the flood elevation from the most recent site flood analysis

Analyses of components stored in the FSBs have been performed to determine appropriate measures to prevent seismic interaction. All equipment stored in the buildings is restrained. The Fire Protection and Heating and Ventilation Systems in the FSBs are seismically installed. The lighting, conduits, electrical, and fire detection components are not seismically installed, but are considered insignificant and not able to damage FLEX equipment.

The FSBs are designed to withstand extreme temperatures by using an installed ventilation system. The ventilation system and individual space heaters will maintain temperatures in the buildings about 50°F.

The debris removal equipment required to support the implementation of the FLEX strategies is also stored inside the FSBs in order to protect it from applicable external hazards. Therefore, the equipment will remain functional and deployable to clear obstructions from the pathway between the FLEX equipment's storage location and its staging location(s). This debris removal equipment includes mobile equipment such as a front end loader and tow vehicles.

Deployment of the debris removal equipment and the Phase 2 FLEX equipment from the FSBs is not dependent on offsite power. The building equipment doors can be opened manually.

2.8 PLANNED DEPLOYMENT OF FLEX EQUIPMENT

2.8.1 Haul Paths

Pre-determined, preferred haul paths have been identified and documented in the FSG-05. Figures 2a, 3a, 6a, 6c, and 7 show some of the haul paths from the FSBs to the various deployment locations. These haul paths have been reviewed for potential soil liquefaction and have been determined to be stable following a seismic event. Additionally, the preferred haul paths minimize travel through areas with trees, power lines, narrow passages, etc. to the extent practical. However, high winds can cause debris from distant sources to interfere with planned haul paths. Debris removal equipment is stored inside the Primary FSB and is protected from the severe storm and high wind hazards such that the equipment remains functional and deployable to clear obstructions from the pathway between the FSB and its deployment location(s).

The deployment of onsite FLEX equipment in Phase 2 requires that pathways between the FSBs and various deployment locations be clear of debris resulting from BDB seismic, high wind (tornado), or flooding events. A front end loader is available to deal with more significant debris conditions.

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC and various commodities such as fuel and supplies. 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" locations and from the various plant access routes may be required. The same debris removal equipment used for onsite pathways may also be used to support debris removal to facilitate road access to the site once necessary haul routes and transport pathways onsite are clear.

2.8.2 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 high energy line break protection. These doors and gates are typically administratively controlled to maintain their function as barriers during normal operations. Following a BDBEE and subsequent ELAP, 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. The MCR contains a duplicate set of security keys for use by Operations personnel in implementing the FLEX strategies.

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

2.9 DEPLOYMENT STRATEGIES

2.9.1 AFW Makeup Strategy

The cooling lake or UHS provides a supply of water, as makeup to the CST for supply to the TDAFWP or directly to the suction of the FLEX Core Cooling Pump.

The FLEX Core Cooling Pump will be transported from either FSB to a location near the selected water source (CST or RWST). Hoses stored in the FSB will be deployed and routed per the applicable FSG. These hoses are stored with each FLEX Core Cooling Pump in the FSBs.

2.9.2 RCS Makeup Strategy

The FLEX RCS Makeup Pumps are stored in the Auxiliary Buildings and are protected against all BDBEE hazards described in Section 2.6.

The primary and alternate FLEX RCS Makeup Pump discharge connections are located inside of the Auxiliary Building and provide a path to the RCS hot legs. Accordingly, these connections are protected against all BDBEE hazards.

The alternate supply of water for the FLEX RCS Makeup Pump on the 1974' elevation of the Auxiliary Building is through a suction connection from the RWST. This connection is on the emergency water supply from RHR A mini-flow vent valve line and is on the 1974' elevation of the Auxiliary Building. Accordingly, these connections are protected against all BDBEE hazards.

2.9.3 Spent Fuel Pool Makeup Strategy

The SFP makeup strategy will initiate makeup by deploying the FLEX Spent Fuel Pool Pump from either FSB. The discharge of the FLEX Spent Fuel Pool Pump will be connected to a hose connection just inside the 2000' elevation roll up door of the Fuel Building that is seismically designed and missile protected.

The primary supply of water for the FLEX Spent Fuel Pool Pump is through a suction connection on the RWST with an alternate suction on the CST.

The FLEX SFP makeup connection is sufficiently sized to restore SFP level long term following the loss of SFP cooling with a makeup rate of 250 gpm.

2.9.4 Electrical Strategy

One FLEX 480 VAC/500 kW DGs is stored in each FSB and are, therefore, protected from the BDBEE hazards identified in Section 2.6.

A FLEX 480 VAC/500 kW DG will be deployed to primary staging Area A3 or alternate staging Area 2. The FLEX 480 VAC/500 kW DGs each have a set of color coded cables (stored with the DG in each FSB) which connect from the deployed DG to a FLEX Connection Panel. The color coded cables from each generator output circuit will be connected with proper phase rotation to the color coded mating receptacles on the applicable FLEX Control Panel. In addition to color coding, a phase rotation meter is provided in the receptacle panel for each 480 VAC circuit.

2.9.5 Fueling of Equipment

FLEX equipment is stored in the fueled condition. Once deployed during a BDBEE, a fuel transfer truck will refuel this equipment in the first 24 hours or sooner as required. The fuel transfer truck has three separate fuel tanks: 1550 gallons (off-road) diesel, 350 gallons of highway diesel, and 400 gallons of unleaded regular gasoline

The general coping strategy for supplying fuel oil to diesel driven portable equipment being utilized to cope with an ELAP is to draw fuel oil out of any available existing diesel fuel oil tanks on the WCGS site. The following onsite fuel sources will be used to refuel the FLEX equipment via the fuel transfer truck (or portable containers) as required.

The site has multiple sources of on-site diesel fuel:

- Four (4) 10,000-gallon underground tanks (3 diesel fuel and 1 gasoline) at the vehicle maintenance shop (non-safety)
- Two (2) 600-gallon, seismically qualified EDG day tanks
- Two (2) 100,000-gallon, seismically qualified EDG 7-day storage tanks (Technical Specification minimum 74,200 gallons/tank LCO 3.8.3)
- One (1) 469,000-gallon auxiliary boiler fuel tank (above ground and non-seismic)

The site has procured four (4) DC fuel transfer pumps that can be used to move fuel from any of their on-site sources and into either jerry cans or their existing fuel truck. The current pumps can provide 8-10 gpm with a 30-minute on/off duty cycle, which means that the pumps would need to be rotated into and out of service after providing 240 to 300 gallons of fuel to the jerry cans or fuel truck. Once the jerry cans of the fuel truck are filled, this fuel can be transported to the pump that requires refueling and the pump would be refueled.

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.

With all required functions running continuously (Core Cooling, RCS Inventory Makeup/Boration, SFP Makeup/Spray, Yard Tank Makeup, and the repowering of the Safety Function Support items) the fuel usage calculated to be approximately 80 gal/hr.

Even with a fuel consumption rate of greater than 880 gal/hour, WCGS can cope without need of offsite fuel by using only the volume available in the EDG day tanks and 7-day tanks.

The diesel fuel consumption information above does not include diesel fuel requirements for the portable 4160 VAC DGs to be received from the NSRC. More than adequate diesel fuel is available on site for these generators if the above ground 469,000 gallon auxiliary boiler fuel tank is available. If not, 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.

The BDBEE response strategy includes a very limited number of small support equipment that is powered by gasoline engines (lights, chop saws, and small electrical generator units). These components will be re-fueled using portable containers of fuel. Unleaded gasoline will be obtained from the WCGS 10,000 gallon underground fuel storage tank.

Diesel for off road vehicles will be obtained from two (2) 10,000 gallon underground storage tanks. Diesel for on-road vehicles will be obtained from one 10,000 gallon underground storage tank. WCGS also maintains 250 gallons of kerosene to support portable heaters. Oil for the 2-cycle engines is also available in the FSBs.

2.10 OFFSITE RESOURCES

2.10.1 National SAFER Response Center (NSRC)

The industry has established two (2) NSRCs to support utilities during BDB events. The Wolf Creek Nuclear Operating Corporation (WCNOC) has established contracts with the Pooled Equipment Inventory Company to participate in the process for support of the NSRCs as required. Each NSRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. In addition, onsite FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC.

In the event of a BDBEE and subsequent ELAP 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 WCGS site and staged at the NSRC onsite Staging Area "B" on the north side of the site by helicopter if ground transportation is unavailable

Communications will be established between the WCNOC and the NSRC team. If normal communications are interrupted, satellite phones will be used. WCGS personnel and the NSRC Team will coordinate moving required equipment to the site as needed. First arriving equipment will be delivered to the site within 24 hours from the initial request. The order in which equipment is delivered is identified in the WCGS SAFER Response Plan (Reference 21).

2.10.2 Equipment List

The equipment stored and maintained at the NSRC for transportation to the local assembly area to support the response to a BDBEE at WCGS is listed in Table 2. Table 2 identifies the equipment that is specifically credited in the FLEX strategies for WCGS, 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.

2.11 EQUIPMENT OPERATING CONDITIONS

2.11.1 Ventilation

Following a BDB external event and subsequent ELAP event at Wolf Creek, ventilation providing cooling to occupied areas and areas containing FLEX strategy equipment will be lost. Per the guidance in NEI 12-06 (Reference 3) FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDBEE resulting in an ELAP. 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 (Reference 40) 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:

- Main Control Room
- NK Battery Rooms
- DC Switchboard Rooms
- ESF Switchgear Rooms
- Auxiliary Building 1974' and 2000' Elevations
- Fuel Building General Area
- Turbine Driven Auxiliary Feedwater (TDAFW) Pump Room
- TDAFW Pump Discharge Valve Nitrogen Accumulator Rooms
- Boric Acid Tank and Transfer Rooms.

These areas have been evaluated (Reference 40) to determine the temperature profiles following a 7-day ELAP event. The results provided by Reference 40 are considered conservative, as many of the temperatures are calculated utilizing internal room heat loads that represent equipment operating either normally or in accident conditions. During an ELAP, the majority of this equipment will be non-functional and will therefore generate no heat. The room where this conservatism applies is denoted in the following sections. In addition, these results do not include any heat removal that may be provided by implemented compensatory measures.

Main Control Room

Reference 40 conservatively determined that MCR temperature reaches 162°F after 7-day ELAP assuming no compensatory measures are implemented. Procedure EMG C-0 directs all MCR equipment cabinet and several Control Building doors to be opened within 30 minutes after a loss of all AC power. Vital instrument cooling is assured if the cabinet doors are opened within 30 minutes from loss of all AC power.

In addition, FSG-04, , ELAP DC Load Shed/Management, provides direction on implementing a flow path through the MCR utilizing a FLEX electric high flow fan providing outside air from the south stairwell through Doors 32016 and 36161. This action is not accounted for in Reference 40. Therefore, predicted temperatures for the MCR Area will remain below the predicted temperature response.

NK Battery Rooms, DC Switchboard Rooms, and ESF Switchgear Rooms

Reference conservatively determined that NK Battery rooms reach 108°F, the DC Switchboard Rooms reach 122°F to 124°F, and the ESGRs reach 114°F after 7-day ELAP assuming no compensatory measures are implemented. Room temperatures are explicitly calculated for the Train B equipment rooms (which have bounding heat loads to Train A), and the maximum temperature in each Train B room is applied to the corresponding Train A room.

To compensate, FSG-05 directs operators to stage one portable FLEX 120/240 VAC/15 kW DG and four FLEX high flow electric fans at staging Area A3. Concurrently, FSG-04 directs operators to block open various Class 1E equipment room doors and turn on the staged four FLEX high flow electric fans inside the Control Building to provide cooling as well as provide a flow path for the dispersion of hydrogen gas. This action is directed to occur within 8 hours after an ELAP per FSG-05. This arrangement provides outside air through Door 32018 with a fan blowing up the south stairwell to upper Control Building elevations. These compensatory actions are not considered in Reference 40, so the predicted room temperatures are conservative and will remain below the predicted temperature response.

An additional ventilation concern applicable to Phase 2 is the potential buildup of hydrogen in the NK battery rooms. Off-gassing of hydrogen from batteries is only a concern when batteries are charging. Once the FLEX 480 VAC/500 kW DG restores power to the battery chargers to begin re-charging the Class 1E batteries, the FLEX forced ventilation arrangement described above will preclude any significant hydrogen accumulation. However, per analysis (Reference 42) during an ELAP with extreme low temperature BDBEE, if battery rooms are maintained below 60°F, hydrogen generation rate is reduced such that ventilation is not required to prevent a 2% buildup for eleven days. This allows for operational flexibility to reduce ventilation in these areas to support operators maintain the room temperatures under extreme cold weather conditions.

Auxiliary Building Areas – Elevations 1974' and 2000'

Reference 40 conservatively determined that temperature in the Auxiliary Building elevations 1974' and 2000' reaches 120°F after 7-day ELAP which states that with the exception of the RHR Heat Exchanger Rooms, the TDAFWP room, and the MSHV Rooms, the ambient temperature outside of the containment in rooms and corridors which do not have Engineered Safety Feature (ESF) coolers will not exceed 120°F during loss of normal ventilation conditions, because of the lack of heat sources. These areas do not have ESF coolers; therefore, the 120°F maximum temperature applies. No compensatory actions to ventilate these areas are required.

Fuel Building General Area

The Fuel Building General Area post-ELAP temperatures calculated in Reference 43 and evaluated in Reference 40, considers the scenarios of normal and full core offload in the SFP, in conjunction with two scenarios of when the rollup door may be opened during the FLEX Integrated Plan.

Under normal plant operation SFP load, Fuel Building temperature remains below 105°F until 5.59 hours post-ELAP, at which time the SFP boils, causing ambient temperature to jump over 140°F and slowly climb to 152°F at 35 hours post-ELAP. Under full core offload conditions, temperature remains under 105°F for approximately 2.4 hours, at which point the SFP boils, the ambient temperature jumps over 160°F and continues to climb. In conjunction with full core offload, if the Fuel Building rollup door is not opened until 5.59 hours post-ELAP, the internal Fuel building temperature may reach 212°F around 5 hours post-ELAP.

To compensate, FSG-05 directs operators to perform time-sensitive actions as early as possible during the ELAP but no later than 5 hours and 35 minutes during Modes 1-5, and 2 hours and 23 minutes if defueled, due to the likelihood of extremely high temperature and humidity in the Fuel Building. These actions include directing operators to block open the Fuel Building Rollup Door 61022 and Door 61021 to establish a vent pathway, and perform deployment of the SFP spray equipment in the Fuel Building. The performance of the FSG within these time periods will ensure the SFP Spray strategy is ready for initiation before conditions threaten habitability. The cooling effects of opening of the Fuel Building doors per FSG-05 are not considered in the temperature analysis therefore its predicted temperatures for the Fuel Building will likely remain below the predicted temperature response calculated in Reference 43.

TDAFWP Room

Reference 40 conservatively determined that the TDAFWP Room has a steady-state temperature of 146.4°F that remains applicable for a 7-day ELAP, assuming no ventilation, no lighting, and the TDAFWP operating. To compensate, Procedure EMG C-0 directs doors for the TDAFWP Room and Auxiliary Feedwater corridor to be opened early during a loss of all AC power. This action will provide a path for natural convection through the TDAFWP room, and is not accounted for within Reference 40. Therefore, the predicted room temperature is conservative.

TDAFW Pump Discharge Valve Nitrogen Accumulator Rooms

Reference 40 determined the SG ARV Room that contains the accumulators will reach a temperature of 120°F during the 7-day ELAP consistent with the Auxiliary Building general areas. The accumulator rooms do not have ESF coolers; therefore, the 120°F maximum temperature applies to them. No compensatory actions to ventilate these areas are required.

BAT Room

Reference 40 conservatively determined that the BAT Room has a steady-state temperature of 106.6°F during 7-day ELAP. The evaluation models a heat generation rate of 7,400 BTU/hour within the room, which is conservative for an ELAP condition. No contingency actions for ventilation are required for elevated temperatures. However, for extreme low temperature BDBEEs, 480 VAC/45 kW Electric Heaters rated at 154,000 BTU (one stored in each FSB), are available to be deployed to maintain BAT Room temperature. FSG-05 provides guidance for use of the portable electric heating to maintain BAT room temperature above minimum temperature of 70°F.

2.11.2 Heat Tracing

Heat tracing to FLEX connections is not required. All FLEX connections for hose or piping carrying water are located inside buildings. For hoses that are routed outside and are susceptible to freezing during extreme low temperatures a method of recirculation is provided such that flow can be maintained in the exposed hose at all times thereby preventing freezing. In addition, portable heaters stored in each FSB, may be used with temporary enclosures to provide freeze protection. Major components for FLEX strategies that are deployed to outside areas are provided with cold weather packages to protect the equipment from damage due to extreme cold weather and help assure equipment reliability. Extreme cold is not expected to impact CST availability. The CST is insulated and adequately protected from extremes of hot and cold weather. The volume and initial temperature of the CST contents and associated piping would preclude the significant loss of heat required for freezing upon loss of all AC power within the Phase 1 timeframes. In addition, the CST refill connection pressure gauge instrument tubing inside the CST Valve house credited for BDB and subject to freezing conditions in an ELAP event, will be protected with the use of portable kerosene heaters per FSG-5 which can be powered from small FLEX generators or from the small generators that are included as part of the large FLEX pump skids.

The UHS would remain available as a water source during extreme cold conditions. During the relatively short period of time when the FLEX strategies required CST makeup from the UHS, the ESW pump house forebay is expected to remain accessible to allow deployment of the CST makeup submersible pump into the ESW forebay. During Phase 3 when access to UHS outside the ESW Pumphouse is required and in the event that the UHS was covered with a layer of ice, sufficient means and personnel are available to break through the ice to gain access to the water for the lift pumps, suction hoses, and strainers

2.12 HABITABILITY

Habitability was evaluated as discussed in Section 2.11.1 in conjunction with equipment operability and determined to be acceptable.

2.13 LIGHTING

MCR lighting is powered by plant batteries and adequate portable lighting is provided to support activities outside of the MCR. Temporary lighting will be provided for the staging area via the small 500 kW generators with attached lighting. FSG-05 contains provisions for setting up portable lighting to illuminate the staging area and the pathway to the FLEX connections.

Most areas contain emergency lighting fixtures (Appendix "R" lighting) consisting of a battery, battery charger and associated light fixtures. These emergency lights are designed and periodically tested to insure the battery pack will provide a minimum of eight (8) hours of lighting with no external AC power sources. Therefore, these currently installed emergency lighting fixtures provide adequate lighting to light pathways and implement the FLEX strategies for Phase 1 mitigation strategy activities for 8 hours.

In addition to installed Appendix "R" lighting, and the portable light plants, the FSBs also includes a stock of flashlights and headband lights to further assist the staff responding to a BDB event during low light conditions.

2.14 COMMUNICATIONS

In the event of a BDBEE and subsequent ELAP, communications systems functionality could be significantly limited. A standard set of assumptions for an ELAP is identified in NEI 12-01, Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities (Reference 26).

Communications necessary to provide onsite command and control of the FLEX strategies and offsite notifications at WCGS can be effectively implemented with a combination of sound powered phones, satellite phones, and hand-held radios.

Onsite:

Dedicated sets of sound-powered phone headsets and cords are available for the implementation of the FLEX strategies between the MCR, the Technical Support Center (TSC), and areas which implement the FLEX strategies (e.g., TDAFWP, SG ARVs, etc.). The operation of this sound-powered phone subsystem is not dependent on the availability of the electric power system.

Indoor and outdoor locations where temporary FLEX equipment is used may also be served with either hand-held radios, satellite phones, or sound-powered phone headsets connected with extension cords to nearby jacks.

There are dedicated hand-held radios available for the implementation of onsite FLEX strategies. Sufficient batteries and chargers are also available. Use of the hand-held radios is somewhat limited (on a point to point basis).

Offsite:

Satellite phones are the only reasonable means to communicate offsite when the telecommunications infrastructure surrounding the site is non-functional. They connect with other satellite phones as well as normal communications devices.

NEI 12-01 (Reference 26) outlines the minimum communication pathways to the federal, state, and local authorities. Several handheld satellite phones are available for initial notifications. These phones are stored in the MCR, the Emergency Operations Facility (EOF), the TSC, the Coffey County Courthouse, and the Kansas Division of Emergency Management. Phones are also with the WCNOC Chief Executive Officer and the WCGS Call Superintendent.

The MCR, EOF, and TSC satellite phones are installed units. The antennae setup is a system with fiber optics cable from the inside "desk sets" to outdoor, battery powered, dish antennae. The outdoor antennae systems also have fiber optic connections for connecting a portable antennae dish. This portion of the communications strategy is powered by 72 hour uninterruptable power supplies. These phones and the remaining satellite phones are functionally tested on a quarterly frequency.

2.15 WATER SOURCES

2.15.1 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 2.6. 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 event. As noted in Table 3, at least three water sources would survive all applicable hazards for WCGS and are credited for use in FLEX strategies.

The water sources have a wide range of associated chemical compositions. Therefore, extended periods of operation with the addition of these various water sources to the SGs were evaluated for impact on SG performance resulting from SG material (e.g., tube) degradation and potential impact on the heat transfer capabilities of the SGs. Use of the available clean water sources, tanks and condenser, are limited only by their quantities. The water supply from cooling lake (available for all BDBEEs except for seismic) is essentially unlimited by quantity, but is limited in quality, specifically the concentration of total suspended solids (TSS).

Analysis of alternate secondary side water sources indicates that the RWST (a borated coolant source) is most limiting source in regards to corrosion of SG internals (Reference 38). This same analysis concludes that the use of the UHS poses a corrosion risk that is significantly low over the analyzed period of 72 hours. Before this time is reached, offsite resources will become available.

The results of the water quality evaluation show that the credited, fully protected, onsite water sources provide an adequate AFW supply source for a much longer time than would be required for the delivery and deployment of the Phase 3 NSRC reverse osmosis (RO)/ion exchange equipment to remove impurities from the onsite natural water sources. The RO units have a capacity of up to 300 gpm. Once the reverse osmosis/ion exchange equipment is in operation, the onsite water sources provide for an indefinite supply of purified water.

2.15.2 Water Sources – Primary Side

Two credited sources for borated water are available onsite: the RWST and the two BATs in the Auxiliary Building. These sources are discussed in Section 2.3.10.4.

2.15.3 Spent Fuel Pool

At WCGS, any water source available is acceptable for use as makeup to the SFP; however, the primary source would be from the cooling lake via the FLEX Spent Fuel Pool 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.

2.16 SHUTDOWN AND REFUELING MODES ANALYSIS

WCGS is abiding by the NEI position paper entitled "Shutdown/Refueling Modes," dated September 18, 2013, addressing mitigation strategies in shutdown and refueling modes (Reference 22). This position paper has been endorsed by the NRC staff (Reference 23)

The reactor core cooling and heat removal strategies previously discussed in Section 2.3 are effective as long as the RCS is intact and the SGs are available for use.

The window between the loss of natural circulation availability (i.e., the SGs are isolated) and when the refueling cavity is flooded (at approximately 50-100 hours), is considered in the Modes 5 and 6 core cooling strategy development. During this window the reactor coolant loops are isolated and the RCS is vented with the removal of at least one Pressurizer Safety Valve.

Should an ELAP occur in this window, the immediate response to a loss of shutdown cooling will be to dispatch an operator to initiate gravity feed to the RCS hot legs from the RWST. This gravity feed injection path will utilize MOVs in the Safety Injection (SI) system that can be manually operated to initiate RCS injection by gravity feed. The SI system is seismically qualified and located in missile protected facilities; therefore, providing assurance it would survive a BDB event and be available to support gravity feed from the RWST. The gravity feed to the RCS hot legs strategy is expected to provide adequate RCS cooling until forced feed can be established.

Shutdown procedures require the pre-deployment of a FLEX Core Cooling Pump with supply and discharge hoses to serve as a low pressure medium flow RCS Injection pump, which will provide a means to establish forced feed of borated water to the RCS cold legs from the RWST during an ELAP in either Modes 5 or 6. When forced RCS injection is established by the FLEX Core Cooling Pump, gravity feed to the RCS hot legs will no longer be necessary. It is the intent of this strategy to transition from gravity feed to forced feed prior to the loss of gravity feed effectiveness.

The RWST is not protected from all hazards (i.e. tornado missiles). In the unlikely event that a tornado missile damages the RWST during Mode 5 or 6, procedures will direct the operators to use blended flow from the CST and BATs to make up for the boiled off coolant.

If this method is not available, the procedures will direct injection of available clean water sources listed in Table 3 with the first priority being the RWST, if it is available. In this case, the flowrate will be reduced to match the boil-off rate of the RCS to minimize dilution of the RCS when adding unborated water. The water supply from the CST would be available following a tornado event, thus providing a method for restoring core cooling for all hazards during Modes 5 and 6.

If an ELAP event results in a loss of RHR during modes 5 and 6, the 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 established following an ELAP event while in Modes 5 or 6. FSG-12, Alternate Containment Cooling in Mode 5 and 6, contains provisions to manually vent containment pressure by opening GP HV-30 (Compressed air to atmosphere isolation valve). This procedure restricts containment pressure to no more than 5 psig. Above that pressure, indications on instrument systems may be affected. The adequacy of this vent path for stopping containment pressurization and depressurizing the containment has been confirmed by analysis (Reference 39).

2.18 SEQUENCE OF EVENTS

Table 4 presents a Sequence of Events (SOE) Timeline for an ELAP at WCGS. Validation of each of the FLEX time constraint actions has been completed per NEI 12-06 (Reference 3) and includes consideration for staffing. Time to clear debris to allow equipment deployment is assumed to be 2 hours. This time is considered to be reasonable based on site reviews and the location of the FSB. Debris removal equipment is stored inside the primary FSBs and is, therefore, protected from the external hazards described in Section 2.6.

2.19 PROGRAMMATIC ELEMENTS

2.19.1 Overall Program Document

Procedure AP 06-005, Diverse and Flexible Coping Mitigation Strategies (FLEX) Program, provides a description of FLEX Program. The key elements of the program include:

- Maintenance of the FSGs including any impacts on the interfacing procedures (EOPs, Off Normal Operating Procedures (OFNs), etc.)
- Maintenance and testing of FLEX equipment (i.e., SFP level instrumentation, emergency communications equipment, portable FLEX equipment, FLEX support equipment, and FLEX support vehicles)
- Portable equipment deployment routes, staging areas, and connections to existing mechanical and electrical systems
- Validation of time sensitive operator actions
- The FSBs and the NSRC
- Hazards considerations (Flooding, Seismic, High Winds, etc.)
- Supporting evaluations, calculations and FLEX drawings
- Tracking of commitments and equipment unavailability
- Staffing, Training, and Emergency Drills
- Configuration Management
- Program Maintenance

In addition, the program description references (1) a list of the BDB FLEX basis documents that will be kept up to date for facility and procedure changes, (2) a historical record of previous strategies and their bases, and (3) the bases 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 (Reference 3) and 2) an engineering basis is documented that ensures that the change in FLEX strategies continues to ensure the key safety functions (Containment, core and SFP cooling) are met.

2.19.2 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 BDBEE conditions, and are not used inappropriately in lieu of existing procedures. When FLEX equipment is needed to supplement EOPs or OFN strategies, the EOP or OFN directs the entry into and exit from the appropriate FSG.

FSGs have been developed per PWROG guidelines. The FSGs provide instructions for implementing available, pre-planned FLEX strategies to accomplish specific tasks in the EOPs or OFNs. 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 Procedure EMG C-0 and Procedure OFN NB-034, Loss of All AC Power-Shutdown Conditions, to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP

FSG maintenance is performed by the Operations Procedures Group per Procedure AP 15C-004, Preparation, Review and Approval of Procedures, Instructions, and Forms. Procedure AP 06-005 provides guidance for configuration control of the FLEX Program based on NEI 12-06 (Reference 3). It provides criteria to determine if changes to FLEX strategies require NRC approval prior to implementation.

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 FSBs when appropriate.

2.19.3 Staffing

Using the methodology of NEI 12-01 (Reference 26), an assessment of the capability of the WCGS on-shift staff and augmented Emergency Response Organization (ERO) to respond to a BDBEE was performed. The results were provided to the NRC in a letter dated May 7, 2014 (Reference 26).

The assumptions for the NEI 12-01 (Reference 26) Phase 2 scenario postulate that the BDB event involves a large-scale BDBEE that results in:

- An ELAP
- An LUHS
- Impact on the unit (unit is operating at full power at the time of the event)
- Impeded access to the unit by offsite responders as follows:
    - 0 to 6 Hours Post Event- No site access.
    - 6 to 24 Hours Post Event - Limited site access. Individuals may access the site by walking, personal vehicle, or via alternate transportation capabilities (e.g., private resource providers or public sector support).

- 24+ Hours Post Event - Improved site access. Site access is restored to a near-normal status and/or augmented transportation resources are available to deliver equipment, supplies and large numbers of personnel.

A team of subject matter experts from Operations, Maintenance, Radiation Protection, Chemistry, Security, Emergency Preparedness, and Industry Consultants performed tabletop exercises in December 2013 and January 2014 to conduct the on-shift portion of the assessment. The participants reviewed the assumptions and applied existing procedural guidance, including applicable FSGs for coping with a BDBEE using minimum on-shift staffing.

Particular attention was given to the sequence and timing of each procedural step, its duration, and the on-shift individual performing the step to account for both the task and time motion analyses of NEI 10-05, Assessment of On-Shift Emergency Response Organization Staffing and Capabilities (Reference 27). The staffing analysis concluded that there were no task overlaps for the activities that were assigned to the on-shift personnel.

The expanded ERO analysis portion of the staffing assessment concluded that sufficient personnel resources exist in the current WCGS augmenting ERO to fill positions for the expanded ERO functions. Thus, the ERO resources and capabilities necessary to implement Transition Phase coping strategies performed after the end of the "no site access" 6-hour time exist in the current program.

The staffing assessments noted above were performed in conjunction with the development of procedures and guidelines that address NRC Order EA-12-049 (Reference 2). Once the FSGs were developed, a validation assessment of the FSGs was performed using communication equipment determined available post-BDBEE and the staff deemed available per the staffing studies. The validation process was performed and documented per NEI Guidance (Reference 28).

2.19.4 Training

WCGS's Training Program has been revised to assure personnel proficiency in utilizing FSGs and associated FLEX equipment for the mitigation of BDBEEs is adequate and maintained. These programs and controls were developed and have been implemented per the Systematic Approach to Training (SAT) Process.

Initial training has been provided and periodic training will be provided to ERO leaders on BDB emergency response strategies and implementing guidelines. Personnel assigned to direct the execution of the FLEX mitigation strategies for BDBEEs 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 BDBEE accident mitigation. The testing/evaluation of Operator knowledge and skills in this area have been similarly weighted.

Per NEI 12-06 (Reference 3) and ANSI/ANS 3.5-2009 (Reference 29), certification of simulator fidelity is considered to be sufficient for the initial stages of the BDBEE scenario until the current capability of the simulator model is exceeded. Full scope simulator models will not be upgraded to accommodate FLEX training or drills.

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

2.19.5 Equipment List

The equipment stored and maintained at the WCGS FSBs necessary for the implementation of the FLEX strategies in response to a BDBEE is listed in Table 1. Table 1 identifies the quantity, applicable strategy, and capacity/rating for the major FLEX equipment components only, as well as various clarifying notes.

2.19.6 N+1 Equipment Requirement

NEI 12-06 (Reference 3) invokes an N+1 requirement for the major BDB 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 on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of equipment required by FLEX strategies. Therefore, where a single resource is sized to support the required function 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 (Reference 3). Other FLEX support equipment provided for mitigation of BDBEEs, 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. 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 BDB 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.

2.19.7 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 per 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 is subject to periodic maintenance and testing per NEI 12-06 (Reference 3) and the Institute of Nuclear Power Operations (INPO) AP 913, Equipment Reliability Process, (Reference 30), 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 BDBEE.

EPRI has completed and has issued Preventive Maintenance Basis for FLEX Equipment - Project Overview Report (Reference 31). 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 will be maintained as necessary to ensure continued reliability. Performance verification testing of FLEX equipment is scheduled and performed as part of the WCGS PM process (AP 16B-003, Planning and Scheduling of Preventive Maintenance and AI 23O-002, Maintenance Optimization, Evaluation Process Guide).

The unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy for core cooling, containment, and SFP cooling will be managed such that risk to mitigation strategy capability is minimized. Maintenance/risk guidance conforms to the guidance of NEI 12-06 (Reference 3) as follows:

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

3 REFERENCES

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4 TABLES

TABLE 1 – FLEX Portable Equipment Stored Onsite

Portable Equipment[1]	Inventory	Storage	Use and (potential/flexibility) diverse uses					Nominal Equipment rating/Notes
			Core	Containment	SFP	Instrumentation	Accessibility / Support	
Diesel Driven FLEX Core Cooling Pump and associated hoses and fittings	2	FSB	X	X				500 gpm, 500 psig 1 stored in each FSB
Electric Driven FLEX RCS Makeup and Boration Pump and associated hoses and fittings	2	Auxiliary Bldg.	X	X				20 gpm, 1650 psig One pump @1974'El., and one @2000' El.
Diesel Driven FLEX SFP Pump and associated hoses and fittings	2	FSB			X			250 gpm, 213 ft TDH 92.2 psig 1 stored in each FSB
FLEX 480 VAC/500 kW DG and associated cables and connectors	2	FSB	X	X	X	X		480 VAC, 500 kW, 625 A 1 stored in each FSB
Electric Driven Air Compressor and associated hoses and connections	2	Auxiliary Bldg.	X	X				21 CFM @ 125psig Both @ 1974'EL.
Diesel Driven 120/240Vac Generator and associated cables and connectors	2	FSBs					X	14kW, 58.3 Amps @ 240Vac 1 stored in each FSB
FLEX Electric Driven Blowers	10	FSB-Conex					X	120Vac, 1.5kW, Variable speed up to 14,625 CFM 5 stored in each FSB Conex
Diesel Driven FLEX Debris Removal Vehicle	1	FSB					X	CAT 924 Wheel Loader, 8 ft by 24 ft , 26,497 lbs .stored in primary FSB

TABLE 1 – FLEX Portable Equipment Stored Onsite									
			Use and (potential/flexibility) diverse uses					Nominal Equipment rating/Notes
Portable Equipment[1]	**Inventory**	**Storage**	**Core**	**Containment**	**SFP**	**Instrumentation**	**Accessibility / Support**	
Diesel Driven FLEX Tow Vehicle/flatbed	2	FSB					X	FORD 1 Ton Pickup with both gooseneck and tag hitch 1 stored in each FSB
Diesel Drive Portable Light Towers	8	FSB					X	6kW generator, 4000 watt lighting 4 stored in each FSB
FLEX Electric Heaters and extension cord	2	FSB					X	480 VAC , 45 kW 1 stored in each FSB
Toolbox for Loss of Instrumentation	4	FSB/Power block					X	Toolboxes support alternate means to obtain instrument readings. Located in: • Both FSB-Conexes • MCR • Auxiliary Bldg. Tool Room

[1]**Does not include all FLEX support equipment but only the equipment that directly supports recovery of safety functions or instrumentation**

TABLE 2 – FLEX Portable Equipment from NSRC								
		Use and (potential/flexibility) diverse uses					Performance Criteria/Notes
Portable Equipment	**Inventory**	**Core**	**Containment**	**SFP**	**Instrumentation**	**Accessibility / Support**	
FLEX Medium Voltage Generators and associated cables	3	X	X	X	X	X	4160 VAC, 1.0 MW
FLEX Low Voltage Generator and associated cables	1	X	X		X	X	480 VAC, 1.0 MW
FLEX High Pressure Injection Pump and associated hoses and fittings	1	X					60 GPM, 2000 PSI
FLEX Core Cooling Pump and associated hoses	1	X		X			500 GPM, 500 PSI
FLEX Low Pressure/ Medium Flow Pump and associated hoses	1	X					2,500 GPM, 300 PSI, 12 ft Lift
FLEX Low Pressure/High Flow (Dewatering) Pump and associated hoses	1	X					5,000 GPM, 150 PSI, 12 ft Lift
FLEX Suction Booster Lift Pump	2	X					5000 GPM, 26 ft Lift
FLEX Mobile Boration with 65 bags	1	X					1,000 Gal. ; Provides 6 batches @ 7750ppm BAC

TABLE 2 – FLEX Portable Equipment from NSRC							
		Use and (potential/flexibility) diverse uses					Performance Criteria/Notes
Portable Equipment	Inventory	Core	Containment	SFP	Instrumentation	Accessibility / Support	
FLEX Water Treatment System (Pre-filter) (Non-Generic) and associated hoses	1					X	500 GPM
FLEX Water Treatment System (Reverse Osmosis) (Non-Generic) and associated hoses	1					X	250 GPM
Mobile Lighting Towers	3					X	440,000 Lumens, 30 ft height

[1]**Does not include all FLEX support equipment but only the equipment that directly supports recovery of safety functions or instrumentation**

Table 3 - Water Sources						
Water Source	**Volume**	**Applicable Hazard**				
		Satisfies Seismic	**Satisfies Flooding**	**Satisfies High Winds**	**Satisfies Low Temp**	**Satisfies High Temp**
CST	450,000,gal (385,646 gal available)	Y	Y	Y	Y	Y
Demineralized Water Storage Tank	50,000 gal	N	Y	N	Y	Y
Reactor Makeup Water Storage Tank	126,000 gal	N	Y	N	Y	Y
WCGS Cooling Lake	111,280 acre-ft	Y[1]	Y	Y	Y	Y
Potable Water Storage Tank (PWST)	70,000 gal	N	Y	N	Y	Y
UHS	455 acre-ft	Y	Y	Y	Y	Y
RWST	450,000 gal (394,000 gal available)	Y	Y	N	Y	Y

Note 1: The dam creating the WCGS cooling lake is qualified to OBE but not accredited to be available during BDB seismic event

TABLE 4 - WCGS FLEX TIMELINE - PHASE 1		
Action	Required Complete (Hours)	Remarks
Event Starts	N/A	Plant at 100% power.
Perform SBO Coping Analysis	N/A	SBO actions are proceduralized refer to Procedure EMG C-0 or OFN NB-034.
MCR Ventilation	0.5	Ventilation is created in the MCR by opening a series of doors per Procedure EMG C-0 or OFN NB-034.
Load Shed	1.0	Load shedding increases battery life to 8 hours. Load shedding is to begin within 45 minutes and will be completed no later than 1.0 hour.
Declare ELAP	1.0	ELAP entry conditions can be verified by MCR staff. One hour is reasonable assumption for system operators to perform initial evaluation of creditable AC power sources (off-site power, EDG's, and SBO DG's). Entry into ELAP provides guidance to operators to perform ELAP actions.
TDAFW Pump Room Ventilation	1.5	Procedure EMG C-0 or OFN NB-034 actions to block open the doors of TDAFW Room.
SFP Area Vent Maximum Heat Load	2.4	Time based on SFP time to boil assuming normal maximum heat load (core offload), with initial bulk temperature is 140°F and the all pipe penetrating the SFP remains intact. Pre-staging the containment vent path and FLEX Core Cooling Pump is performed prior to entering Modes 5 or 6. FSGs direct staff to stage RCS/SFP makeup and spray strategy equipment in Fuel Building prior to SFP affecting habitability.
Provide Power to Communication Equipment	3.0	Communication power is assumed at 3 hours after event start.
SFP Area Vent Normal Heat Load	5.59	Time based on SFP time to boil assuming normal heat load, with initial bulk temperature is 140°F and the all pipe penetrating the SFP remains intact. FSGs direct staff to pre-stage SFP makeup and spray strategy equipment in Fuel Building prior to SFP affecting habitability.
Perform Damage Assessment	6.0	Evaluate and document the condition of plant systems, structures, and components after an ELAP event. The damage assessment will be comprehensive enough to allow planning recovery strategies. Based on the expected complexity of the task, it is assumed the assessment would take approximately 6 hours, depending on local site conditions. Furthermore, it is assumed that Critical plant conditions would be known by the CRS to perform appropriate actions following the completion of this task.

TABLE 4 - WCGS FLEX TIMELINE - PHASE 2		
Action	Required Complete (Hours)	Action
Debris Removal (Access)	6.0	Earliest need for FLEX equipment deployment paths.
Deploy FLEX 500 kW Generator	8.0	Earliest need for generator to repower station DC battery chargers based on extended battery capacity of 8 hours.
Establish Battery Room Ventilation	8.0	Portable fans used to vent hydrogen must be started when battery charging begins. If Battery Room temperature is less than 60°F, doors 32014 and 34021 remain closed as. low temperatures result in reduced hydrogen generation and will not require ventilation for eleven days. (Reference 42)
Stage FLEX Core Cooling Pump	10.0	Steam pressure should not be decreased enough to compromise TDAFW pump operation, however, back up should be staged when able, preferably prior to commencing cooldown at approximately 8 hours.
Plant Cooldown	12.0	WCGS FLEX Integrated plan assumes RCS cooldown no sooner than 2 hours. However, WCGS has installed the Generation III SHIELD® RCP seals which limit RCS leakage to 1 gpm therefore allowing cooldown to be delayed for eight hours. Assuming four hours to complete the cooldown, it is expected that actions to reduce temperature and pressure conditions will be completed by this time.
Establish Equipment Refuel Capacity	N/A	During Phase 2, depletion of FLEX equipment fuel supplies is expected at 10.0 hours plus equipment deployment time necessitating refueling activities to be performed using FLEX Fuel truck and Fuel Transfer pump carts are necessary.
Align FLEX RCS Pump from BAT	13.0	Initiation of RCS borated makeup from a BAT is required to meet shutdown margin at 14.01 hours (rounded to 14 hours) after the start of the ELAP assuming the accumulators are isolated. To allow for sufficient time for the boration to uniformly mix in the RCS the initiation time is reduced by one hour. Therefore this time ensures that borated makeup injection to achieve shutdown margin plus one hour for boron mixing prior to reaching 24 hours into the ELAP (Reference 9, Table 5-2-2).
Commence Staging and deployment of FLEX CST Makeup Pump	15.8	Based on analysis (Reference 12), time to reach 5.5 psig AFW suction pressure, depletion of CST level based on S/G usage requirements provided by TDAFW or FLEX Core Cooling Pump, actions to deploy CST makeup from UHS is initiated. Use of CST inventory for SFP makeup occurs after FLEX CST Makeup to CST is aligned from UHS.
Provide CST Makeup From UHS	31.1	Based on analysis (Reference 12), depletion of CST based on S/G usage requirements provided by TDAFW or FLEX Core Cooling Pump, actions to completed deployment and initiate CST makeup from UHS is to be completed. .
Align FLEX Spent Fuel Pool Pump	34.93	The limiting time to boil of 5.59 hours is based on normal heat load in SFP, and an initial SFP Temperature of 140°F. It will take an additional 29.34 hours for SFP inventory to boil down to the top of the racks which established the time of 34.93 hours to have FLEX SFP makeup initiated (Reference 9, Table 5-2-2).

TABLE 4 - WCGS FLEX TIMELINE - PHASE 2		
Action	Required Complete (Hours)	Action
Align FLEX RCS Pump from the RWST	42.43	Based on BAT volume of 17,659 gallons, starting at 13 hours and a flow rate of 10 gpm, the BAT will be depleted after 29.43 hours, for a total time of 42.43 hours. Therefore the RCS pumps are aligned from the RWST to continue to provide borated makeup to RCS.

TABLE 4 - WCGS FLEX TIMELINE - PHASE 3		
Action	Required Complete (Hours)	Action
Large Debris Removal	68.0	Support earliest deployment of NSRC equipment.
Align FLEX MV Generator	72.0	NSRC to bring three 4160VAC generators and one 480VAC to support powering of RHR and CCW. Earlier deployment would support earlier entry onto RHR.
Align Mobile Water Filtration System	72.0	The mobile purification system will provide filtered water to support core cooling and the mobile boration unit.
Align UHS Pump	72.0	UHS pump will be needed to achieve indefinite coping using RHR. NSRC provides the necessary lift pumps to support the WCGS portable FLEX ESW High Flow Pump to recover ESW and CCW systems. Earlier deployment would support earlier entry onto RHR.
Establish Large Fuel Truck service	72.0	On-site fuel supplies are expected to last >72 hours based on minimum seismically qualified storage of 149,600 gallons diesel fuel which supports usage of 2077 gallons/hour. WCNOC will coordinate replenishment of diesel fuel after 72 hours.
Align Mobile Boration Unit (blender)	132.0	RWST minimum volume will last for ~700 hours assuming only used for makeup to RCS. If RWST is also used for makeup to SFP, then RWST inventory would deplete in approximately 132 hours.

5 FIGURES

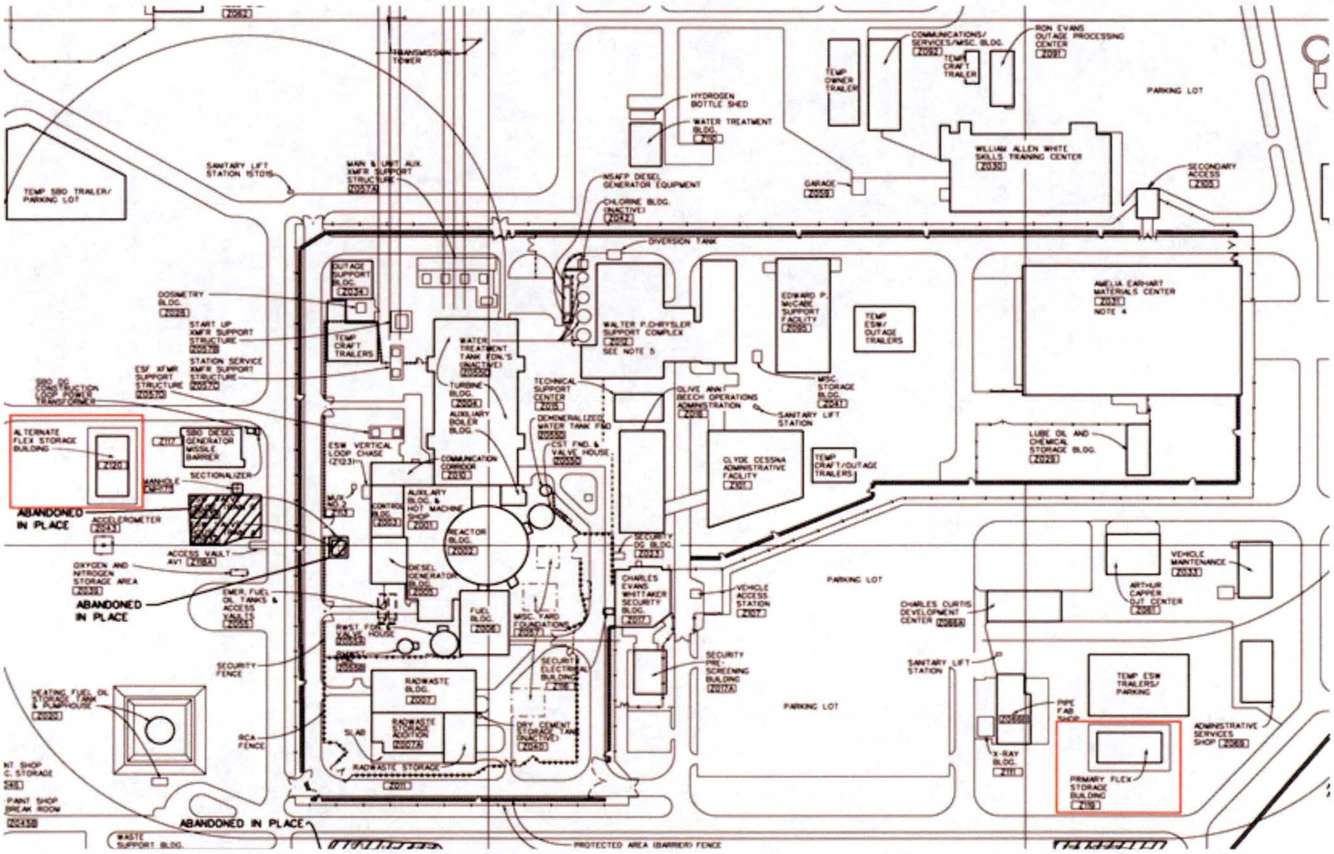

Figure 1: FLEX Storage Building Locations (from Drawing 8025-C-KG1202)

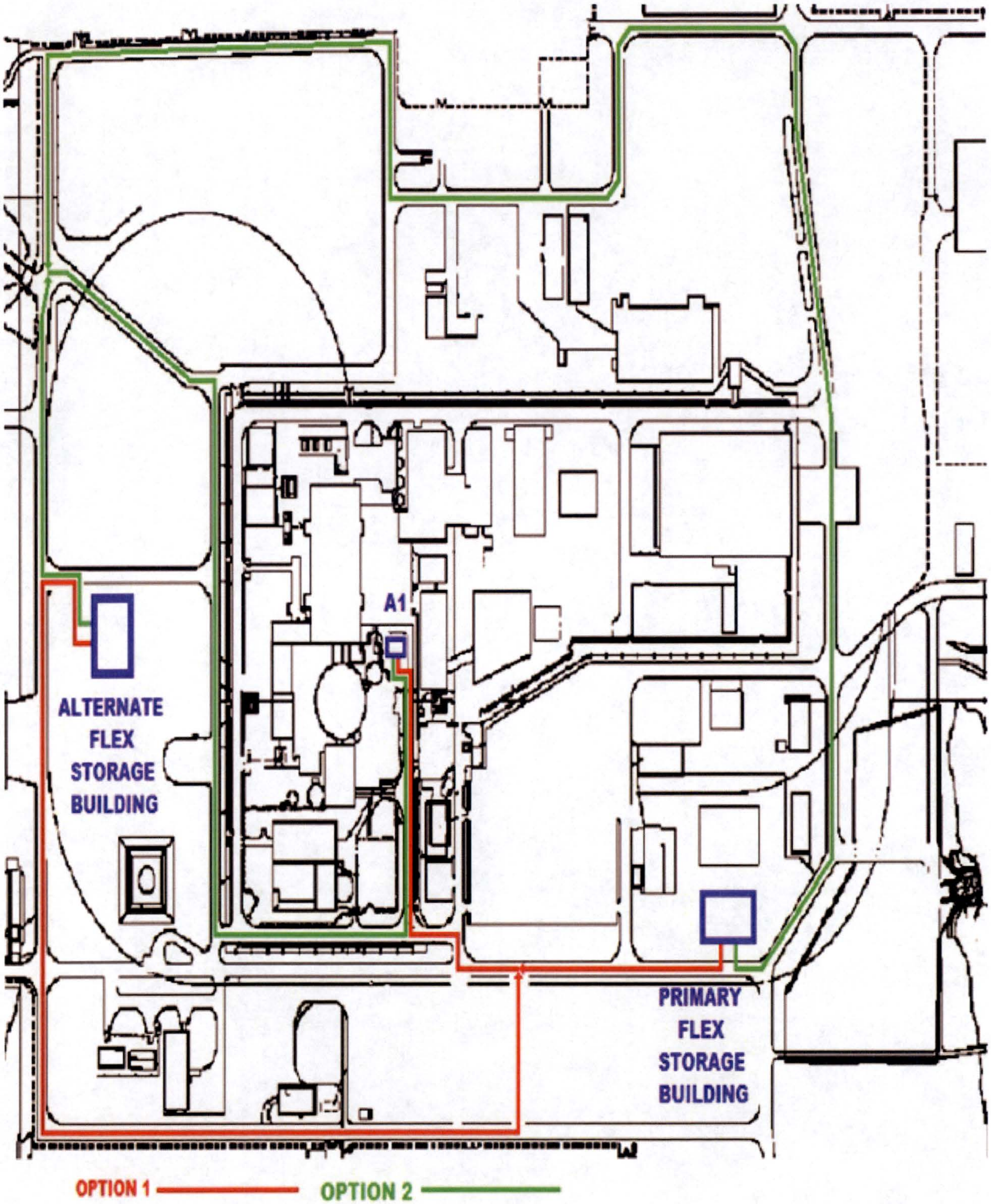

Figure 2a: Staging Flex Core Cooling Pump And Diesel Air At CST (from FSG-05 Figure 7)

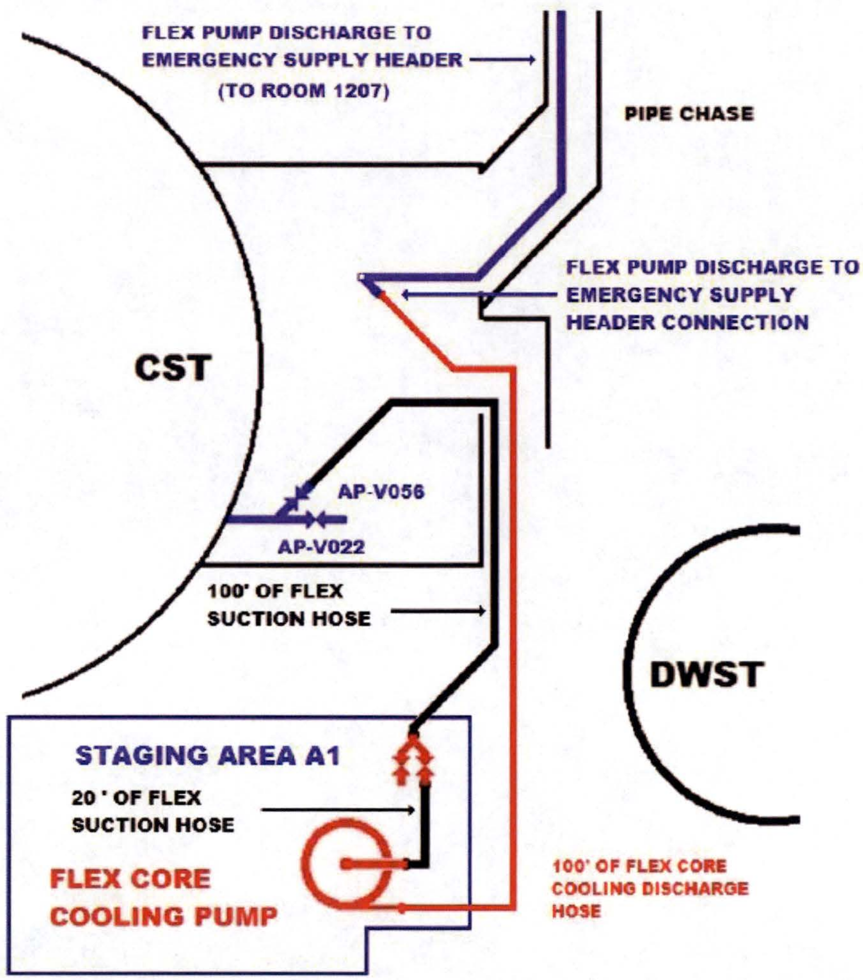

Figure 2b: Deployment of Flex Core Cooling Pump (from FSG-03 Figure 1)

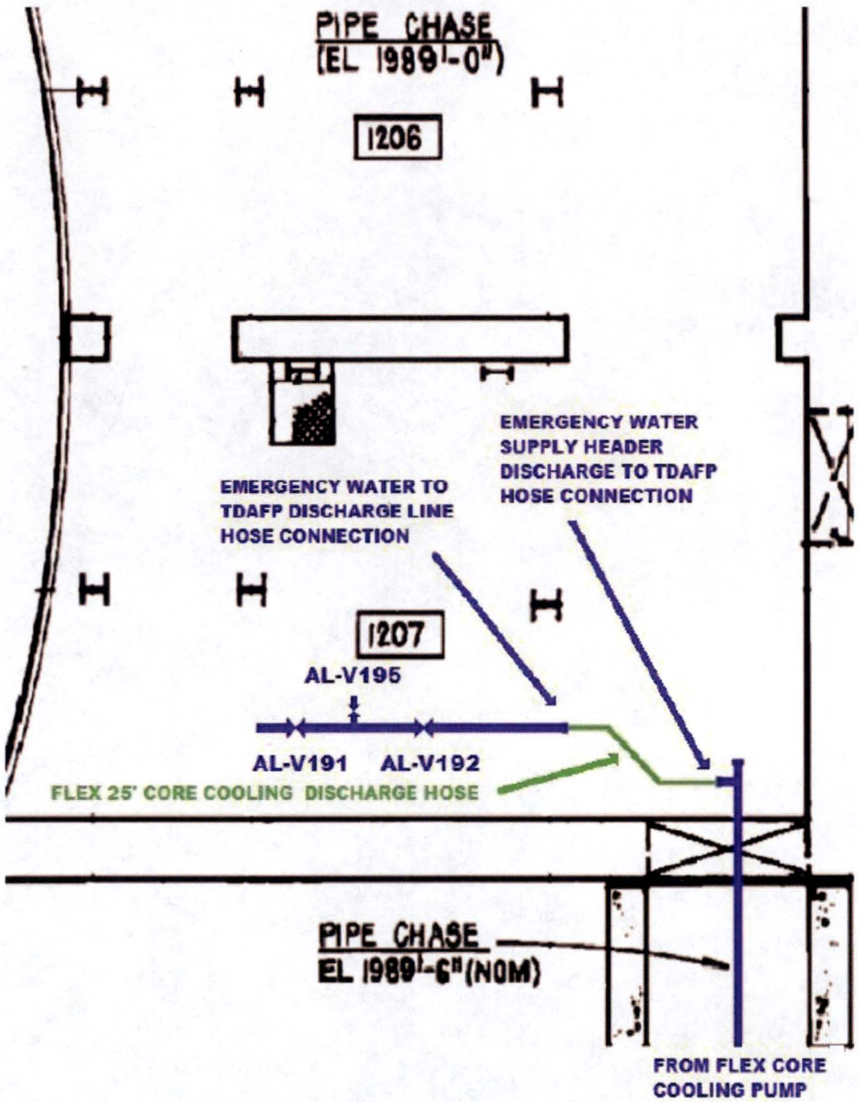

Figure 2c: Auxiliary Feedwater Primary Connection (from FSG-03 Figure 2)

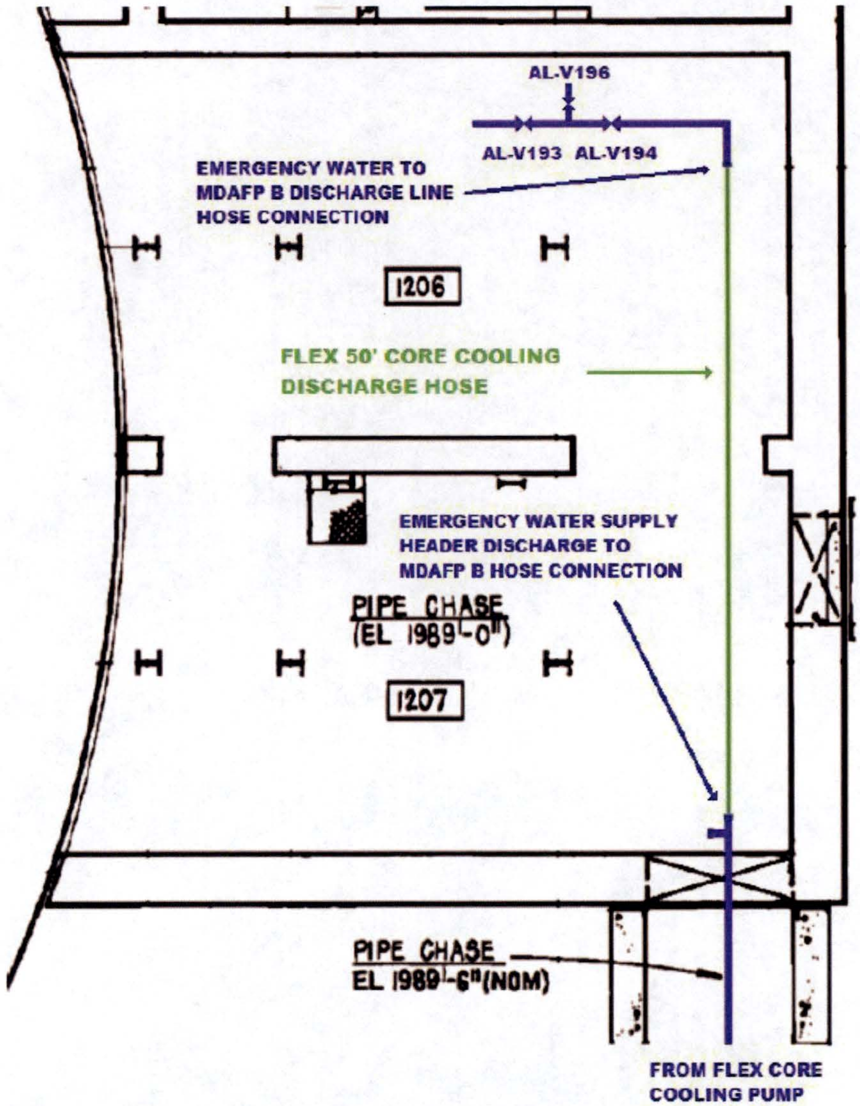

Figure 2d: Auxiliary Feedwater Alternate Connection (from FSG-03 Figure 3)

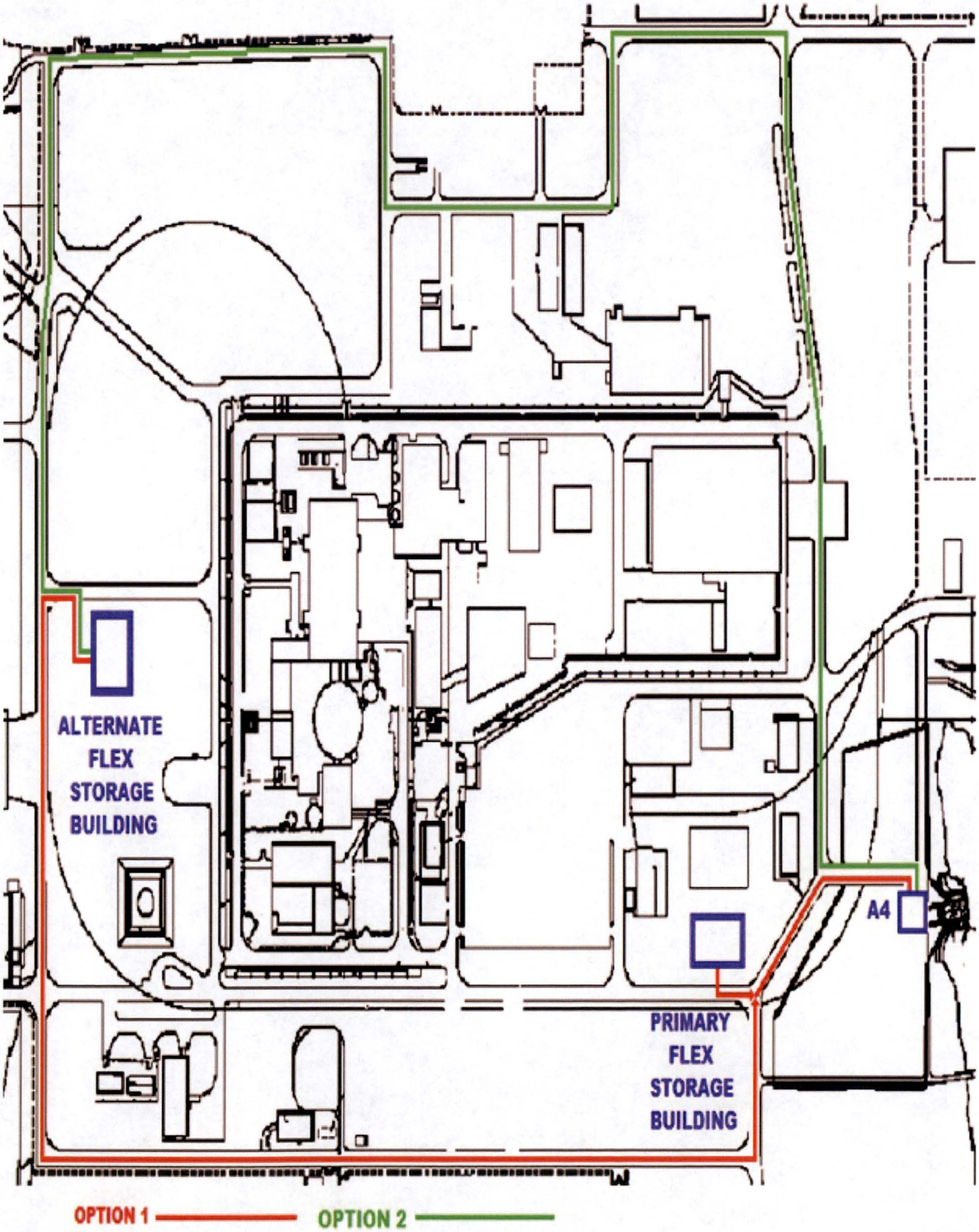

Figure 3a: Staging Flex CST Makeup Pump at ESW House (A4) (from FSG-05 Figure 12)

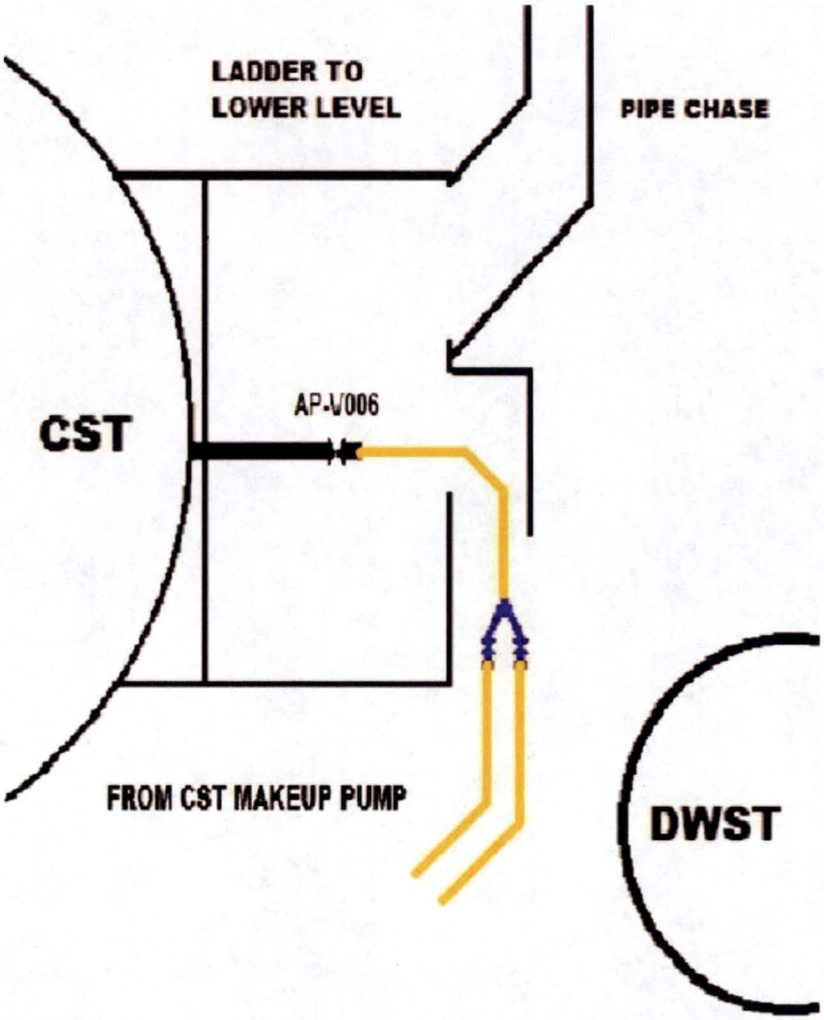

Figure 3b: Connection in CST Building for CST Makeup (from FSG-06 Figure 3)

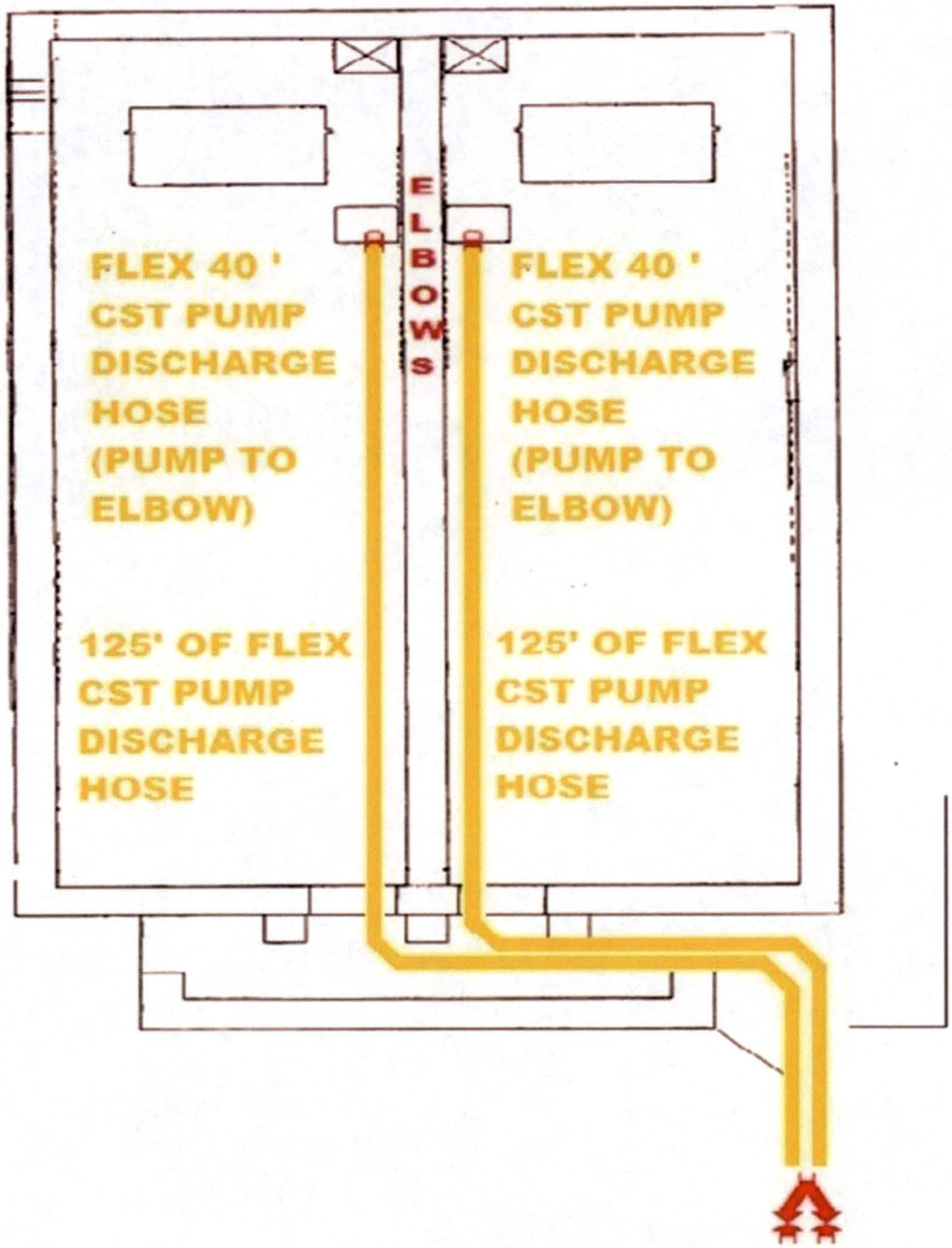

Figure 3c: Deployment Path for CST Makeup (from FSG-06 Figure 1)

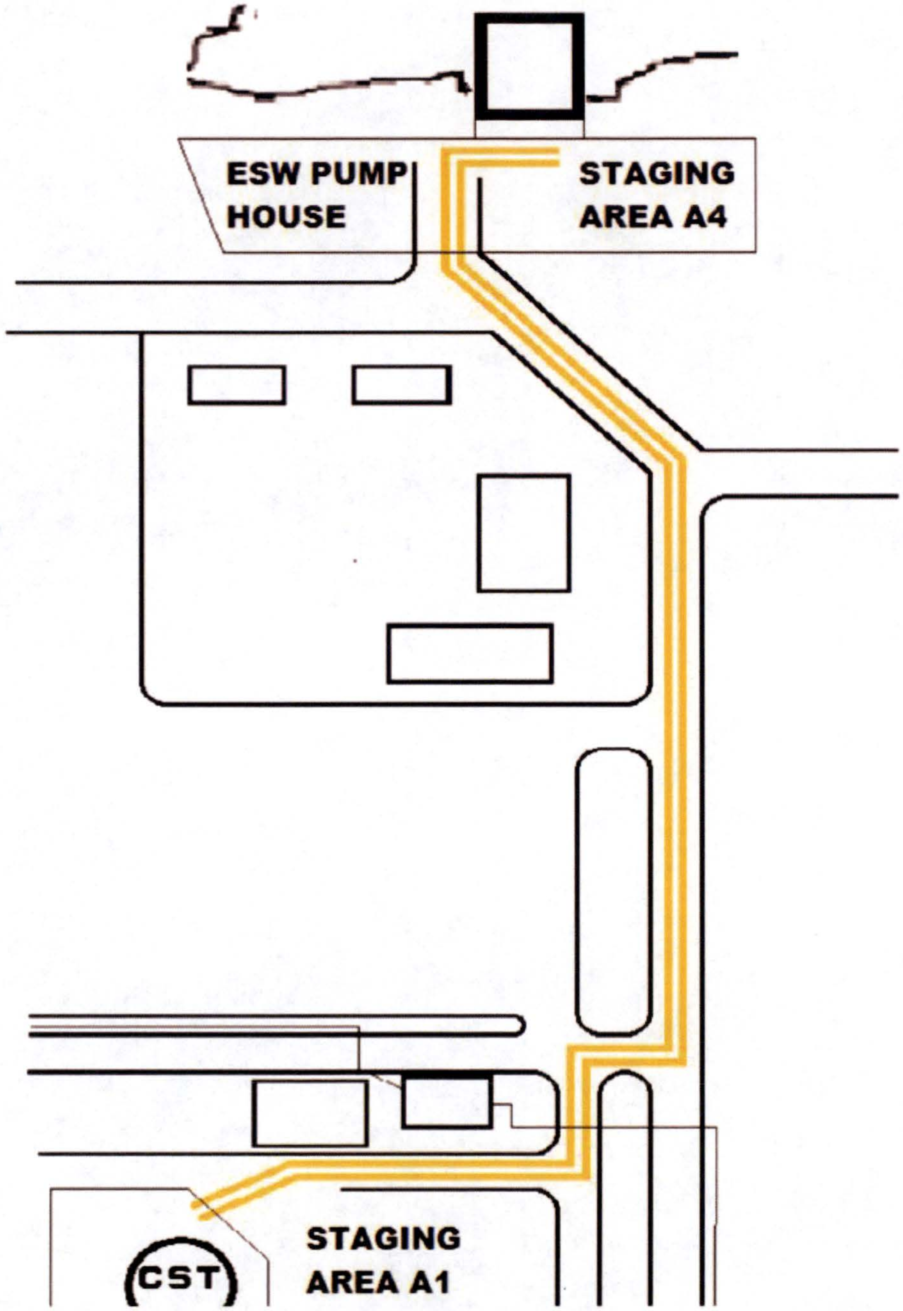

Figure 3d: Deployment Path for CST Makeup (from FSG-06 Figure 2)

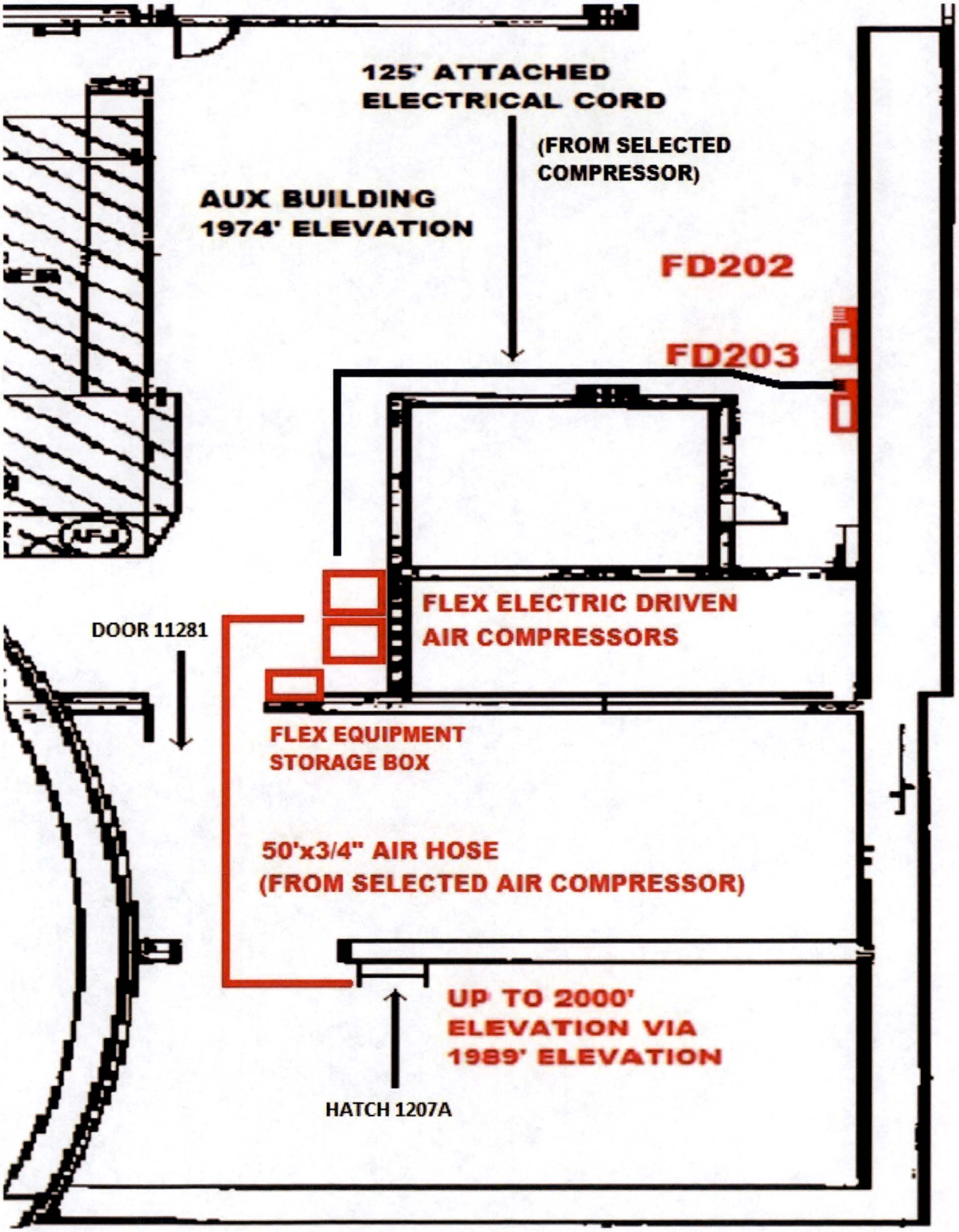

Figure 4a: Deployment of Electric Air Compressor 1974' El (from FSG-05 Figure 6)

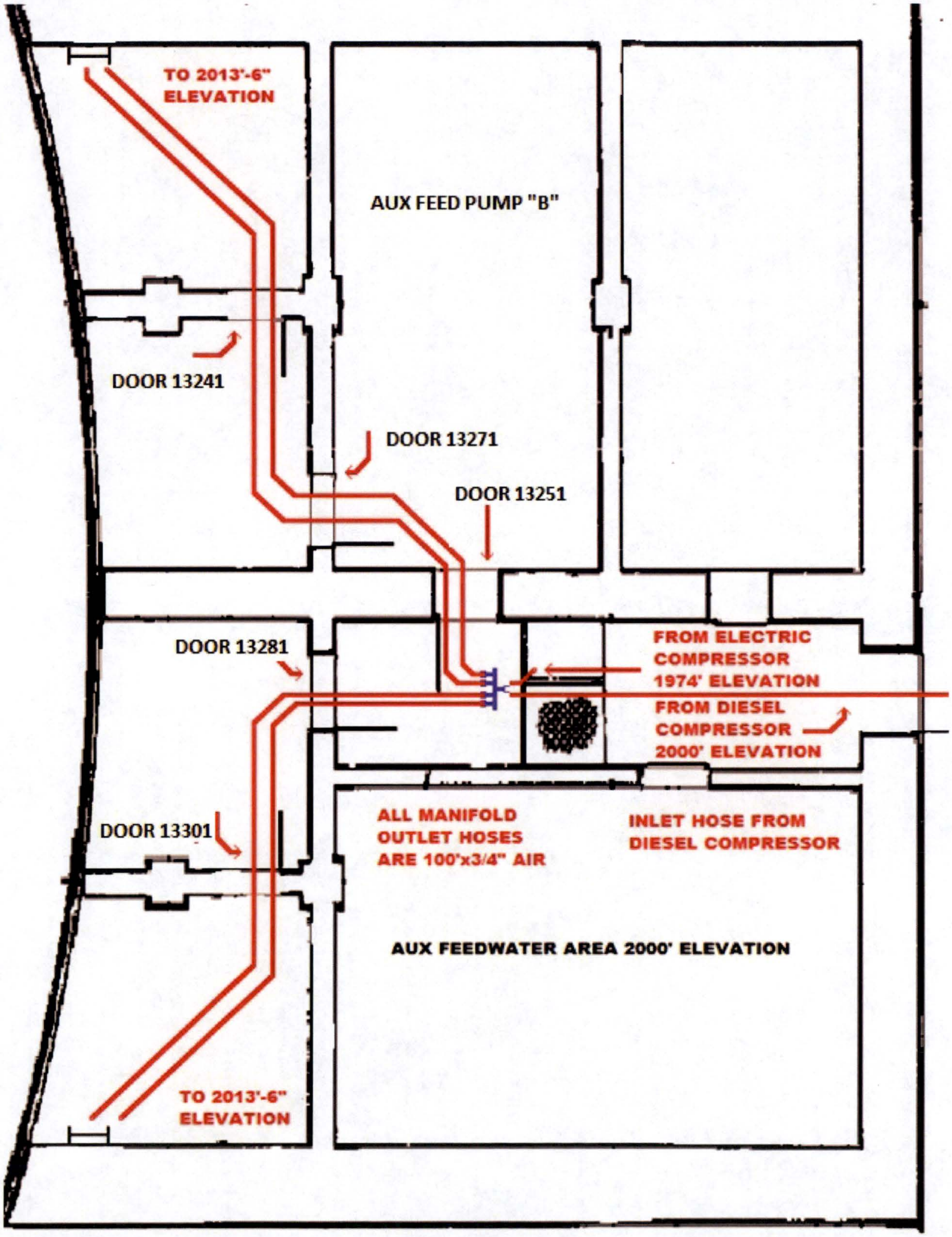

Figure 4b: Deployment of Air Hoses And Manifold 2000' El (from FSG-05 Figure 9)

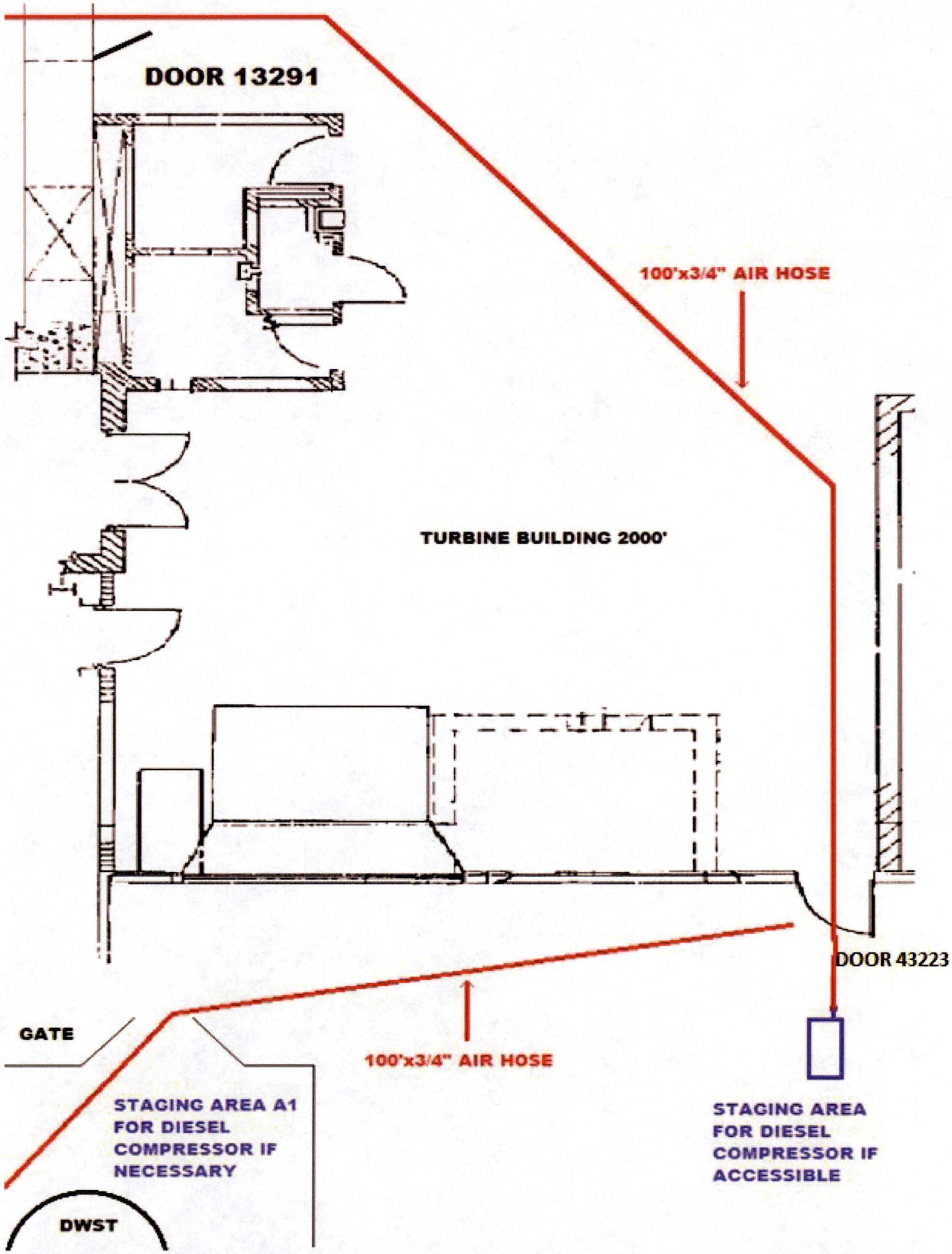

Figure 4c: Deployment of Diesel Air Compressor 2000' El (from FSG-05 Figure 8)

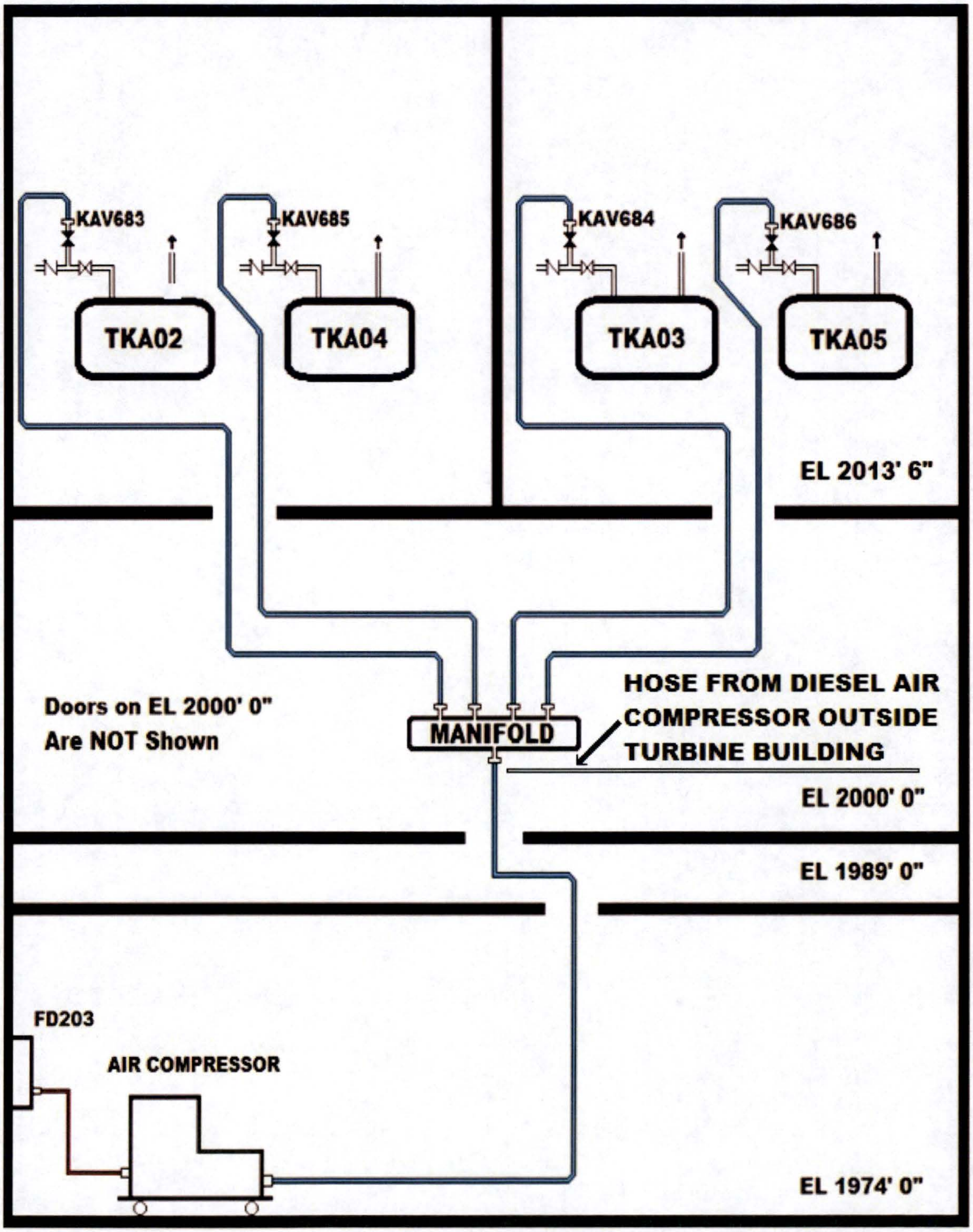

Figure 4d: FLEX Air Compressor Overview (from FSG-05 Figure 11)

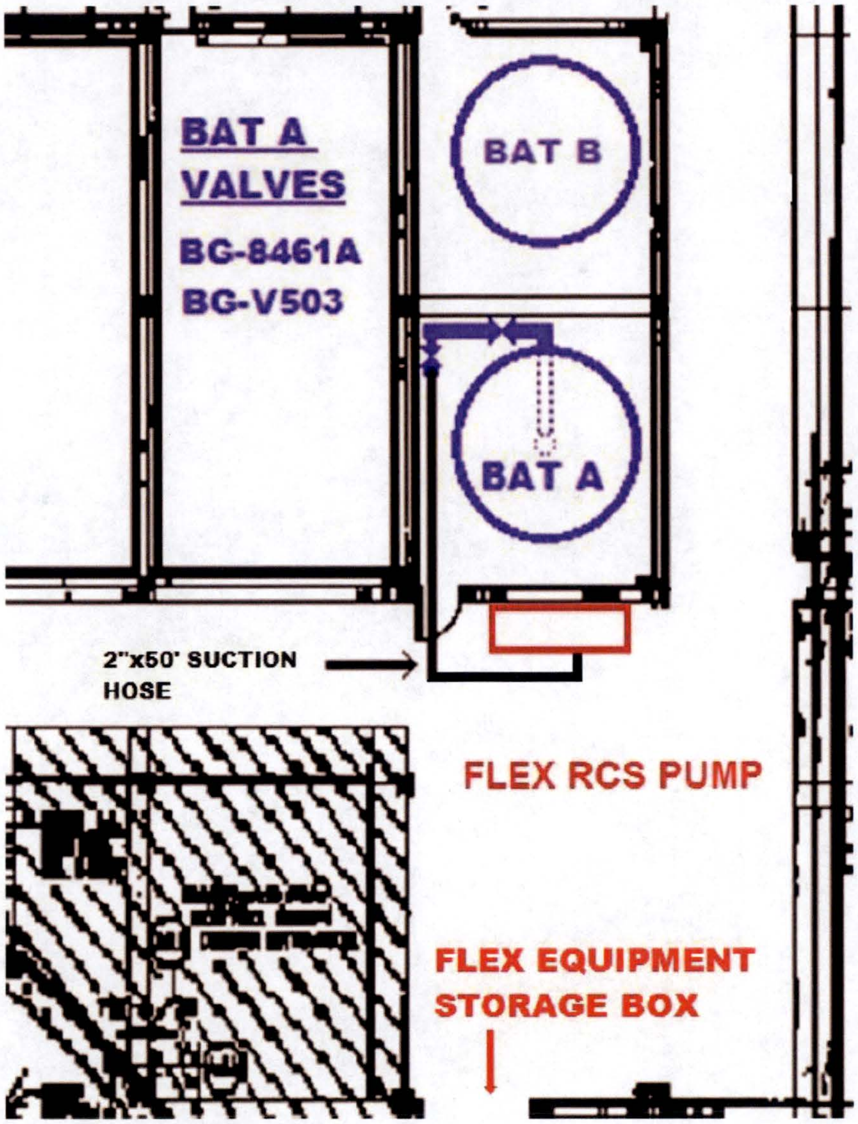

Figure 5a: BAT A Suction Alignment to 1974' FLEX RCS Pump (from FSG-01 Figure 2)

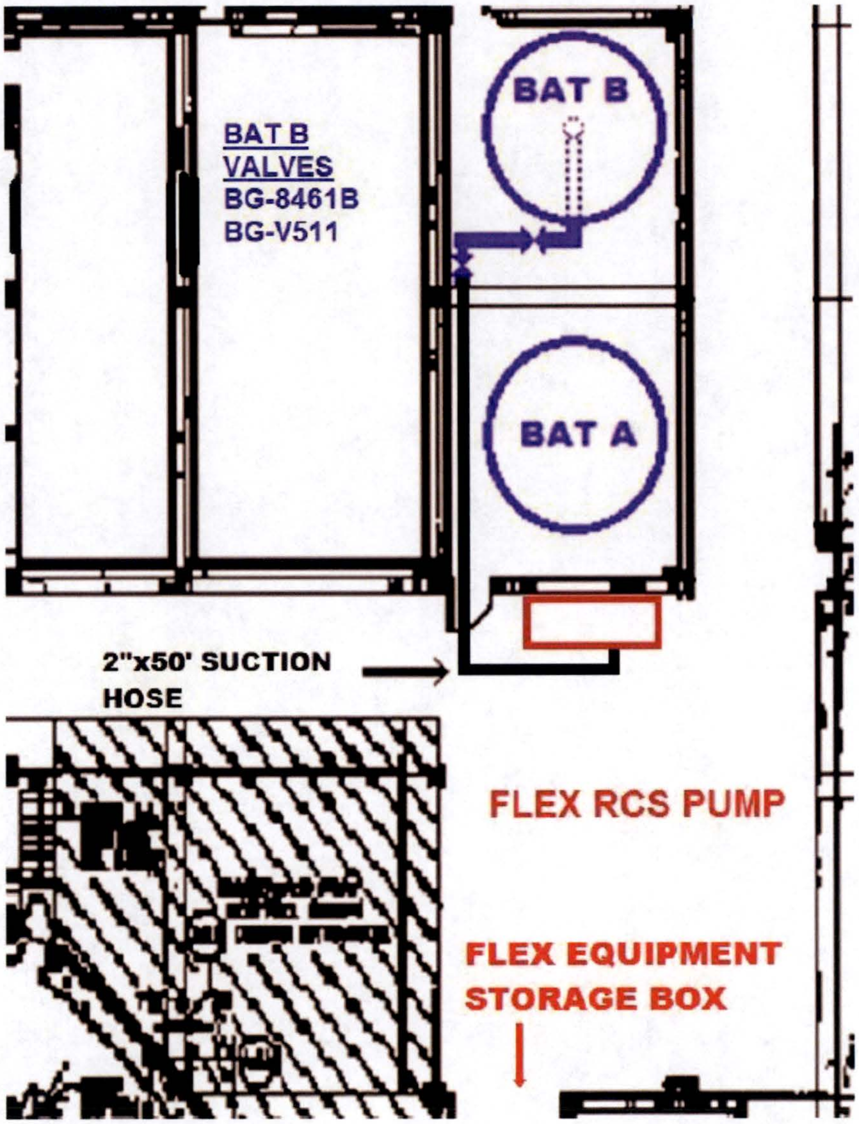

Figure 5b: BAT B Suction Alignment to 1974' FLEX RCS Pump (from FSG-01 Figure 3)

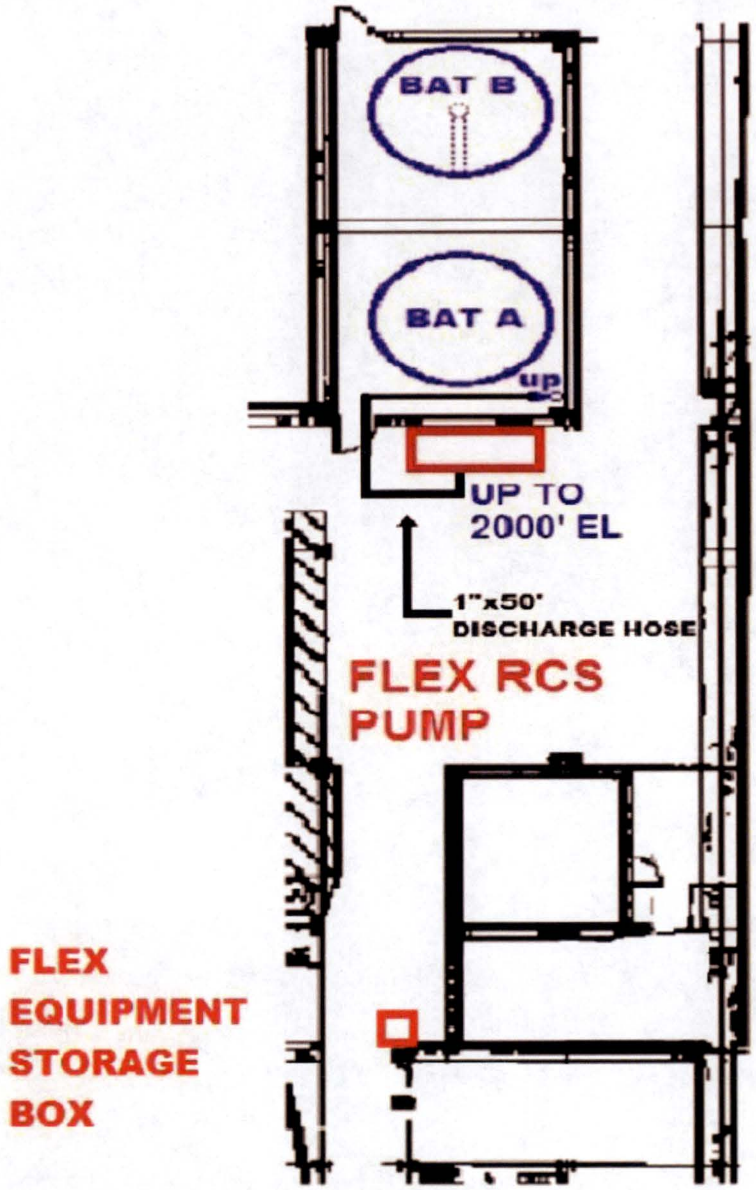

Figure 5c: Primary FLEX RCS Makeup Discharge Alignment at Elevation 1974' (from FSG-01-Figure 5)

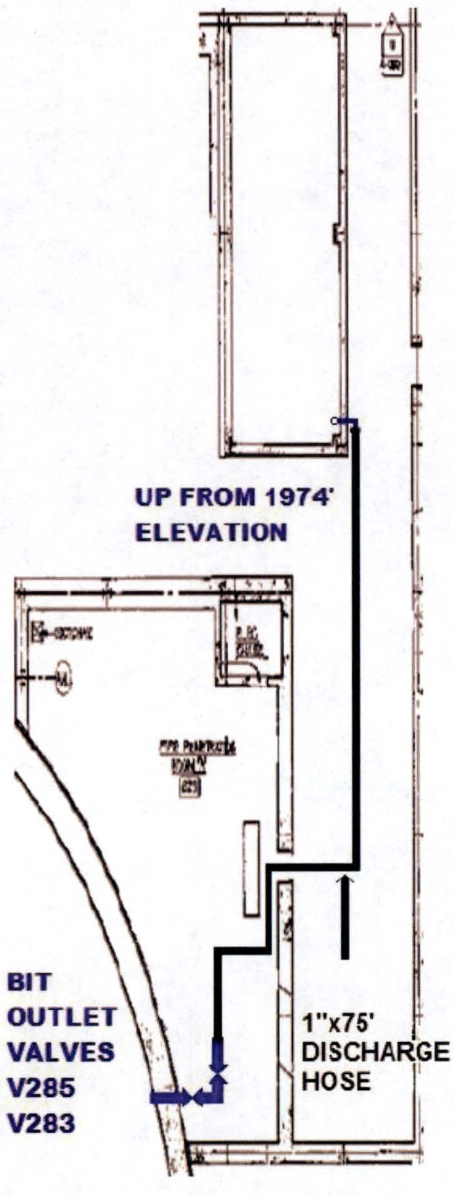

Figure 5d: Primary FLEX RCS Makeup Discharge Alignment at Elevation 2000' (from FSG-01 Figure 6)

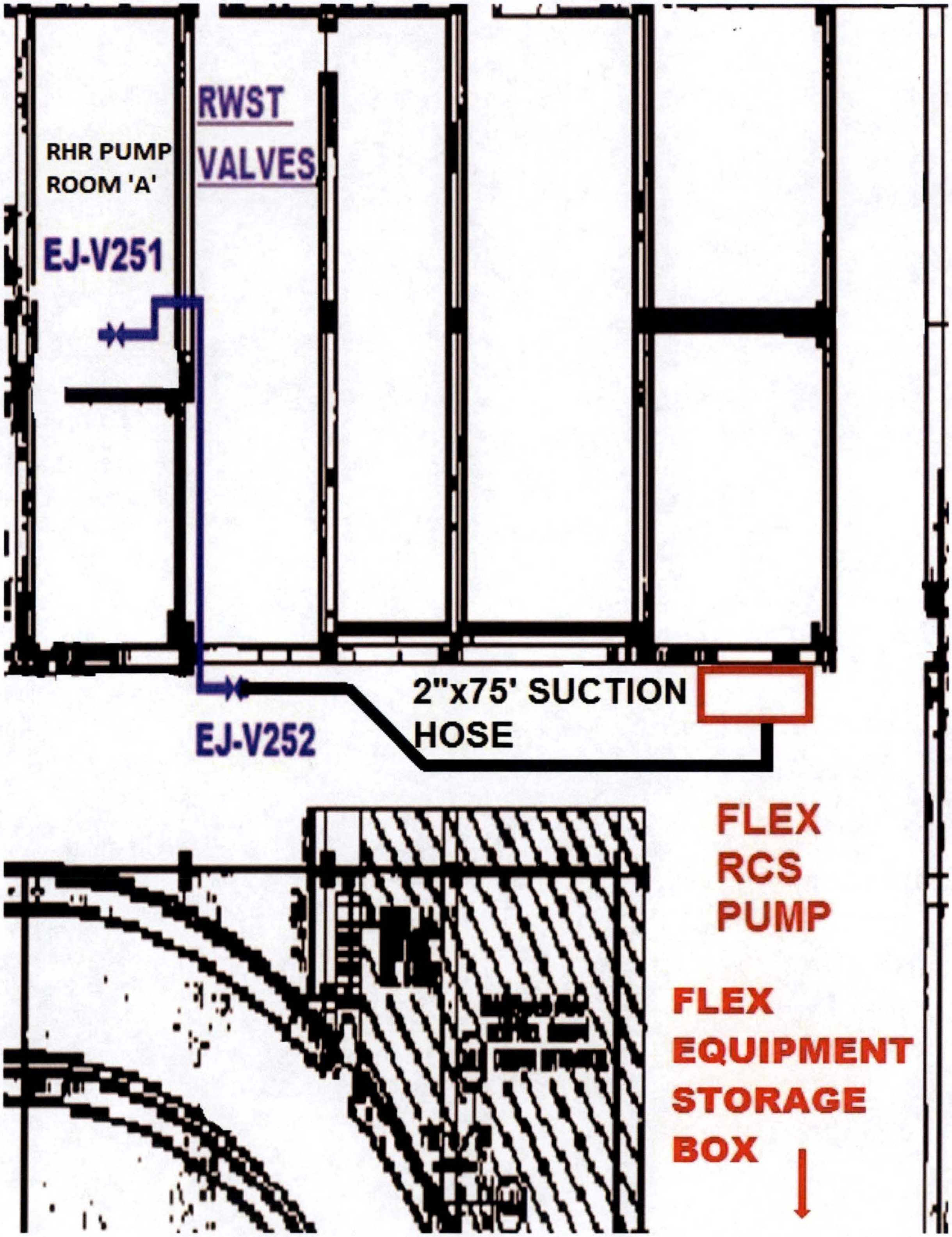

Figure 5e: RWST Suction Alignment to 1974' Flex RCS Pump (from FSG-01 Figure 4)

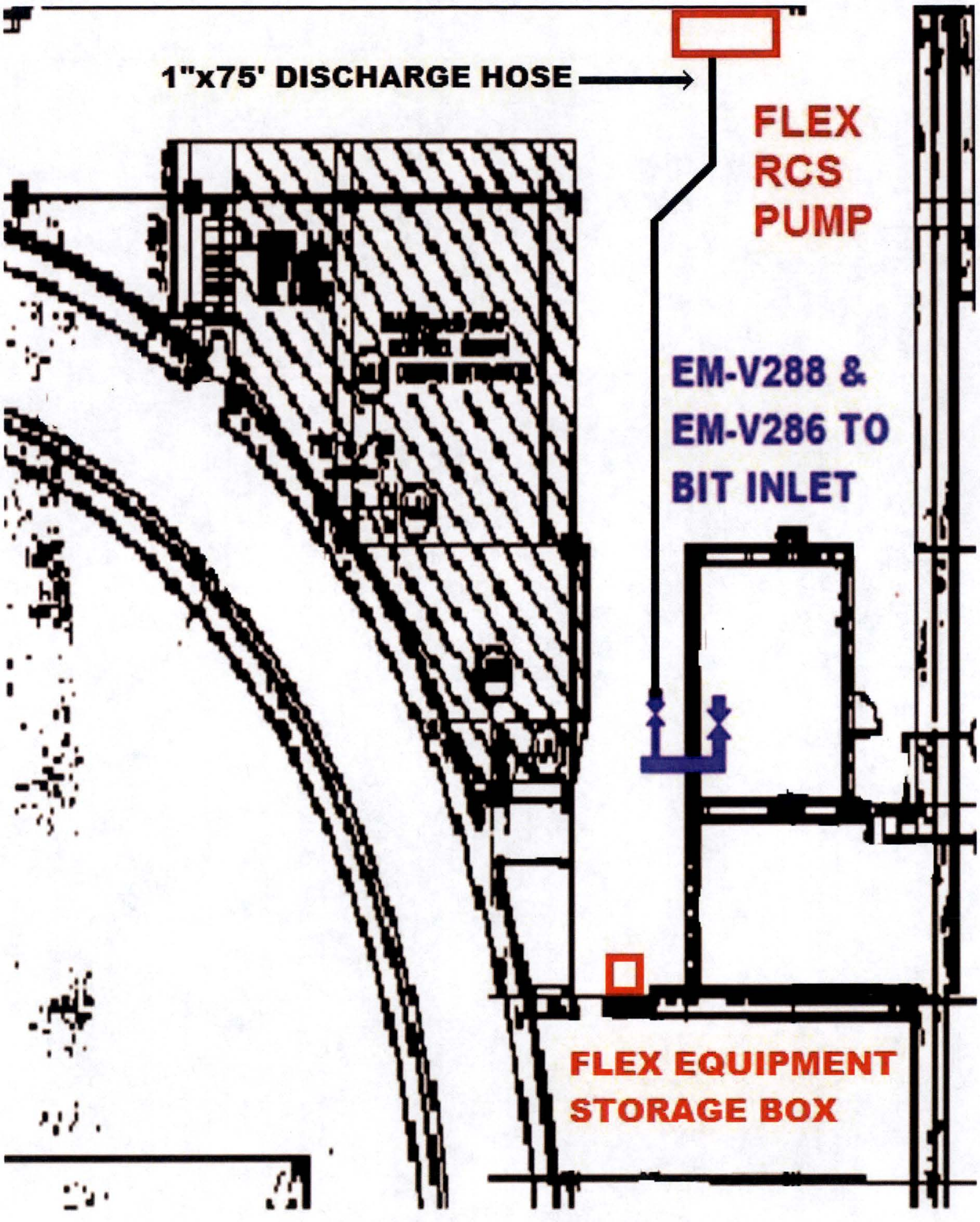

Figure 5f: Alternate Injection to BIT Inlet from 1974' Flex RCS Pump (from FSG-01 Figure 7)

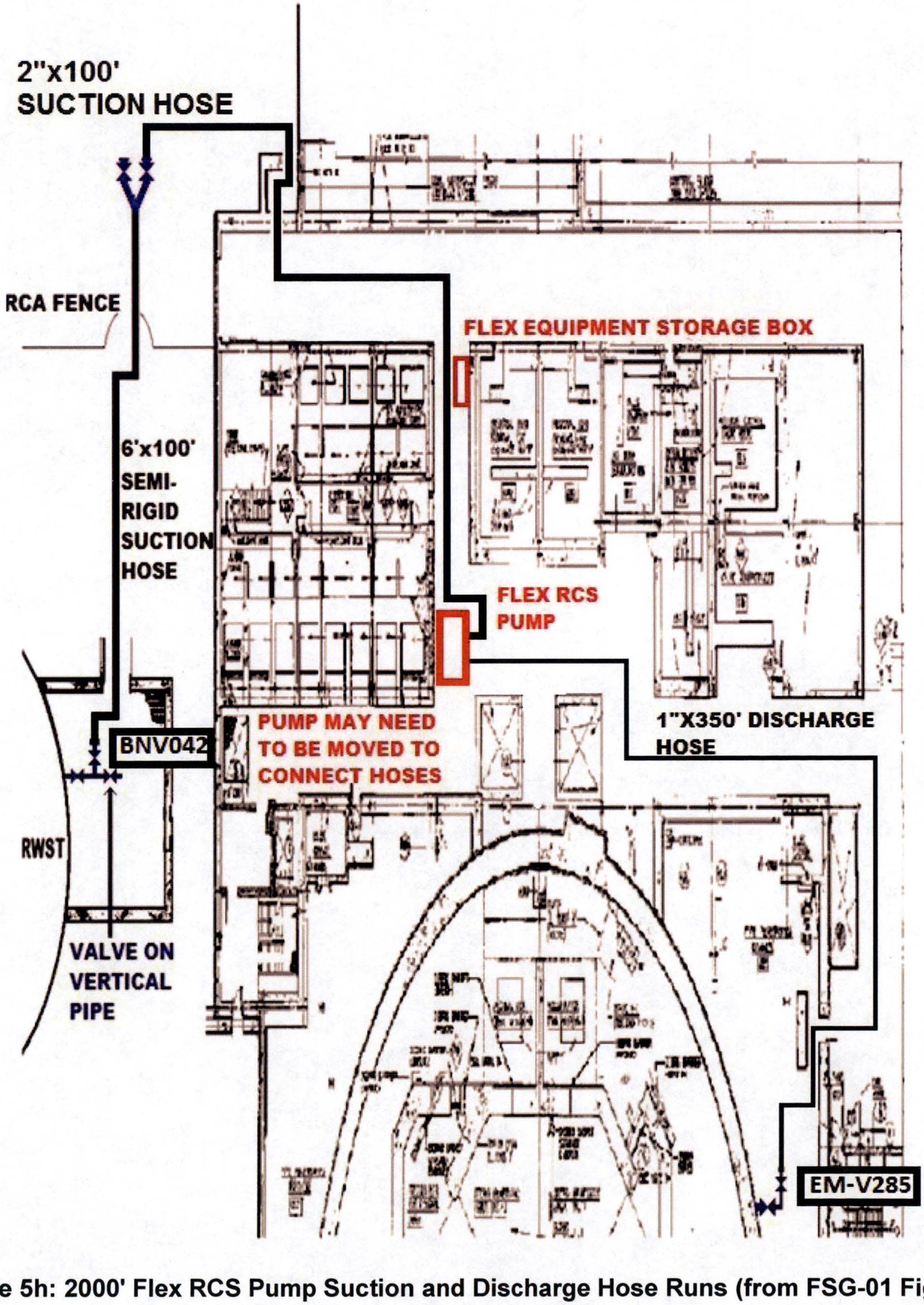

Figure 5h: 2000' Flex RCS Pump Suction and Discharge Hose Runs (from FSG-01 Figure 8)

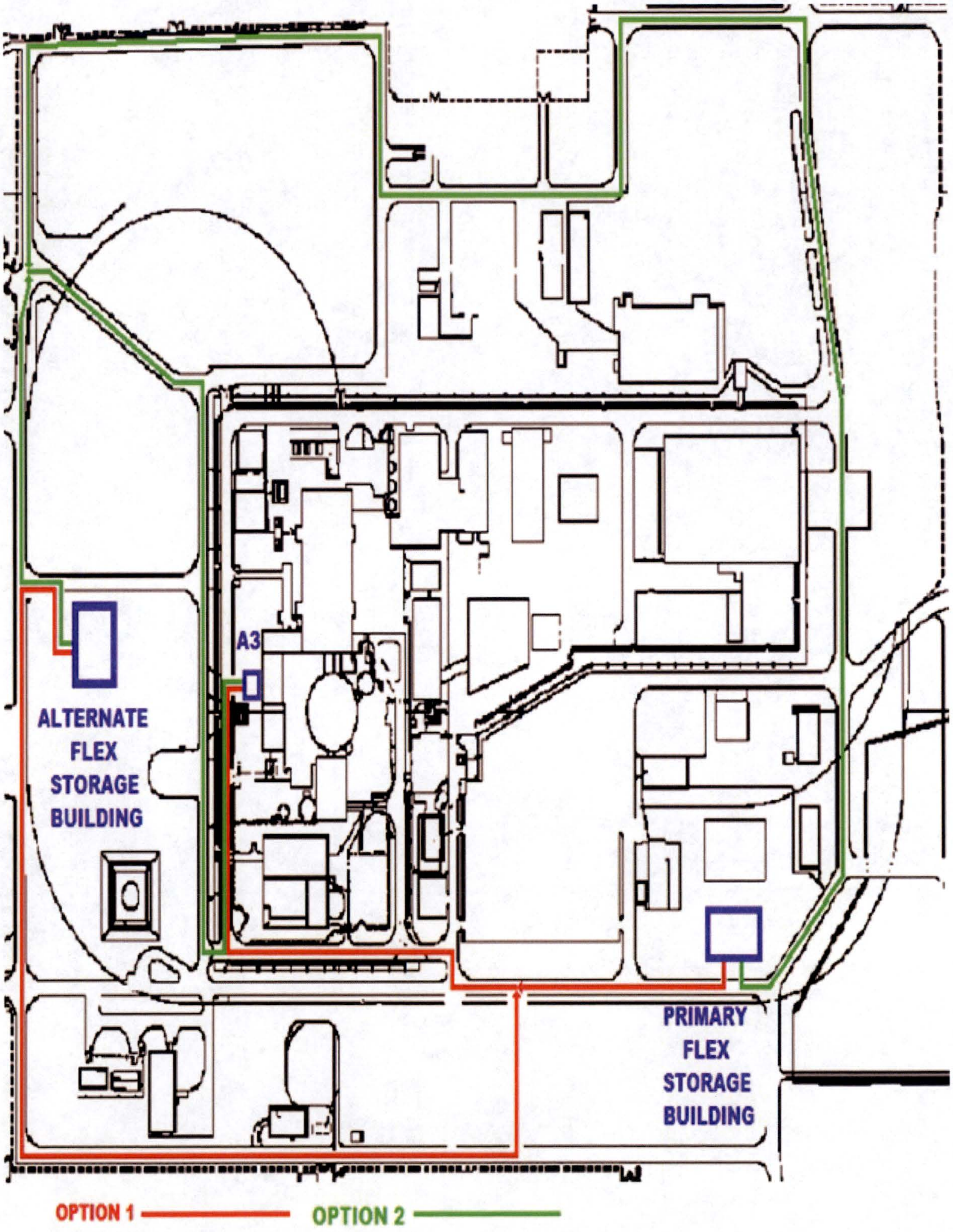

Figure 6a: Staging Flex Generator at Primary Location (A3) (from FSG-05 Figure 4)

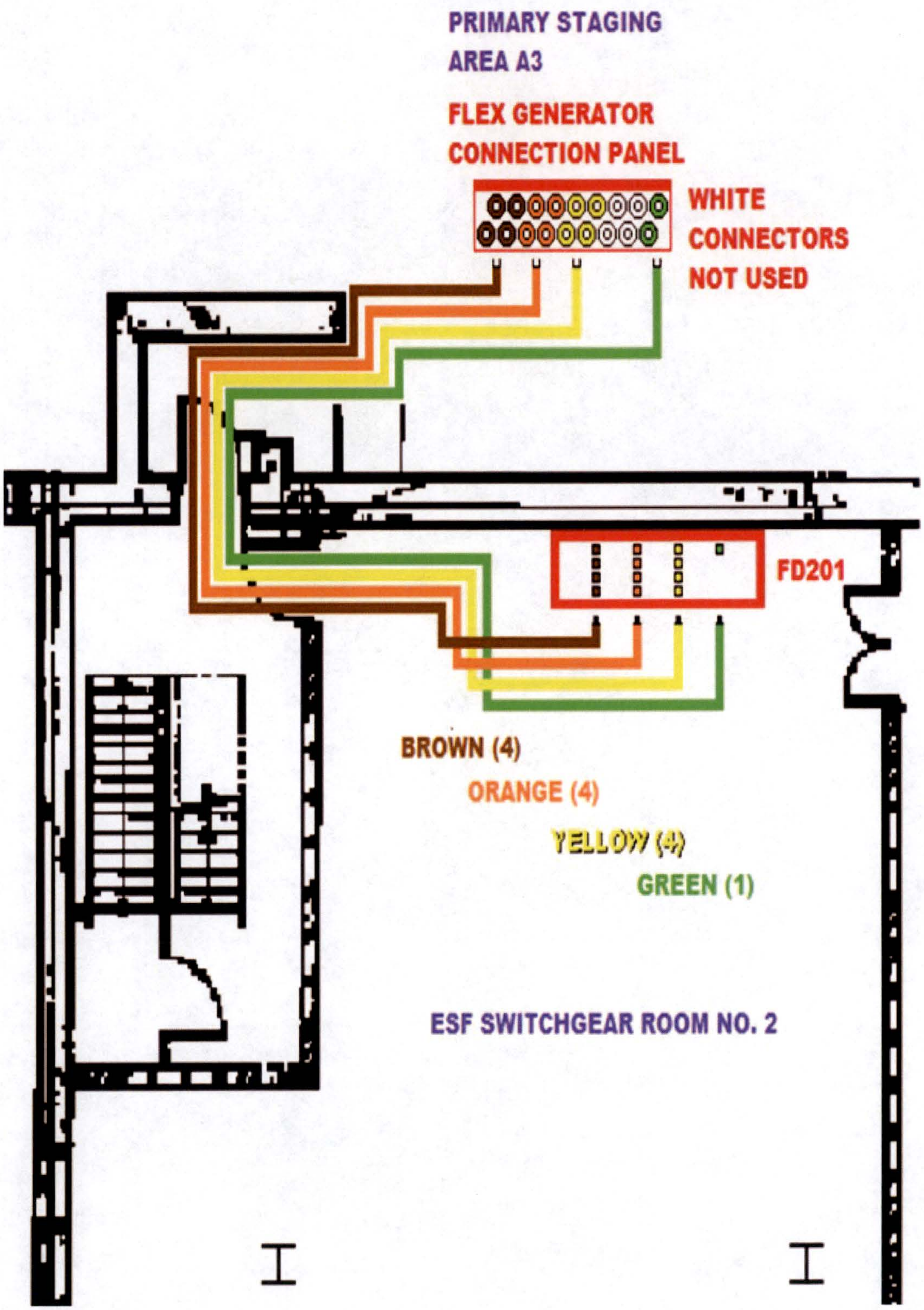

Figure 6b: Routing of FLEX Cables to Primary Connection at FD201 (from FSG-04 Figure 1)

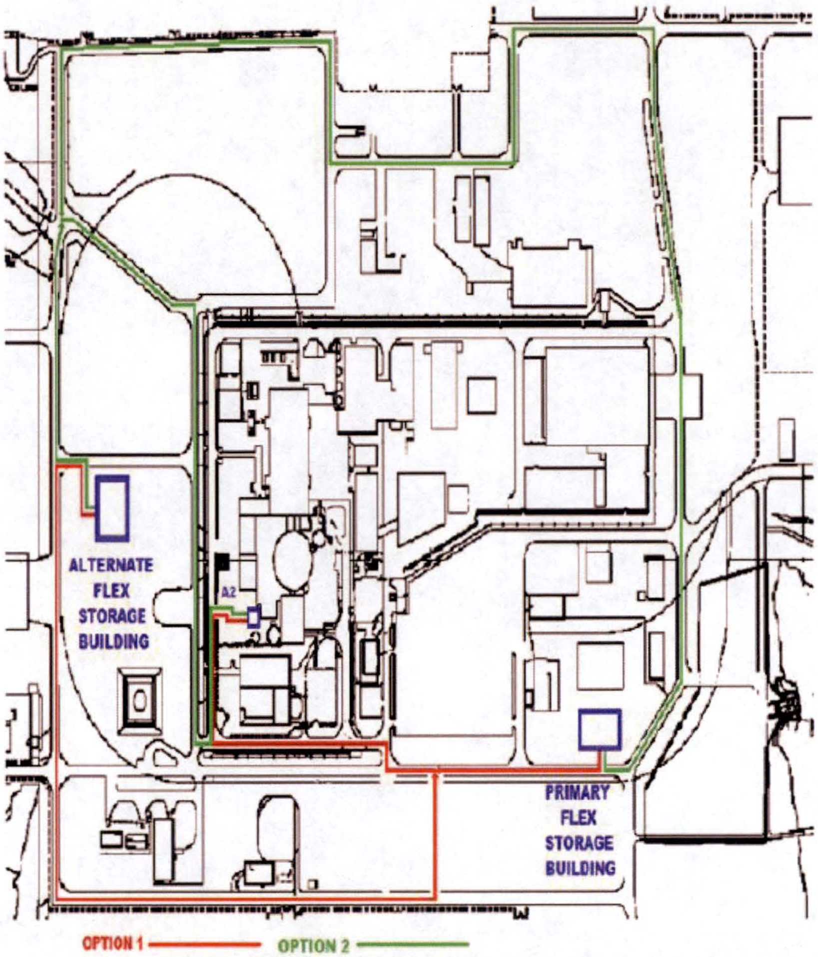

Figure 6c: Staging of the FLEX Generator to the Alternate Location (A2) (from FSG-05 Figure 5)

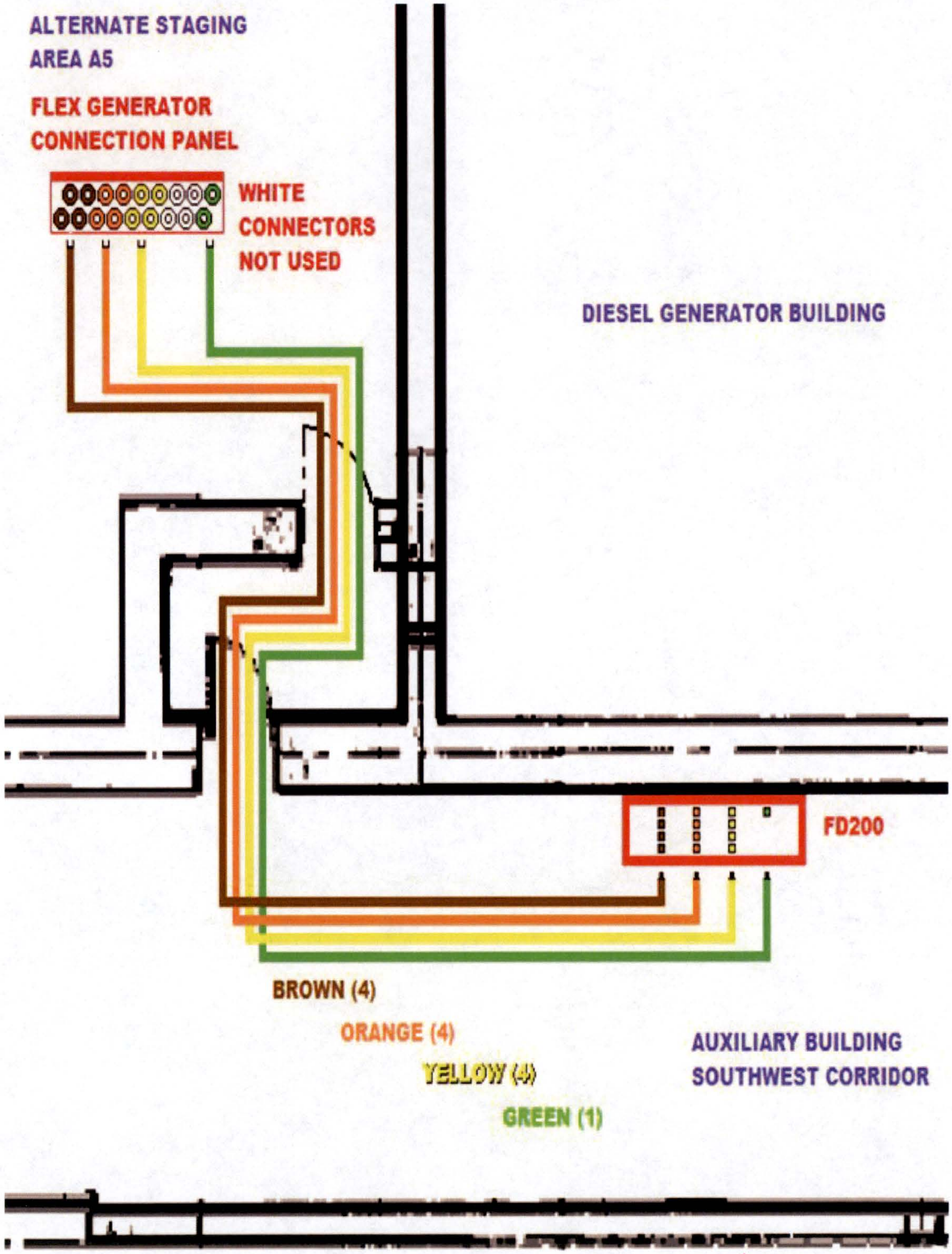

Figure 6d: Routing FLEX Cables to Alternate Connection at FD200 (from FSG-04 Figure 2)

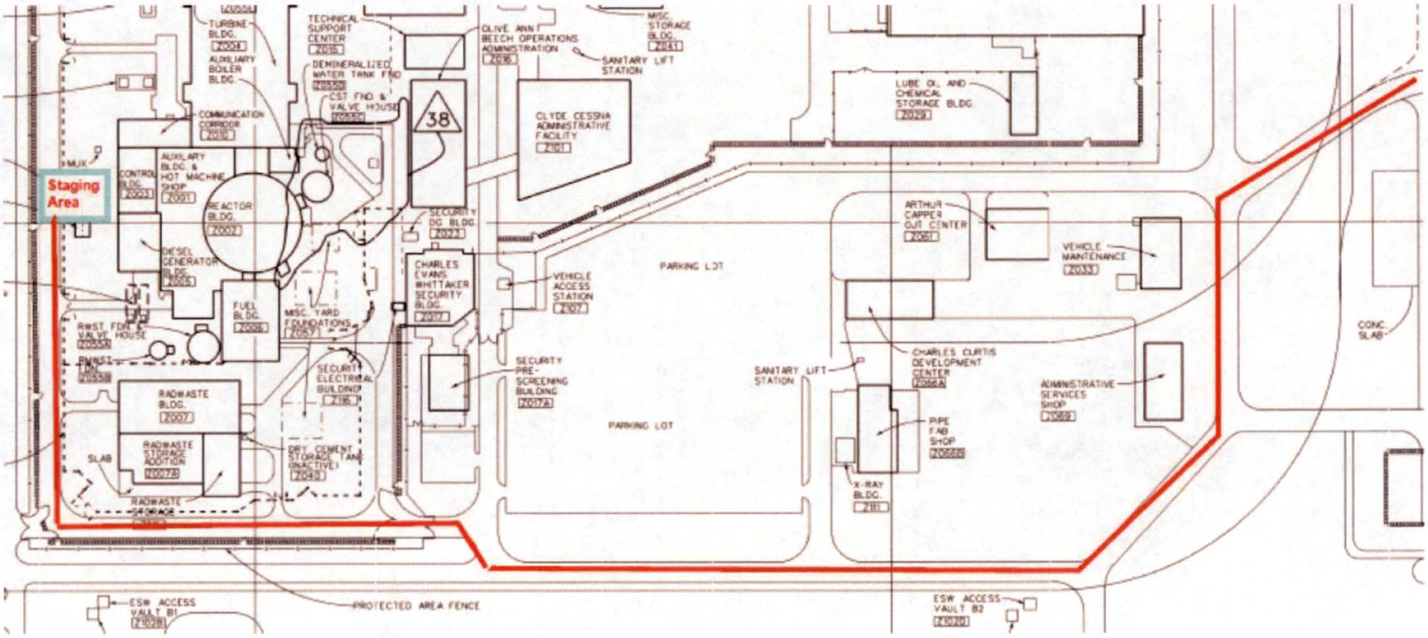

Figure 7: Deployment Path for 4160 VAC Generator from NSRC

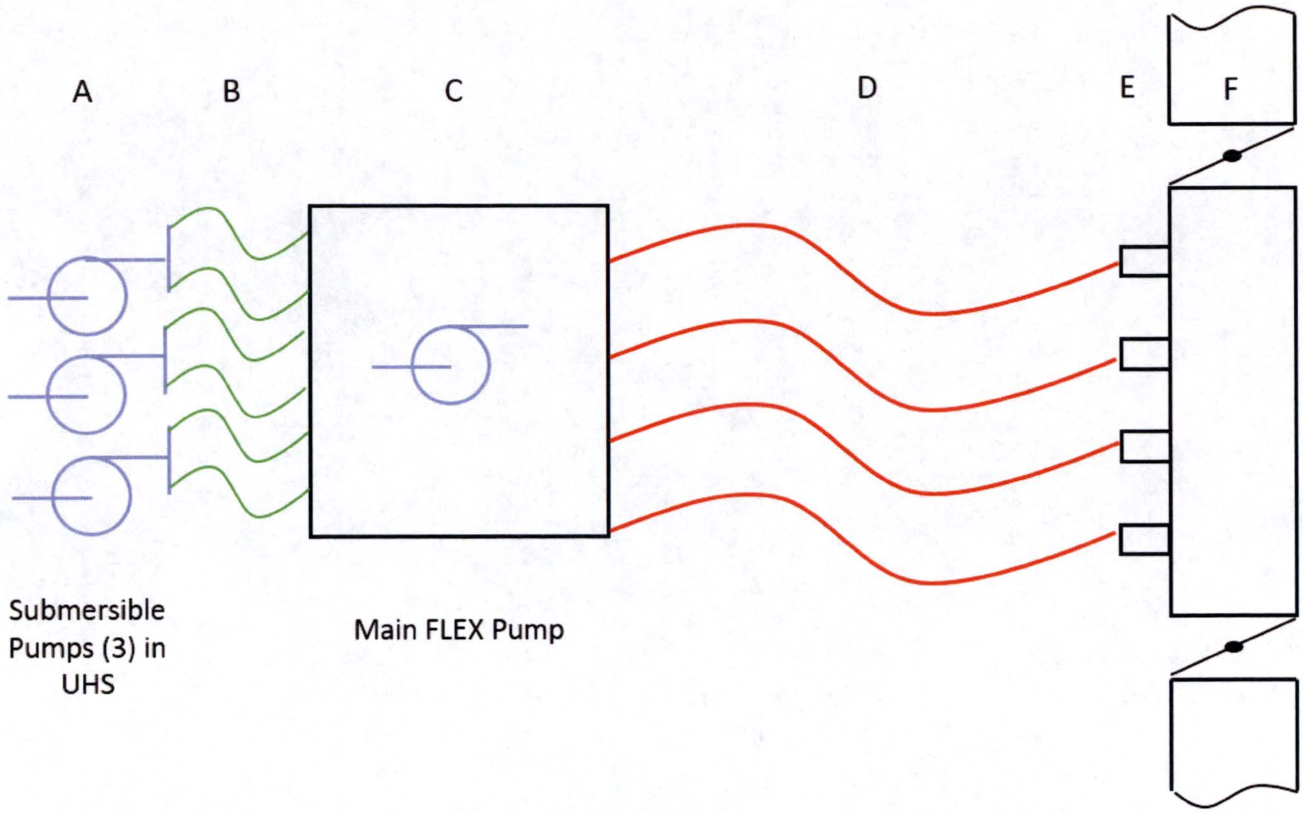

Figure 8: ESW Supply Configuration

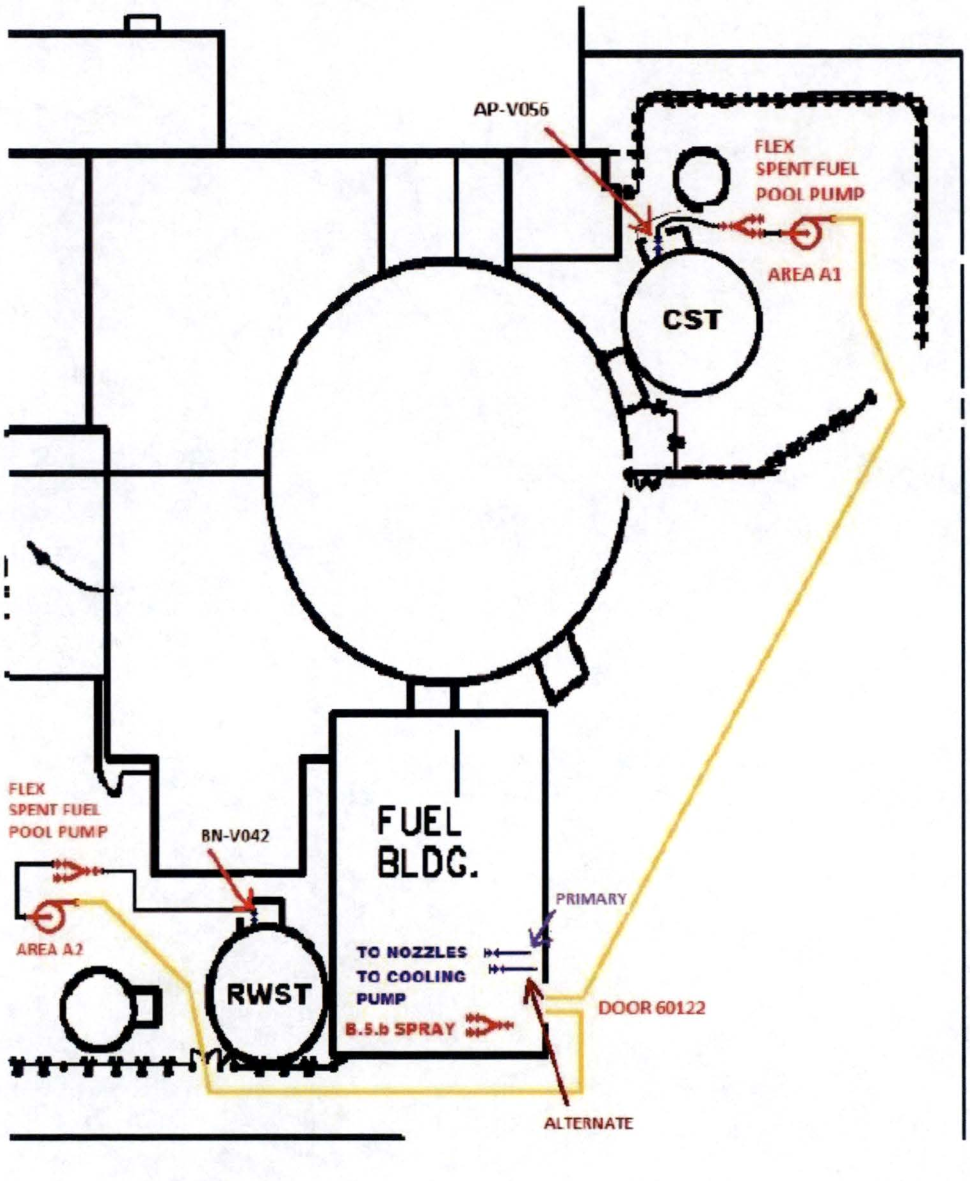

Figure 9a: RWST or CST Hose Routes to Fuel Building (from FSG-11 Figure 1)

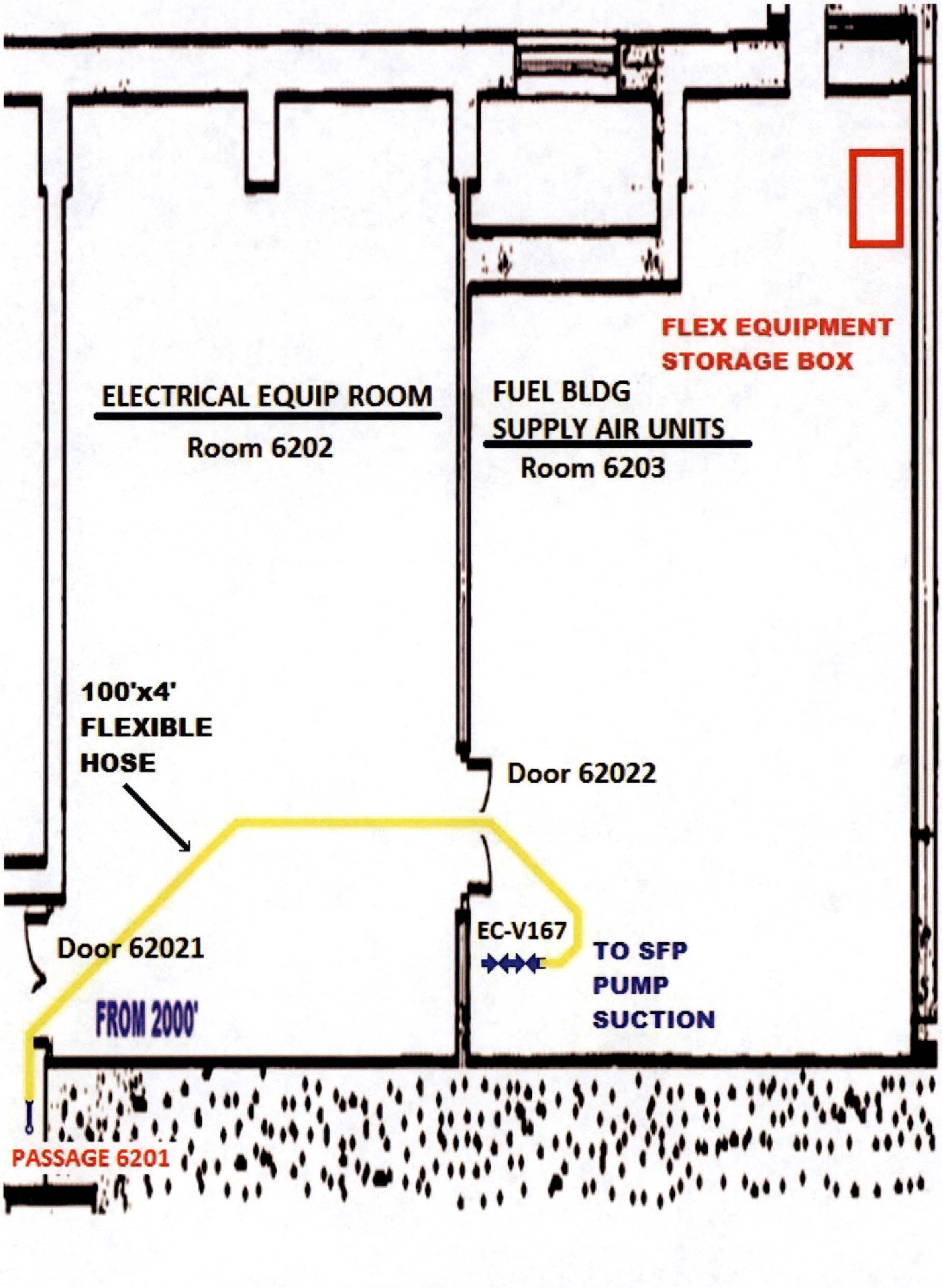

Figure 9b - Deployment of Flex Intermediate Hose (from FSG-05 Figure 1)

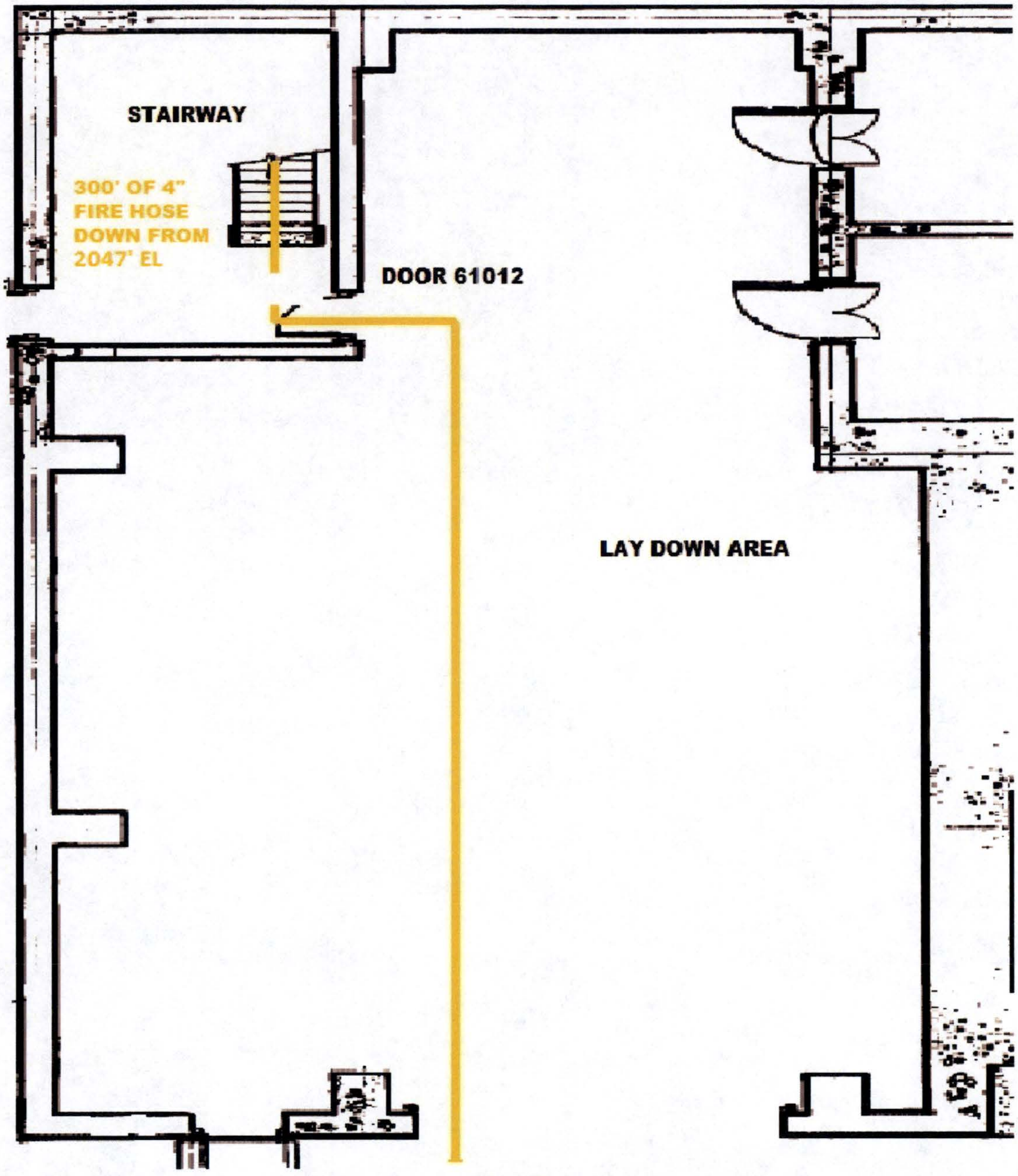

Figure 9c: Deployment of B.5.B Equipment for Fuel Pool Spray 2000' El (from FSG-05 Figure 2)