Department of Energy
Washington, DC 20585

QA: N/A
DOCKET NUMBER 63-001

August 13, 2009

ATTN: Document Control Desk
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YUCCA MOUNTAIN – REQUEST FOR ADDITIONAL INFORMATION – VOLUME 2, CHAPTER 2.1.1.2, SET 2 (DEPARTMENT OF ENERGY'S SAFETY ANALYSIS REPORT SECTIONS 1.2.2, 1.2.8, 1.3.3, 1.4.1, 1.4.2 and 1.4.3) – Description of Systems, Structures and Components

Reference: Ltr, Jacobs to Williams, dtd 07/20/09, "Yucca Mountain – Request For Additional Information – Volume 2, Chapter 2.1.1.2, Set 2 (Department Of Energy's Safety Analysis Report Sections 1.2.2, 1.2.8, 1.3.3, 1.4.1, 1.4.2 and 1.4.3)"

The purpose of this letter is to transmit the U.S. Department of Energy's (DOE) responses to twelve of the eighteen Requests for Additional Information (RAI) identified in the above-referenced letter. DOE expects to submit the remaining responses to the RAIs in Set 2 on or before October 28, 2009. Each RAI response is provided as a separate enclosure. References not previously submitted are enclosed. One of the references contains electronic attachments that contain complex data files that are not appropriate for electronic information exchange (EIE) transmittal, but are required by NRC in reviewing RAI responses. Additionally, drawings listed as attachments to RAI Number 16 are provided as separate enclosures. The references, electronic attachments, and drawings are provided on optical storage media and will be provided to the public upon request.

There is one commitment in the response to RAI Number 6. If you have any questions regarding this letter, please contact me at (202) 586-9620, or by email to jeff.williams@rw.doe.gov.

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Office of Technical Management

OTM: SAB-0976

NMSS25

Enclosures (13)

1 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 5
2 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 6
3 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 8
4 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 9
5 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 10
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8 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 13
9 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 14
10 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 15
11 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 16
12 Response to RAI Volume 2, Chapter 2.1.1.2, Set 2, Number 17
13 Optical Storage Media disk titled, "RAI – Volume 2, Chapter 2.1.1.2, Set 2-Description of Systems, Structures and Components, August 13, 2009, Disk 1 of 1

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EIE Document Components:

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[183723]_860-E10-EEN0-00103-000-00A.pdf	871
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51A-DB0-IH00-00105-000-00A.pdf	1,043
51A-DB0-IH00-00106-000-00A.pdf	1,065
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51A-SS0-IH00-00111-000-00B.pdf	1,357
51A-SS0-IH00-00112-000-00B.pdf	1,391

Note: These PDF files for supporting responding to Yucca Mountain Repository License Application RAIs were prepared with Adobe Acrobat Version 8 using the current job options file provided by the NRC on its website. Some files included in this submittal may have been initially prepared with another version of Acrobat and another job options file. All files were reviewed using the NRC preflight profile provided on its website and have been determined to meet NRC specifications in the June 2009 revision of Guidance for Electronic Submissions to the NRC. As discussed with NRC staff, the addition of accessibility tagging for compliance with Section 508 of the Rehabilitation Act frequently causes the preflight to return "fonts not embedded" error messages. Specifically, the content is usually flagged as unembedded Times-Roman font. The Adobe preflight errors for unembedded fonts have been reviewed and represent nonprinting and nondisplaying Section 508 tagging information.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 5:

Explain the procedure to prevent an overflow of potentially contaminated water during a fire event and subsequent fire suppression efforts at each of the surface facilities.

In accordance with NFPA 801 (NFPA 2008), a specific capacity of effluent containment must be provided to each building. This volume is roughly 16,500 gal, assuming the sprinkler and manual hose station water flows as described in NFPA 801 and the SAR. In the DOE design, it appears that either a 200 gal or a 14,320-gal tank is provided beneath several facilities (e.g., Section 6.1.2.6 of BSC 2007, 060-M0A-FP00-00100-000-00B describes a 200 gal and a 14,320-gal tank), with added containment capacity provided in remote tanks. The facility description includes a brief discussion of the transfer pumps used to move effluent water from the primary tank (local to the building) to the secondary tank (remotely located) but does not clearly describe the procedure and the automatic or manual nature of the fluid transfer to prevent overflow of the primary sump tanks.

1. RESPONSE

The credible volume of fire suppression water discharged during a 30 minute fire event in the surface facilities is 9,900 gal, using the criteria in Section 5.10.2(2) of NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*. To size the liquid low-level waste (LLW) collection sumps and tanks, the estimated weekly volume of liquid LLW from other sources (a maximum of 200 gal for the Initial Handling Facility (IHF), Canister Receipt and Closure Facility (CRCF) and Receipt Facility (RF), and 1000 gal for the Wet Handling Facility (WHF)) is added to the volume of fire suppression water, as well as the volume of the largest single container of flammable or combustible material used or stored in a potentially contaminated area (500 gal). This gives a cumulative volume of 10,600 gal for the IHF, CRCF, and RF, and 11,400 gal for the WHF. The attached Table 1 provides a summary of the liquid LLW sump and tank volumes. These volumes also include design margin (20%), freeboard capacity (10%), and a sampling tank volume of 320 gal for the IHF, CRCF, and RF to determine the required working capacity for each sump or tank. As automatic fire suppression is provided throughout the surface facilities, Section 5.10.2(3) of NFPA 801 is not applicable to the design of the liquid LLW collections systems, therefore manual hose station water flows that would result in increased fire suppression water discharge are not required in the sizing calculations. Further details of the calculated volume of fire suppression water, and the volume of the sumps and tanks within the drainage and collection systems, are provided in the response to RAI 2.2.1.1.6-001. As discussed in the response to RAI 2.2.1.1.6-001, the capacity of the sumps and tanks local to each facility is sufficient to receive the volume of water generated during a fire event and subsequent fire suppression efforts. Transfer of fire suppression water from the local sumps and tanks to the remote tanks is not expected to be necessary during or after the fire event in order to prevent overflow of the primary sump tanks.

The liquid LLW collection systems for collecting potentially contaminated wastewater during fire suppression in the surface nuclear facilities are designed in accordance with guidance provided in Regulatory Guide 1.189, *Fire Protection for Operating Nuclear Power Plants*, Section C.4.1.5, and NFPA 801, Section 5.10.

Procedures for operating, inspecting, and maintaining liquid LLW collection systems will be developed prior to receipt of waste. Procedure development is addressed in SAR Section 5.6.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

NFPA 801. 2003. *Standard for Fire Protection for Facilities Handling Radioactive Materials.* 2003 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 254811.

Regulatory Guide 1.189. 2001. *Fire Protection for Operating Nuclear Power Plants.* Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20060105.0191.

Table 1. Surface Facilities Liquid LLW Tank Volumes

Facility	Waste Sampling Tank		Waste Sump		Collection Tank	
	Maximum Volume	Working Capacity	Maximum Volume	Working Capacity	Maximum Volume	Working Capacity
IHF, RF & CRCF	320	200	15,150	14,320	15,650	15,150
WHF–C2 Areas	NA	NA	NA	NA	15,300	15,100
WHF–C3 Areas	NA	NA	NA	NA	15,300	15,100

NOTE: All tank volumes and capacities are provided in gallons. Working capacity is denoted as the minimum required capacity. Maximum volume accounts for rounding up of the sump or tank dimensions.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 6:

> Provide information on fire alarm functions that are necessary to ensure reliability of SSCs ITS (e.g., air handler shutdown and fire/smoke damper control in ITS HVAC systems), and the technical basis for classification of the fire-alarm system as non-ITS. (SAR Section 1.4.3.2.1.3).

1. RESPONSE

The fire alarm system monitors signals from fire protection equipment in specific facilities and provides alarms to notify building occupants of fire conditions. In the surface facilities, fire protection signals report to a facility fire alarm panel in each facility, which in turn transmits the signals to the Fire, Rescue, and Medical Facility and initiates horns and strobes in the facility to alert occupants of fire conditions. The facility fire alarm panel in each facility also provides signals to fire and smoke dampers mounted in heating, ventilation, and air-conditioning (HVAC) system ductwork and fire door closure interlocks within that facility. Although the fire alarm system interfaces with other systems to receive or provide signals, the fire alarm system does not provide any function that is necessary to ensure reliability of important to safety (ITS) systems.

1.1 EXPLANATION OF THE TECHNICAL BASIS FOR CLASSIFYING THE FIRE ALARM SYSTEM AS NON-ITS

The fire alarm system is not relied upon in the preclosure safety analysis to reduce the frequency or mitigate the consequences of any Category 1 or Category 2 event sequence and, therefore, has been classified as non-ITS.

1.2 EXPLANATION OF USAGE OF FIRE AND SMOKE DAMPERS IN ITS HVAC SYSTEMS

The Canister Receipt and Closure Facility (CRCF), the Wet Handling Facility (WHF) and the Emergency Diesel Generator Facility (EDGF) are the only facilities that have ITS HVAC systems. The CRCF and WHF have ITS HVAC exhaust systems serving ITS confinement areas and ITS HVAC supply and exhaust systems serving the ITS electrical equipment and battery rooms. The EDGF has ITS HVAC supply and exhaust systems serving the ITS generator rooms and ITS switchgear and battery rooms. These systems do not have fire and smoke dampers installed in the ITS HVAC ductwork for two reasons.

First, as stated in SAR Section 1.4.3.2.1.4, fire and smoke dampers are not installed within the exhaust flow paths of ventilation systems within confinement areas. This is in accordance with Section 14.4.2 of DOE-STD-1066-99, *Fire Protection Design Criteria*, and applies to both non-ITS confinement areas and ITS confinement areas. During a fire, the ITS exhaust fans in the CRCF and WHF will continue to operate and maintain negative pressure in the ITS confinement areas.

Second, fire and smoke dampers are normally installed in HVAC ducting where the ducting penetrates the fire barrier between adjacent fire areas. The equipment and ducting associated

with the ITS HVAC supply systems serving the ITS electrical equipment and battery rooms in the CRCF and WHF are all within the respective fire area for each train. Similarly, the ITS HVAC supply and exhaust systems serving the ITS generator rooms and the ITS switchgear and battery rooms in the EDGF are also within the respective fire area for each train. Therefore, fire and smoke dampers are not required to be installed.

1.3 EXPLANATION OF FIRE ALARM SYSTEM INTERACTIONS WITH AIR HANDLING UNITS AND FAN COIL UNITS

The air handling units that supply air to the ITS confinement areas in the CRCF and WHF facilities are non-ITS units. A non-ITS smoke detector, integral to the fire detection system, is provided at the discharge duct of each air handling unit to shut down the unit in the event that smoke is detected. The smoke detectors will also transmit a smoke alarm signal to the facility fire alarm panel, the only interaction between the smoke detectors and the fire alarm system. In the event that an air handling unit shuts down, the standby air handling unit will automatically start up. If the standby air handling unit smoke detector detects smoke, that unit will also shut down. The exhaust system will continue to operate and maintain negative pressure in the confinement areas even if the supply system is not operational.

The ITS electrical equipment and battery rooms in the CRCF and WHF are cooled by ITS fan coil units. Non-ITS smoke detectors, integral to the fire detection system, are provided at the discharge duct of each fan coil unit to detect smoke and transmit a smoke alarm signal to the facility fire alarm panel. In accordance with NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, each smoke detector is interlocked with its respective fan coil unit to shut down the unit in the event that smoke is detected, as shown in SAR Figures 1.2.4-105, 1.2.4-106, 1.2.4-109, 1.2.4-110, 1.2.5-88, and 1.2.5-90. The Preclosure Nuclear Safety Design Bases in SAR Tables 1.9-3 and 1.9-4 identify that the fan coil units in the CRCF and WHF support the ITS electrical function by cooling the ITS electrical equipment and battery rooms. The fan coil units are relied upon to provide this function, even in the event of a fire. The preclosure safety analysis has identified that the interlock between the smoke detectors and the fan coil units results in an unacceptable reduction in the reliability of the ITS cooling function. Consequently, the interlock between the smoke detectors and the fan coil units will be removed, although the other alarm and notification functions will remain.

The ITS switchgear and battery rooms in the EDGF are cooled by ITS air handling units. ITS smoke detectors, integral to the fire detection system, are provided at the discharge duct of each air handling unit to detect smoke and transmit a smoke alarm signal to the facility fire alarm panel. In accordance with NFPA 90A, each smoke detector is interlocked with its respective air handling unit to shut down the unit in the event that smoke is detected, as shown in SAR Figures 1.2.8-28 and 1.2.8-33. The Preclosure Nuclear Safety Design Bases in SAR Tables 1.9-3 and 1.9-4 identify that the air handling units in the EDGF support the ITS electrical function by cooling the ITS switchgear equipment and battery rooms. The air handling units are relied upon to provide this function, even in the event of a fire. The preclosure safety analysis has identified that the interlock between the smoke detectors and the air handling units results in an unacceptable reduction in the reliability of the ITS cooling function. Although the smoke detectors are classified as ITS, industry data show that smoke detectors do not have sufficient

reliability to preclude spurious shutdown of the air handling units. Consequently, the interlock between the smoke detectors and the air handling units will be removed, although the other alarm and notification functions will remain.

2. COMMITMENTS TO NRC

The DOE commits to update the license application in a future update to reflect that the smoke detectors in the ductwork for the ITS cooling function are not interlocked with the corresponding air handling units or fan coil units and to change the safety classification of the smoke detectors in the EDGF to non-ITS. The proposed license application changes are described in Section 3.

3. DESCRIPTION OF PROPOSED LA CHANGE

The SAR will be updated by revising SAR Figures 1.2.4-105, 1.2.4-106, 1.2.4-109, 1.2.4-110, 1.2.5-88, 1.2.5-90, 1.2.8-28, and 1.2.8-33 to delete the interlock between the smoke detectors and the corresponding air handling unit or fan coil unit and to change the safety classification of the smoke detectors in the EDGF to non-ITS. The text in SAR Sections 1.2.4.4.2 and 1.2.8.3.1.2 will be updated to clarify that the smoke detectors are not interlocked with the air handling units or fan coil units, as applicable.

4. REFERENCES

DOE-STD-1066-99. 1999. *Fire Protection Design Criteria.* Washington, D.C.: U.S. Department of Energy. TIC: 249984.

NFPA 90A. 2005. *Standard for the Installation of Air-Conditioning and Ventilating Systems.* 2002 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 258045.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 8:

Describe the design features of the ITS Diesel Generator Lubricating Oil System that can detect and control system leakage and its consequences. In addition, describe the features that allow the system to be isolated from other portions of the system in the event of excessive leakage.

SAR section 1.2.8.2.4.2 describes the operational process as "... operating, circulation is accomplished by an engine-driven gear pump that draws oil from the sump and passes it through a lube oil cooler, filter, and strainer before distributing to the bearings. Oil returns to the sump by gravity drain." In the SAR section 1.2.8.2.4.8, DOE states that the lubricating oil system is to be designed in compliance with ANSI/ANS-59.52-1998, which states, ".... a gravity drain is an acceptable alternative; however, if the latter is used, consideration shall be given to potential system leakage and its consequences". It is not clear whether or not DOE has considered this guidance in the design of the lubricating oil system.

1. RESPONSE

During detailed design of the diesel generators, potential system leakage will be considered when assessing and implementing design features that provide leak prevention, detection, containment, and isolation of the lubricating oil system. Potential design features to be assessed include double-lined sumps, appropriately sized catch basins to collect lubricating oil leaks, catch basins with oil detection capabilities, automatic oil level regulation (make-up) systems, and remote lubricating oil pump shutdown capabilities. Such features will be considered in addition to standard diesel generator sensory components that monitor lubricating oil pressure and temperature.

With respect to the consequences of lubricating oil system leaks, relevant requirements pertaining to fire prevention and fire risk control, and storage (including containment, drainage, and spill control), will be implemented in accordance with NFPA 30, *Flammable and Combustible Liquids Code*.

With respect to isolation of the lubricating oil system, in accordance with Chapter 7 of NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, a remote shutdown capability for the lubricating oil pump will be incorporated into the diesel generator lubricating oil system design. This feature will prevent any significant oil leakage by precluding lubricating oil flow from the lubricating oil storage tank or the diesel engine sump. Events initiating shutdown of the lubricating oil pump and the necessary controls required to detect and respond to such events will be established during detailed design of the diesel generators. The potential need for additional isolation features to supplement the lubricating oil pump shutdown capability will also be established during detailed design.

A comprehensive and dedicated inspection, testing, and reliability-centered maintenance program will be employed for the important to safety diesel generators (including their supporting subsystems) to monitor and consequently prevent or remedy potential issues that

could adversely affect their safe and reliable operation. Inspection, testing, and maintenance of the diesel generators will be in accordance with manufacturer's recommendations, and IEEE Std 387-1995, *Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations.*

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ANSI/ANS-59.52-1998. 2007. *American National Standard, Lubricating Oil Systems for Safety-Related Emergency Diesel Generators.* La Grange Park, Illinois: American Nuclear Society. TIC: 259964.

NFPA 30. 2006. *Flammable and Combustible Liquids Code. 2003 Edition. Quincy, Massachusetts*: National Fire Protection Association. TIC: 258720.

NFPA 37. 2006. *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.* 2006 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 260349.

IEEE Std 387-1995. 2001. *Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258750.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 9:

Provide information on interface requirements and codes and standards to be applied for the engine-mounted components of the emergency diesel generators (SAR Section 1.2.8.2.4.8).

In SAR Section 1.2.8.2.4.8, DOE states that the ITS Diesel Generator Lubricating oil subsystem is designed in accordance with ANSI/ANS-59.52-1998. The scope of this standard excludes "engine mounted" components except to define interface requirements. The staff needs information on interface requirements and the codes and standards applicable to the design of the engine–mounted components of emergency diesel generator, to verify compliance with 10 CFR 63.21(c) (3).

1. RESPONSE

The design of engine-mounted components and their interfaces for the important to safety (ITS) diesel generators will be evaluated during detailed design. In particular, the design will consider the effects of seismic and nonseismic vibration on the integrity of the engine-mounted components and incorporate design features to maintain the structural and operational reliability of the diesel generators. The ITS diesel generators (and all supporting subsystems) will also be qualified for seismically induced vibration and component aging due to nonseismic vibration per IEEE Std 323-2003, *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.*

The design of the ITS diesel generators will consider the physical configuration and mechanical support of attached auxiliaries, accessories, hardware, piping, wire and cable, and raceways. In addition to manufacturers' standards, the design of the engine-mounted components will be in accordance with the following:

- IEEE Std 387-1995, *IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations*, Section 4.5.1
- NFPA 37-2006, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, Section 7.3.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

IEEE Std 323-2003. 2004. *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255697.

IEEE Std 387-1995. 2001. *Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258750.

NFPA 37-2006. *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.* 2006 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 260349.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 10:

Describe the plan for performing preventative and corrective maintenance, and potential upgrades needed for the hardwired interlocks which typically have a limited useful life that is considerably less than the required 100-year preclosure operational period. Include a discussion regarding the design for accessibility of the sensors to facilitate periodic preventative or correctional maintenance.

SAR Section 1.4.2 describes the control philosophy of ITS controls. SAR section 5.6 addresses corrective and preventive maintenance of controls. ITS controls and interlocks are hardwired and cannot be overridden by automation-based controls. Some of the controls such as interlocks, sensors, limit switches etc. will be mounted inside of cask and canister handling equipment or may not easily accessible for a long time (100 year preclosure period) for maintenance, replacement, or upgrade purposes.

1. RESPONSE

Specific plans and procedures for preventive and corrective maintenance of hardwired important to safety (ITS) interlocks and other ITS structures, systems, and components (SSCs) will be developed prior to the receipt and possession of high-level radioactive waste. Such plans and procedures will be developed in a phased manner to support the operation of each waste handling facility as construction is completed, and will result in an integrated set of procedures that define the interfaces, roles, responsibilities, accountabilities, and authority for maintenance. Programmatic controls will be put in place to ensure that maintenance of SSCs is performed in accordance with the processes outlined in SAR Section 5.6.4.

Preventive maintenance of hardwired ITS interlocks will be based upon manufacturer's recommendations, industry codes and standards, equipment qualification data, and surveillance testing based on reliability requirements to ensure that the hardwired ITS interlocks maintain the required degree of performance and reliability, in accordance with the preclosure safety analysis (PCSA). Preventive maintenance activities for hardwired ITS interlocks will be undertaken in a manner consistent with the repository reliability centered maintenance process and the equipment qualification program to ensure that parts susceptible to degradation are replaced prior to impacting performance of the required safety functions. The equipment qualification program is described in SAR Section 1.13.2.5.

Preventive maintenance will be performed when operability of the affected component is not required for waste handling, or it will be performed within the permissible time stated in the action statement associated with the limiting conditions for operation for the component. The action statement times will be based upon the PCSA modeling of event sequences and availability of ITS components.

Upgrading hardwired ITS components (e.g., interlocks, sensors, limit switches) will be considered if a particular component becomes obsolete, making replacement parts unavailable, or if deemed necessary by the reliability centered maintenance program. Any component

upgrade will be treated as a design change and will be subject to the requirements of the configuration management program to evaluate the impact of the proposed change in accordance with 10 CFR 63.44, as well as any specific license conditions.

Access to SSCs, including interlocks, sensors, and limit switches, for preventive and corrective maintenance is a design requirement that has been addressed at a macroscopic level in the design to date, and will be addressed in the final design of the SSCs to ensure that provisions are made for ease of maintenance and to meet as low as is reasonably achievable design goals. Design of electrical equipment, including hardwired ITS interlocks and sensors, is in accordance with NFPA 70, *National Electrical Code*, which requires that access and sufficient working space be available for maintenance. Additionally, final equipment design will follow the methods and practices of the applicable guidelines of DOE-HDBK-1140-2001, *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance*, MIL-STD-1472F Change Notice 1, *Human Engineering*, and Regulatory Guide 8.8, *Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable*. This design approach will ensure that controls such as interlock, sensors, limit switches etc. will be accessible during the 50 year design life of the surface facilities.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

NFPA 70. 2005. *National Electrical Code*. 2005 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 258735.

DOE-HDBK-1140-2001. *Human Factors/Ergonomics Handbook for the Design for Ease of Maintenance*. Washington, D.C.: U.S. Department of Energy. ACC: MOL.20060105.0203.

MIL-STD-1472F, Change Notice 1. 2003. *Human Engineering*. Washington, D.C.: U.S. Department of Defense. TIC: 256247.

Regulatory Guide 8.8, Rev. 3. 1978. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be as Low as is Reasonably Achievable*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238609.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 11

Provide information on the codes and standards used for the radiating cables and antennas operating in hostile environment in the subsurface facility (SAR Section 1.4.2.4).

SAR Section 1.4.2.4 describes communication systems to be used in subsurface facilities. Radiating cables and perhaps antennas are placed in the access mains and air intake shafts to minimize exposure to radiation and high temperatures, as shown in SAR Figure 1.4.2-9, and radio frequency transceivers are in alcoves. All the three are important components of wireless communications.

1. RESPONSE

Radiating cables, antennas, and transceivers are installed in the access mains and alcoves of the subsurface facility and, in some cases, they are located in the air intake shafts. None of these communication system components are used in hostile environments, which would include the turnouts, the emplacement drifts, and the exhaust mains and shafts where high temperatures or high radiation fields may be present. The equipment for communication systems will be suitable for use based on the environmental conditions in the aforementioned intake shafts, access mains, and alcoves. These conditions are stated in SAR Section 1.2.2 and represent environmental conditions that fall within normal operating parameters for such equipment. The systems, structures, and components associated with the communication systems are not important to safety.

Only mobile equipment such as the transport and emplacement vehicle, inspection gantry, and drip shield emplacement gantry will enter and function in the turnouts or emplacement drifts. Each of these mobile units will carry its own communications equipment, which is suitable for its intended use and the environment inside the turnout or emplacement drift. As described in SAR Section 1.13.2, the equipment qualification program will implement requirements for mobile equipment electrical system operations in harsh environments in accordance with *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations* to ensure equipment operability in these environments.

The codes and standards implemented for design of the communications system radiating cables and antennas in the expected subsurface operating environment include:

- IEEE Std 802.3ah-2004. *IEEE Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements. Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications. Amendment: Media Access Control Parameters, Physical Layers, and Management Parameters for Subscriber Access Networks*

- IEEE Std 802.11b-1999. *Supplement to IEEE Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and*

Metropolitan Area Networks—Specific Requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Higher-Speed Physical Layer Extension in the 2.4 GHz Band

- IEEE Std 802.11g/D6.1. *Draft Supplement to Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Further Higher-Speed Physical Layer Extension in the 2.4 GHz Band.*

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

IEEE Std 323-2003. 2004. *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255697.

IEEE Std 802.3ah-2004. *IEEE Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements. Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications. Amendment: Media Access Control Parameters, Physical Layers, and Management Parameters for Subscriber Access Networks.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 257033.

IEEE Std 802.11b-1999. 2000. *Supplement to IEEE Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Higher-Speed Physical Layer Extension in the 2.4 GHz Band.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 254758.

IEEE Std 802.11g/D6.1. 2003. *Draft Supplement to Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Further Higher-Speed Physical Layer Extension in the 2.4 GHz Band.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 254396.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 12

Provide information on the standards and codes applicable to the Programmable Logic Controller (PLC), and the technical basis for designating the PLC as non-ITS.

Actions of the TEV are implemented by an onboard PLC while being monitored and controlled by operators in the Central Control Center as described in SAR section 1.3.3.5.1.1. There are several PLCs used in the TEV as shown in WP TEV Process and Instrumentation Diagram (BSC 2007). The PLC interfaces with the locking mechanism.

In SAR Table 1.3.3-6, SAR page 1.3.3.-62, it is stated that the PLC on TEV senses the loss of power, alerts the operator and enters a locked mode. Upon power restoration the PLC alerts the operator and waits for the operator to send a command. The onboard PLC plays a critical role in communicating the status of TEV to the operator and is also relied on to limit or prevent potential event sequences or mitigate their consequences.

1. RESPONSE

The transport and emplacement vehicle (TEV) is designed with a control system that includes control and oversight provided by operators in the Central Control Center and equipment actions that are enabled by the operator and implemented through a programmable logic controller (PLC) onboard the TEV.

1.1 IMPORTANT TO SAFETY CLASSIFICATION BASIS OF THE PROGRAMMABLE LOGIC CONTROLLER

Although TEV equipment functions are performed by the onboard PLC, it is used only to implement preprogrammed equipment operational sequences; it does not perform important to safety (ITS) functions, and it is not relied upon to prevent or mitigate an event sequence. To implement this design strategy, the TEV design approach has been developed to include specific design features and components that support the capability of the PLC to perform TEV functions but do not allow the PLC to initiate a TEV action that could result in potential personnel exposure.

An example of this design strategy implementation is the TEV speed control. Sensors and a speed control mechanism are connected through the PLC to regulate the speed of the TEV from a standstill up to transport speed. However, the design configuration of the TEV drive motors and gearboxes is such that the TEV physically cannot exceed the design rated load speed limit (150 ft/min or 1.7 mph) recommended by ASME NOG-1-2004, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)* (SAR Section 1.3.3.5.1.1). A potential TEV runaway at this speed that leads to derailment and a collision impact has been analyzed in the preclosure safety analysis and does not result in a breach of the waste package or potential exposure. Similarly, collision of the TEV with a waste package in the emplacement

drift at the design rated load speed limit will not cause a breach of the waste package and will not initiate an event sequence.

Another example of the design strategy implementation for precluding the PLC from affecting TEV ITS functions involves unlocking and opening the TEV shielded enclosure doors. This operation can only be accomplished after activation of a mechanically operated switch that is mounted on the TEV. The ITS mechanical switch mounted on the TEV can only be activated through physical interaction with a stationary, actuating device mounted to the rails in the loadout rooms of the surface nuclear facilities and within the subsurface turnouts (SAR Figure 1.2.4-93). The stationary actuating device activates the switch on the TEV as it enters the loadout rooms or emplacement drifts, which allows the PLC and control system components responsible for operating the locks of the shielded enclosure doors to function. The onboard PLC is capable of unlocking the doors and implementing the TEV functions needed to load or emplace waste packages only after the ITS mechanical switch on the TEV has been activated. When operations in the surface nuclear facilities loadout rooms or the emplacement drifts are completed, the TEV leaves these areas. As the TEV exits the loadout rooms or emplacement drifts, the shielded enclosure doors are closed by the PLC and the stationary actuating bracket again engages and operates the mechanical switch on the TEV. This action deactivates the switch and disables unlocking of the front shield door locks and raising of the rear shield door ensuring that the shielded enclosure doors cannot be inadvertently opened.

The PLC and ITS mechanical switch are functionally independent of each other. Once the ITS mechanical switch has been engaged and deactivated, the operator cannot open the TEV shielded enclosure doors via the PLC, so an operator error cannot occur that inadvertently opens the shield doors. Since the PLC and ITS mechanical switch are independent of one another, a software error related to the PLC would not result in unlocking or opening of the doors of the TEV shielded enclosure without a concurrent (and independent) failure of the ITS mechanical switch.

1.2 RESTORATION OF POWER

Upon loss of power, the TEV drive motor brakes and the screw jack motor brakes actuate to stop linear and vertical motion and retain the load in place. Power loss to the brakes results in the brakes being automatically applied, ensuring that the TEV is brought to a stop. The PLC senses the loss of power, alerts the operator, and enters a locked mode (suspends execution of any operational steps). The PLC and the communications equipment on the TEV continue to be powered by the onboard battery system, providing monitoring information to the operator in the Central Control Center. Upon power restoration, the PLC senses the restoration, alerts the operator if possible, and waits for the operator to send a command that enables the execution of a programmed sequence by the PLC with no autonomous TEV actions taken by the PLC. Operator actions would be determined after evaluating TEV status and position and evaluating other repository conditions, in accordance with operating procedures.

Although the PLC continues to provide information to the operator in the Central Control Center during a power loss, it is not the only means available to the operator of determining TEV status. If the PLC and communication systems are not functioning properly, additional information can

be gained through cameras located in the subsurface facility. If needed, an inspection gantry can also be used to observe and assess the status of the TEV. At no time will the PLC determine the need for or initiate a recovery action for the TEV. Such a decision and initiating action can only be made by the operator in the Central Control Center based on information regarding status of the TEV, repository conditions, and operating procedures.

1.3 CODES AND STANDARDS

Sections 6410 to 6419 of ASME NOG-1-2004 present requirements that are applicable to control of the TEV. These sections also identify related industry standards that are invoked through ASME NOG-1-2004. Sections 6410 to 6419 identify various aspects of crane control design requirements and parameters that are applicable for the TEV, including: voltage control and voltage variation tolerance, ambient temperature operating range, enclosure requirements, condensation considerations, unit type selection, and hoisting and lowering speed and braking control. In addition, applicable guidelines and recommendations from NUREG/CR-6090, *Programmable Logic Controller and its Application in Nuclear Reactor Systems* (Palomar and Wyman 1993) will be adopted for the design, construction, and operation of the TEV PLCs. Supplementary codes and standards implemented for the TEV PLCs will include applicable portions of the IEC 61131-3, *Programmable Controllers* code series, such as Part 3, which has also been adopted by the National Electrical Manufacturers Association.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ASME NOG-1-2004. 2005. *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*. New York, New York: American Society of Mechanical Engineers. TIC: 257672.

IEC 61131-3. 2003. *Programmable Controllers—Part 3: Programming Languages*. 2nd Edition 2003-01. Geneva, Switzerland: International Electrotechnical Commission. TIC: 260193.

Palomar, J. and Wyman, R. 1993. *Programmable Logic Controller and its Application in Nuclear Reactor Systems*. NUREG/CR-6090. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 237489.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 13:

> Justify the use of commercial grade sensors for monitoring temperature, humidity, etc., in subsurface facilities, since the sensors must operate in extreme environments (SAR section 1.3.5.1.3). Also, provide the specific codes and standards they comply with especially for subsurface facility.

1. RESPONSE

Proposed sensor locations for monitoring and data collection in the subsurface facility are in areas that do not experience extreme environmental conditions. The primary purpose of the subsurface facility sensors will be for monitoring environmental conditions such as temperature, barometric pressure, relative humidity, and dose rate in those portions of the subsurface facility that are accessible to repository personnel, and to ensure that ventilation to the emplacement drifts is maintained at design values.

The ventilation system is designed with an allowed outage time of 30 days in which to implement repairs or mitigate off-normal events and, as such, the system is classified as neither important to safety nor important to waste isolation as described in SAR Section 1.3.5. Similarly, the monitoring sensors for environmental conditions in the subsurface, which operate as an integral part of the ventilation system, do not provide a safety function in the preclosure safety analysis and are categorized as not important to safety.

The sensors are located in the access mains at the emplacement access doors and isolation barriers, at the ventilation intakes, and at the exhaust shaft collars. None of the equipment is located in the turnouts or emplacement drifts (SAR Figure 1.3.5-1). Accordingly, these instruments experience surface ambient conditions for temperature and humidity. Ambient conditions for the geologic repository operations area are stated in SAR Section 1.2.2. Environmental monitoring instrumentation, including radiation monitors, is described in SAR Section 1.4.2.

Only the sensor probes for the instruments located at the ventilation exhaust shaft collars will be exposed to greater than ambient temperatures, since the exhaust air has been heated by decay heat from the emplaced waste. The exhaust shaft sensors will provide information regarding temperature and volume of the exiting airflow and monitor for airborne radioactivity. The environmental conditions for the exhaust air at the shaft collar installations are identified in SAR Section 1.3.5.

Shaft collar facilities, for both intake and exhaust shafts, will include structures, utilities, and instrumentation installations, which will be sufficiently removed from the immediate proximity of the exhaust shafts that only the instrument sensor probes will be exposed to the exhaust airstream. Due to the instrumentation housing locations and designs, the instrumentation units will experience local ambient conditions. In addition to instrument monitoring and data collection, routine operational activities will include instrument calibration, maintenance, and replacement when needed.

The monitoring sensors are typical of those used in non-safety related applications at nuclear facilities. These instruments are reliable and efficient in providing data. None of the environmental monitoring instrumentation in the subsurface facility is relied upon to perform a safety function. The use of properly designed commercial grade sensors at the exhaust shaft collars and other subsurface facility locations is appropriate.

Although commercially available sensors will be used for subsurface facility applications, the process of evaluating, determining performance, and selecting sensor equipment to monitor temperature, barometric pressure, and relative humidity in the subsurface environments will be based on Regulatory Guide 1.23 and in accordance with applicable sections of ANSI/ANS-3.11-2005 and EPA-454/R-99-005. In accordance with Regulatory Guide 8.8, the monitoring sensors will be located and/or shielded to maintain occupational radiation exposures as low as is reasonably achievable. Evaluation and selection of radiation monitoring equipment will be performed in accordance with applicable sections of ANSI/ANS-HPSSC-6.8.1-1981, ANSI N42.17B-1989, and ANSI N42.18-2004.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ANSI/ANS-HPSSC-6.8.1-1981. *Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Nuclear Reactors.* La Grange Park, Illinois: American Nuclear Society. TIC: 253112.

ANSI/ANS-3.11-2005. *American National Standard for Determining Meteorological Information at Nuclear Facilities.* La Grange Park, Illinois: American Nuclear Society. TIC: 258445.

ANSI N42.17B-1989. 2005. *American National Standard, Performance Specifications for Health Physics Instrumentation-Occupational Airborne Radioactivity Monitoring Instrumentation.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258573.

ANSI N42.18-2004. *American National Standard, Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258574.

EPA (U.S. Environmental Protection Agency) 2000. *Meteorological Monitoring Guidance for Regulatory Modeling Applications.* EPA-454/R-99-005. Research Triangle Park, North Carolina: U.S. Environmental Protection Agency. TIC: 253879.

Regulatory Guide 1.23, Rev. 1. 2007. *Meteorological Monitoring Programs for Nuclear Power Plants*. Washington, D.C.: U. S. Nuclear Regulatory Commission. ACC: MOL.20070926.0187.

Regulatory Guide 8.8, Rev. 3. 1978. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be as Low as is Reasonably Achievable*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238609.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 14

Provide the following information:

a) Technical Basis for 900 hp exhaust fans for the subsurface facility representing 70 percent of the required air volume for the emplacement drifts. This information is needed to verify DOE's statement (SAR Section 1.3.5.1.3.1) that a 900 hp exhaust fan can provide 70 percent of the required air volume for the emplacement drifts.

b) Standards and codes used for the interfaces between the mobile diesel backup power generators and the fans, variable speed drives, etc.

c) Capacity of each of the standby diesel generators. This information is needed to verify that three of the four generators have sufficient power to perform their safety functions (SAR Section 1.4.1.1.1.3).

1. RESPONSE

1.1 TECHNICAL BASIS FOR SIZING OF THE SUBSURFACE FACILITY VENTILATION EXHAUST FANS

The subsurface facility ventilation exhaust fans are sized to satisfy the repository cooling requirements at maximum emplacement, with each of the 108 emplacement drifts filled to capacity, and include a 15% margin to the calculated airflow volume requirements. The margin provides additional capacity to accommodate in-drift equipment operation.

1.1.1 Representation of the Repository in Ventilation Calculations

Representation of the repository underground configuration for ventilation modeling purposes is documented in *Subsurface Ventilation Network Model for LA* (BSC 2008) and is based on the underground layout configuration presented in SAR Sections 1.3.1, 1.3.3, 1.3.4, and 1.3.5. A commercially available computer code, VnetPC 2003, Version 1.0.0.1, is used to model the underground openings as a set of interconnected openings for a fully loaded repository (BSC 2008, Figures A-2 through A-8).

Repository ventilation requirements are incorporated into the model by assigning an airflow rate of 32,000 cubic feet per minute (cfm) to each emplacement drift (SAR Section 1.3.5.1.3.1). The observation drift is provided with a nominal airflow rate of 46,000 cfm. In addition, allowances for air leakage are made for the isolation barriers separating the access mains from the exhaust mains (70,000 cfm total). The addition of these quantities for a fully-developed repository (108 emplacement drifts) results in a total repository intake airflow rate requirement of 3,572,000 cfm (BSC 2008, Sections 6 and 7).

The repository exhaust airflow volume is calculated by increasing the intake airflow rate (3,572,000 cfm) with the thermal expansion airflow rates at the exhaust end of each emplacement drift and fan leakage at the exhaust shafts. Emplacement drift airflow rates are

increased by 8,000 cfm at each of the emplacement drift outlet locations to incorporate thermal expansion for outlet air temperatures of approximately 100°C (212°F). Allowances for fan ductwork leakage are taken into consideration by adding 3,000 cfm for each of the six exhaust shafts to the exhaust airflow calculation. The addition of these flow rates results in a total repository exhaust airflow rate of 4,454,000 cfm (BSC 2008, Sections 6 and 7).

Some airflow conveyance capacities are restricted in the model by observing industry guidelines for air velocities in underground facilities. The cross-sectional areas of flow of the openings are adjusted for components within the openings (e.g., invert structures and electrical equipment) and presence of equipment in the openings (i.e., transport and emplacement vehicle) that restrict airflow. Airway frictional losses are also included by the introduction of friction factors (BSC 2008, Sections 3 and 4).

1.1.2 Repository Airflow Distribution

The subsurface facility ventilation network calculations resulted in an allocation of intake and exhaust airflows as represented in Figures 1 and 2, respectively. These figures illustrate the areas of the repository, at full emplacement, that are served by the different inflow and exhaust airways. This allocation is not the only possible solution but one that conforms to the requirements and constraints imposed on the ventilation system. The network modeling for the airflow allocations represented in Figures 1 and 2 results in the exhaust fan operating duties listed in Table 1.

Table 1. Exhaust Fan Operating Duties

Fan Location	Airflow (cfm)	Pressure (milli in. wg.)	Pressure (in. wg.)	Hp
ECRB Exhaust Fan	935,000	5559.6	5.6	1,100
Exhaust Shaft #1*	400,000	5710.5	5.7	479
Exhaust Shaft #2	810,000	6829.2	6.8	1,157
Exhaust Shaft #3N	947,000	5894.6	5.9	1,174
Exhaust Shaft #3S*	400,000	6230.5	6.2	521
Exhaust Shaft #4	962,000	5203.2	5.2	1,051
Total	4,454,000	NA	NA	NA

NOTE: *All shafts contain parallel fan installations. Exhaust Shaft #1 and Exhaust Shaft #3S operate only one of the two fans during normal operations.

in. wg. = milli in. wg./1,000 (rounded); ECRB = Enhanced Characterization of the Repository Block.

Source: BSC 2008, Table 18.

1.1.3 Adjustments for Margin and Standardization

Table 1 lists the fan operating duties for the exhaust shafts. The horsepower requirements per shaft vary from 479 to 1,174 hp. These results do not include the 15% volume margin, which is applied to accommodate higher airflow demand for emplacement drift cooling during equipment operation.

The 15% volume margin is applied to the maximum calculated fan horsepower in Table 1. A 15% volume contingency translates into a 52% increase in the required fan driving power ($1.15^3 = 1.52$ or a 52% increase). Increasing the maximum horsepower value in Table 1 (1,174 hp) by 52% results in 1,784 hp for the full airflow volumetric rate potentially exhausted through the shaft. This is rounded up to 1,800 hp.

The arrangement of the subsurface ventilation system exhaust fan facility contains two fans capable of parallel operation, located at the exhaust shaft collars. For a dual fan installation per shaft, a 900-hp capacity is required per motor (BSC 2008, Section 7.2.3). At full emplacement, two fans with a total available power of 1,800 hp will be operating in parallel on the large diameter shafts (Enhanced Characterization of the Repository Block Exhaust Shaft, Exhaust Shaft #2, Exhaust Shaft #3N, and Exhaust Shaft #4 in Table 1) and one fan with a 900-hp motor will be operating on the small diameter shafts (Exhaust Shaft #1 and Exhaust Shaft #3S in Table 1).

1.1.4 Capability of a Single Fan in a Dual Fan Installation

SAR Section 1.3.5.3.1 states that in a parallel fan installation, 70% of the original airflow volume is maintained if one fan is off-line. This is a typical arrangement of a parallel fan installation (McPherson 1993, p. 349) and is not unique to the subsurface repository exhaust shaft installations.

Figure 3 illustrates the operation of two fans in parallel and shows the system resistance curve that represents the relationship between pressure and airflow volume. A specific fan was identified in Figure 3, but its characteristics are typical of the fan installations to be provided for the repository ventilation system. The single fan curve in Figure 3 shows the operating capability of a single fan. The combined characteristics curve shows the capability of the two fans operating in parallel. The intersection of the system resistance curve and the combined characteristics curve defines the operating point of the parallel fan installation. In this example, the operating point (airflow rate of 835,000 cfm at a pressure of 5.7 in. water gauge) is similar to some of the shaft location operating parameters listed in Table 1. When one fan becomes inoperable the operating point of the remaining fan shifts to the single fan curve intersection with the system resistance curve showing a capacity of about 584,000 cfm at a pressure of about 3.6 in. water gauge. In this example, the reduced airflow for a single fan in the dual fan installation is about 70% of the combined fan volume (BSC 2007a, Section 6.4).

1.2 MOBILE DIESEL BACKUP GENERATORS AND STANDBY DIESEL GENERATORS

SAR Section 1.3.5.3.1 describes the connection of the mobile diesel generators to the fans. There are two sources of backup power for the subsurface facility ventilation system: (1) standby diesel generators that are capable of providing power to any three exhaust fans, and (2) exhaust shaft surface pads equipped with connections for mobile diesel backup generators.

1.2.1 Mobile Diesel Backup Generators

As identified in the *Subsurface Facility Exhaust and Intake Shafts Single Line Diagram* drawings (BSC 2007b, Note 3; BSC 2007c, Note 3; BSC 2007d, Note 3), an interlock is provided between the main switchgear and the "standby diesel generator (SDG)," designated as "mobile backup diesel generators" in SAR Section 1.3.5.3.1, at the shaft surface pads. The mobile backup diesel generators will be brought to the repository and installed as needed. These mobile backup diesel generators would not be needed except during extended power outages.

1.2.2 Standby Diesel Generators

The standby diesel generators are permanently installed at the surface facilities to provide standby power for not important to safety (non-ITS) loads that are important to the efficient operation of the surface and subsurface facilities. These non-ITS loads include backup power to the subsurface facility ventilation system fans (SAR Figures 1.4.1-2, Sheets 1, 2, and 5). The installed standby diesel generators are capable of providing power to any of the exhaust fans during a loss of off-site power.

1.2.3 Diesel Generator Interfaces with Subsurface Ventilation Equipment

The methods and practices of the following codes and standards are pertinent to the design and interfaces of the not important to safety electrical equipment located at the shaft surface pads, including the connection points for the mobile diesel generators:

- Medium Voltage Switchgear: Sections 5.4.2 of IEEE Std C37.20.2-1999, *IEEE Standard for Metal-Clad Switchgear*
- Low Voltage Load Centers: Section 10.3.4 of IEEE 141-1993, *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants*
- Low Voltage Panels (Panel boards): Section 2.10.1 of NEMA PB 1-1990, *Panelboards*
- Adjustable Speed Drives: Part 31 of NEMA MG 1-1998, *Motors and Generators*
- AC Motors: (for motors operating between 251 hp to 4,000 hp such as the subsurface 900 hp, 4.16 kV, 3-ph, 60 Hz fans)
  - ANSI C84.1-2006, *Electric Power Systems and Equipment—Voltage Ratings (60 Hertz)*
  - IEEE 141-1993, *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants*
  - NEMA MG 1-1998, *Motors and Generators*
- Transformers: Table 10-10 of IEEE Std 141-1993, *IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants*

- AC Generators: NEMA MG 1-1998, *Motors and Generators.*

1.3 STANDBY DIESEL GENERATOR CAPACITY

Each of the four non-ITS diesel generators has a rated capacity of 6 MVA, as shown in SAR Figure 1.4.1-2, Sheets 1 and 5.

Activation of three repository exhaust fans requires approximately 3.42 MVA, which is well within the rated capacity of each of the four standby diesel generators.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ANSI C84.1-2006. 2006. *Electric Power Systems and Equipment—Voltage Ratings (60 Hertz).* Rosslyn, Virginia: National Electrical Manufacturers Association. TIC: 259766.

BSC (Bechtel SAIC Company) 2007a. *Shaft Collars and Fan Layout General Arrangement Analysis.* 800-KVC-VU00-00400-000-00A CACN 001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070716.0026; ENG.20080123.0001.

BSC 2007b. *Subsurface Facility Exhaust and Intake Shafts Single Line Diagram.* 860-E10-EEN0-00101-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071001.0007.

BSC 2007c. *Subsurface Facility Exhaust and Intake Shafts Single Line Diagram.* 860-E10-EEN0-00102-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071001.0008.

BSC 2007d. *Subsurface Facility Exhaust and Intake Shafts Single Line Diagram.* 860-E10-EEN0-00103-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071001.0009.

BSC 2008. *Subsurface Ventilation Network Model for LA.* 800-KVC-VUE0-00200-000-00B CACN 001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080115.0013; ENG.20090310.0008.

IEEE Std C37.20.2-1999. 2000. *IEEE Standard for Metal-Clad Switchgear.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 254114.

IEEE Std 141-1993. 1994. *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants*. New York, New York: The Institute of Electrical and Electronics Engineers. TIC: 240362

McPherson, M.J. 1993. *Subsurface Ventilation and Environmental Engineering*. New York, New York: Chapman & Hall. TIC: 215345.

NEMA MG 1-1998, Rev. 1. 2000. *Motors and Generators*. Rosslyn, Virginia: National Electrical Manufacturers Association. TIC: 249172.

NEMA PB 1-1990. *Panelboards*. Standards Publication No. PB 1. Washington, D.C.: National Electrical Manufacturers Association. TIC: 3617.

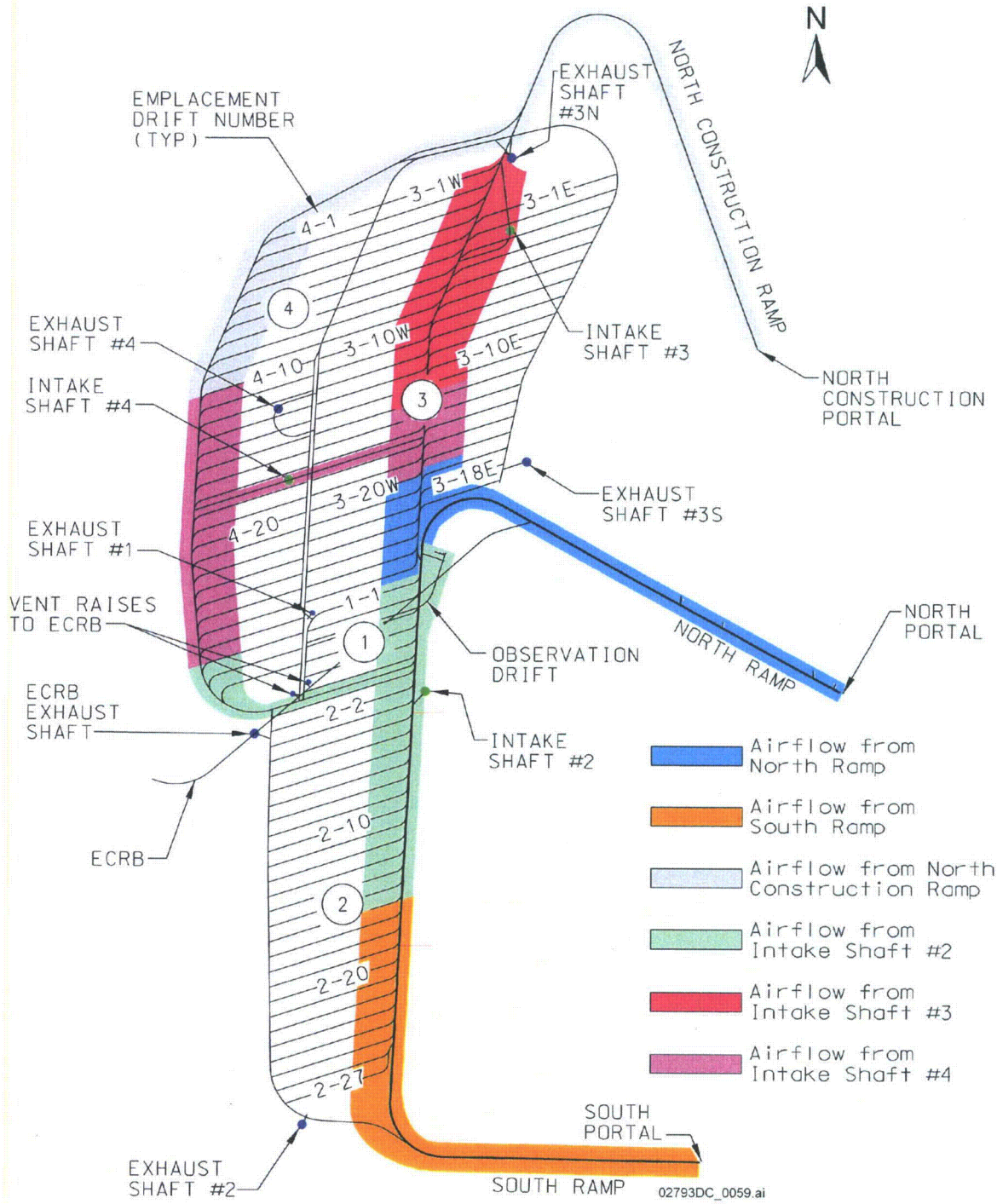

Figure 1. Subsurface Facility Typical Inflow Airflow Allocation in Network Model

Source: BSC 2008, Figure 13.

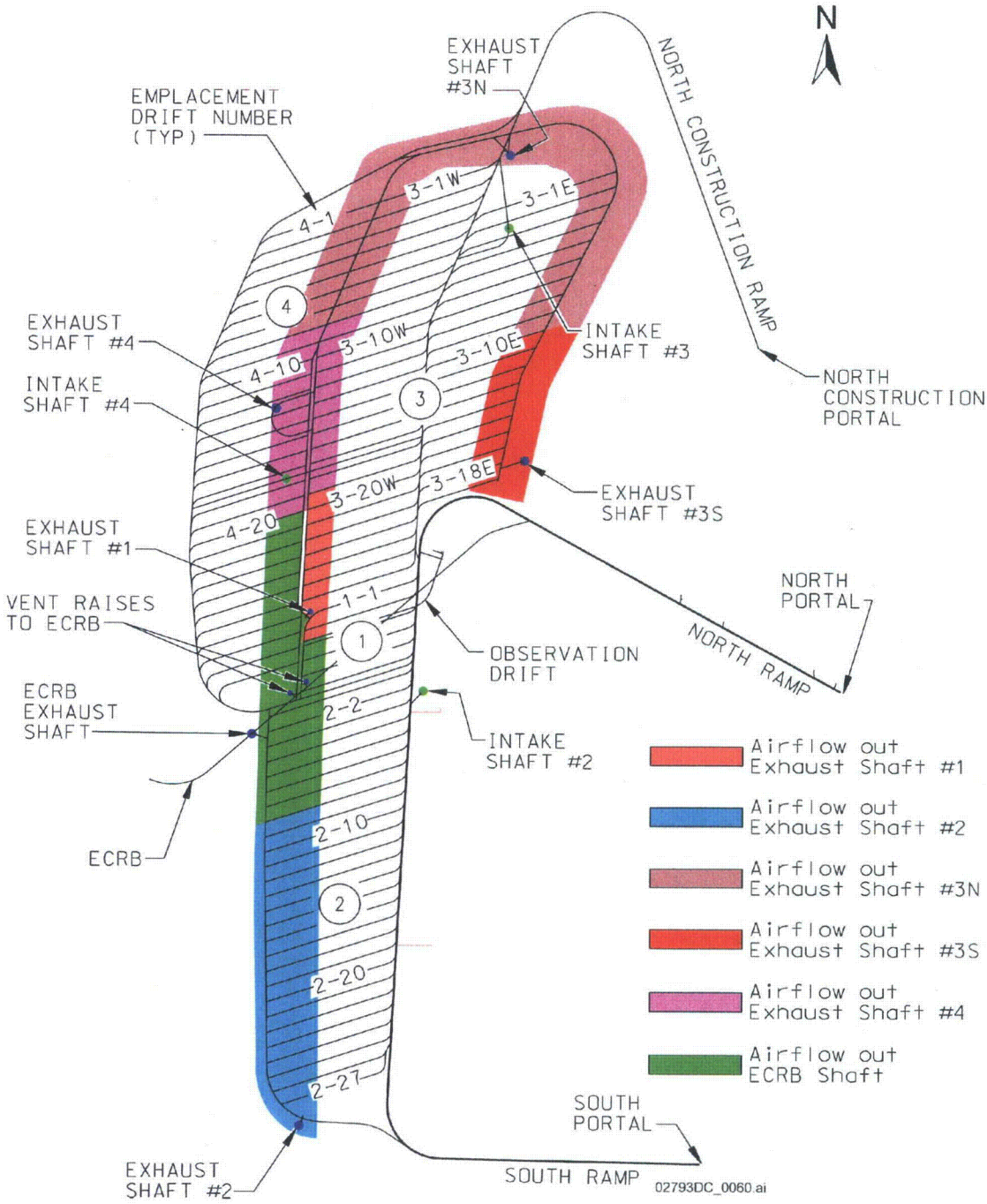

Figure 2. Subsurface Facility Typical Exhaust Airflow Allocation in Network Model

Source: BSC 2008, Figure 14.

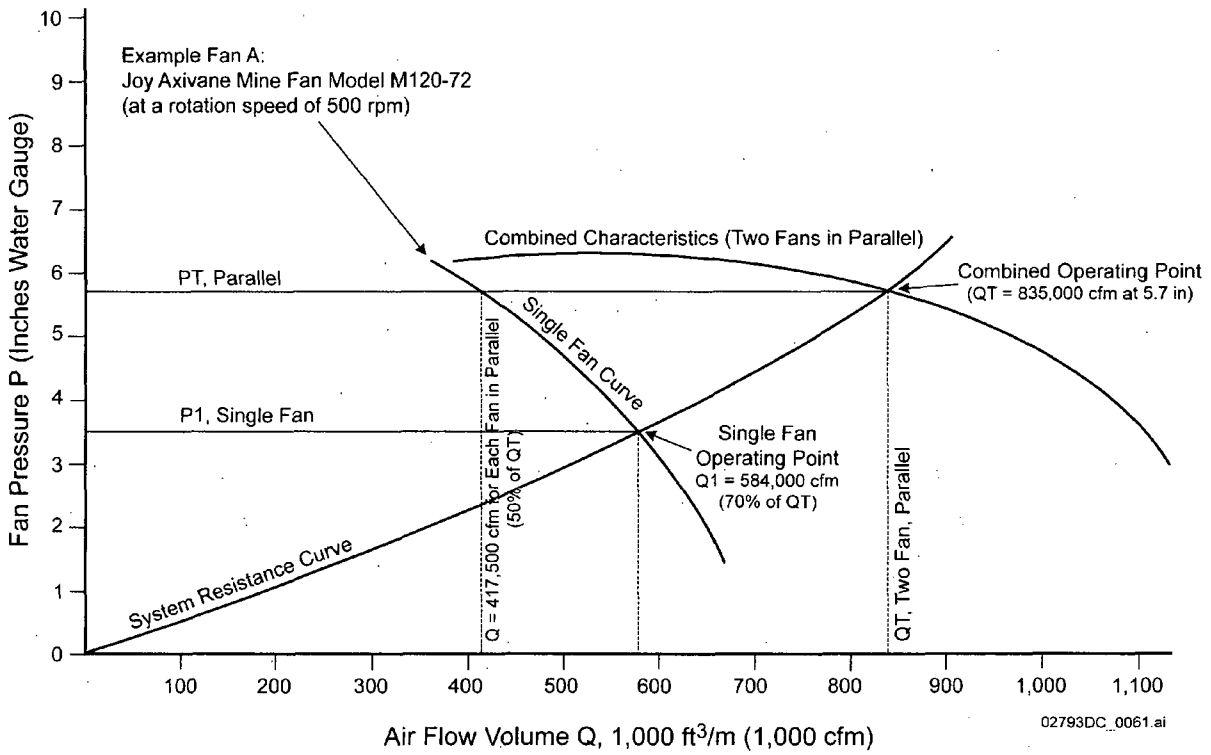

Figure 3. Illustration of Parallel Fan Operation

Source: BSC 2007a, Figure 4.

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Provide the technical basis for using standards for industrial and commercial buildings (e.g, IEEE 446, NACE Standard RP0572-2001), for electrical power and communication systems (SAR Section 1.4.1.4.7), instead of relevant standards for underground installations for tunnels and mines (e.g., Mine Safety and Health Administration standards). This information is needed to verify compliance with 10 CFR 63.21(c)(3)(i).

1. RESPONSE

The appropriate codes and standards for the permanently installed repository facilities and systems, which are typical of industrial applications in buildings, are industrial codes rather than mining codes. Accordingly, industrial and commercial standards were selected (e.g., IEEE 446, NACE Standard RP0572-2001), and are appropriate for the design of repository electrical power and communication systems.

The basis for this decision is that the subsurface emplacement area is an operational high-level radioactive waste facility, segregated from construction activities, and is not similar to an active mine. The operations in the subsurface facility are not dust generating activities such as continuing excavation or transport of ore to the surface as in a mine. Normal activities during operations generally consist of the transport and emplacement vehicle operations related to waste emplacement, drift inspections, performance confirmation activities, and some human presence for inspection, testing, and maintenance activities. Some dust is expected in shafts and drifts under construction, but such conditions are not expected to adversely affect electrical and communication equipment in the subsurface, because such equipment will be installed in operational areas only after excavation is complete in those areas. A mine also depends on temporary and frequently moved electrical utilities, ventilation fans, airways and doors. Instead, the operational subsurface facility entails permanently installed utilities, ventilation fans and airways. Controls imposed on dust-generating activities, and the absence of planned excavation activity in the operational area of the repository, result in a facility more closely aligned to an industrial or commercial facility than an active mine. As such, the selected electrical and communications systems are appropriate to support the emplacement activities.

For ventilation and life safety design to support construction activities, the subsurface facility more closely aligns with mining applications. For these aspects of design, the Mine Safety and Health Administration regulations provide the design basis for the construction ventilation and ventilation doors which establish drift velocity and blast fume clearing. These same systems provide for control of dust and diesel engine use during the excavation process.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

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For the ITS surface facilities, provide information on the structural characteristics of the reinforced concrete and steel components. For example, Appendix A figures (e.g., SAR Figure A-31) provide general arrangements of the facilities. However, information about the floor steel components, reinforcing bars for walls and slabs, and main connection types are not shown. This information is needed for evaluation of the structural design and performance of the ITS buildings to ensure that requirements of 10 CFR 63.21(c) (3)(i) and 63.112(e)(8) are met.

1. RESPONSE

The drawings on the attached list provide information on the structural characteristics of the reinforced concrete and steel components for the important to safety surface facilities. The drawings provide preliminary concrete outline plans, elevations and sections, reinforcing plans and sections, and structural steel framing plans and elevations for the Canister Receipt and Closure Facility (CRCF), Receipt Facility (RF), Wet Handling Facility (WHF), and Initial Handling Facility (IHF). Final reinforcing patterns, including joint details and reinforcement around openings and penetrations, and final structural steel sizes and connection details are aspects of the detailed structural design for construction.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. LIST OF ATTACHMENTS

The preliminary structural characteristics of the reinforced concrete and steel components for each of the important to safety surface facilities are provided in the attached list of drawings (84 total drawings).

CRCF PRELIMINARY STRUCTURAL DRAWINGS	
CRCF Concrete Outline Plans, Elevations, and Sections	**Document ID**
Canister Receipt and Closure Facility #1 Forming Plan at TOC EL 0'-0"	060-DB0-CR00-00101-000-00B
Canister Receipt and Closure Facility #1 Forming Plan at TOC EL 32'-0"	060-DB0-CR00-00102-000-00A
Canister Receipt and Closure Facility #1 Forming Plan at TOC EL 64'-0"	060-DB0-CR00-00103-000-00B
Canister Receipt and Closure Facility #1 Forming Plan at TOC EL 100'-0"	060-DB0-CR00-00104-000-00A
Canister Receipt and Closure Facility #1 Elevation at Col Lines D & E	060-DB0-CR00-00105-000-00B
Canister Receipt and Closure Facility #1 Elevation at Col Lines G & H	060-DB0-CR00-00106-000-00B
Canister Receipt and Closure Facility #1 Elev at Col Lines 1, 2, 3 & 13	060-DB0-CR00-00107-000-00B
Canister Receipt and Closure Facility #1 Elevation at Col Lines 5 & 6	060-DB0-CR00-00108-000-00B
Canister Receipt and Closure Facility #1 Elevation at Col Lines 8 & 9	060-DB0-CR00-00109-000-00B
Canister Receipt and Closure Facility #1 Elev at Col Lines 11 & 12	060-DB0-CR00-00110-000-00B
Canister Receipt and Closure Facility #1 Misc Wall Elevations	060-DB0-CR00-00111-000-00B
Canister Receipt and Closure Facility #1 Details and Sections	060-DB0-CR00-00112-000-00B
CRCF Reinforcing Plans and Sections	
Canister Receipt and Closure Facility #1 Reinf Plan at TOC EL 0'-0"	060-DG0-CR00-00101-000-00B
Canister Receipt and Closure Facility #1 Reinf Plan at TOC EL 32'-0"	060-DG0-CR00-00102-000-00B
Canister Receipt and Closure Facility #1 Reinf Plan at TOC EL 64'-0"	060-DG0-CR00-00103-000-00B
Canister Receipt and Closure Facility #1 Reinf Plan at TOC EL 100'-0"	060-DG0-CR00-00104-000-00A
Canister Receipt and Closure Facility #1 Wall Reinforcing Sections	060-DG0-CR00-00105-000-00B
CRCF Structural Steel Framing Plans	
Canister Receipt and Closure Facility #1 Framing Plan at TOS EL 30'-3"	060-SS0-CR00-00101-000-00B
Canister Receipt and Closure Facility #1 Framing Plan at TOS EL 62'-3"	060-SS0-CR00-00102-000-00B
Canister Receipt and Closure Facility #1 Framing Plan at TOS EL 98'-3"	060-SS0-CR00-00103-000-00B
RF PRELIMINARY STRUCTURAL DRAWINGS	
RF Concrete Outline Plans and Elevations	**Document ID**
Receipt Facility Forming Plan at TOC EL 0'-0"	200-DB0-RF00-00101-000-00B
Receipt Facility Forming Plan at TOC EL 32'-0"	200-DB0-RF00-00102-000-00B
Receipt Facility Forming Plan at TOC EL 64'-0"	200-DB0-RF00-00103-000-00B
Receipt Facility Forming Plan at TOC EL 100'-0"	200-DB0-RF00-00104-000-00B
Receipt Facility Elev at Col Lines 3 and 4	200-DB0-RF00-00105-000-00B
Receipt Facility Elev at Col Lines 6 and 7	200-DB0-RF00-00106-000-00B
Receipt Facility Elev at Col Lines 2, 8 & 9	200-DB0-RF00-00107-000-00B
Receipt Facility Elevation at Col Lines A & C	200-DB0-RF00-00108-000-00B
Receipt Facility Elev at Col Lines E & F	200-DB0-RF00-00109-000-00B
Receipt Facility Elev at Col Lines B, D, E.4 & 5	200-DB0-RF00-00110-000-00B

RF Reinforcing Plans and Sections	
Receipt Facility Reinf Plan at TOC EL 0'-0"	200-DG0-RF00-00101-000-00B
Receipt Facility Reinf Plan at TOC EL 32'-0"	200-DG0-RF00-00102-000-00B
Receipt Facility Reinf Plan at TOC EL 64'-0"	200-DG0-RF00-00103-000-00B
Receipt Facility Reinf Plan at TOC EL 100'-0"	200-DG0-RF00-00104-000-00B
Receipt Facility Wall Reinforcing Sections	200-DG0-RF00-00105-000-00B
RF Structural Steel Framing Plans	
Receipt Facility Framing Plan at TOS EL 30'-3"	200-SS0-RF00-00101-000-00B
Receipt Facility Framing Plan at TOS EL 62'-3"	200-SS0-RF00-00102-000-00B
Receipt Facility Framing Plan at TOS EL 98'-3"	200-SS0-RF00-00103-000-00B
WHF PRELIMINARY STRUCTURAL DRAWINGS	
WHF Concrete Outline Plans and Elevations	**Document ID**
Wet Handling Facility Forming Plans at TOC EL (-)34'-0" and (-52)'-0"	050-DB0-WH00-00101-000-00A
Wet Handling Facility Forming Plan at TOC EL 0'-0"	050-DB0-WH00-00102-000-00B
Wet Handling Facility Forming Plan at TOC EL 20'-0"	050-DB0-WH00-00103-000-00B
Wet Handling Facility Forming Plan at TOC EL 40'-0"	050-DB0-WH00-00104-000-00B
Wet Handling Facility Forming Plan at TOC EL 80'-0" and 100'-0"	050-DB0-WH00-00105-000-00B
Wet Handling Facility Elev at Col Lines 2 and 3	050-DB0-WH00-00106-000-00B
Wet Handling Facility Elev at Col Lines 4 and 5	050-DB0-WH00-00107-000-00B
Wet Handling Facility Elev at Col Lines 6 and 7	050-DB0-WH00-00108-000-00B
Wet Handling Facility Elev at Col Lines 8, 9 & 2.5	050-DB0-WH00-00109-000-00B
Wet Handling Facility Elev at Col Lines B and C	050-DB0-WH00-00110-000-00B
Wet Handling Facility Elev at Col Lines D and E	050-DB0-WH00-00111-000-00B
Wet Handling Facility Elev at Col Lines 3.37, 2.25, 5.18 and 2.75	050-DB0-WH00-00112-000-00A
Wet Handling Facility Elev at Col Lines C.16 & C.18 C.25, C.37, C.49 & C.5, C.79 & C.81	050-DB0-WH00-00113-000-00B
Wet Handling Facility Elev at Col Lines C.58, 3.76, 4.18 and 4.72	050-DB0-WH00-00114-000-00B
WHF Reinforcing Plans and Sections	
Wet Handling Facility Reinforcing Plans at TOC EL (-)34'-0" and (-)52'-0"	050-DG0-WH00-00101-000-00A
Wet Handling Facility Reinf Plan at TOC EL 0'-0"	050-DG0-WH00-00102-000-00B
Wet Handling Facility Reinforcing Plan at TOC EL 20'-0"	050-DG0-WH00-00103-000-00B
Wet Handling Facility Reinforcing Plan at TOC EL 40'-0"	050-DG0-WH00-00104-000-00B
Wet Handling Facility Reinforcing Plans at TOC EL 80'-0" & 100'-0"	050-DG0-WH00-00105-000-00B
Wet Handling Facility Wall Reinforcing Sections	050-DG0-WH00-00106-000-00B
Wet Handling Facility Wall Reinforcing Sections	050-DG0-WH00-00107-000-00B
WHF Structural Steel Framing Plans	
Wet Handling Facility Framing Plan at TOS EL 17'-9"	050-SS0-WH00-00101-000-00B
Wet Handling Facility Framing Plan at TOS EL 37'-9"	050-SS0-WH00-00102-000-00B
Wet Handling Facility Framing Plans at TOS EL 97'-9" & 77'-9"	050-SS0-WH00-00103-000-00B

IHF PRELIMINARY STRUCTURAL DRAWINGS	
IHF Concrete Outline Plans and Elevations	**Document ID**
Initial Handling Facility Forming Plan at TOC EL 0'-0"	51A-DB0-IH00-00101-000-00A
Initial Handling Facility Forming Plan at TOC EL 26'-9"	51A-DB0-IH00-00102-000-00A
Initial Handling Facility Forming Plan at TOC EL 37'-0"	51A-DB0-IH00-00103-000-00A
Initial Handling Facility Elevation at Col Lines 1, 2, 2.3, 2.7, 3, and 4	51A-DB0-IH00-00104-000-00A
Initial Handling Facility Elev at Col Lines 5, 6, 7 and 8	51A-DB0-IH00-00105-000-00A
Initial Handling Facility Elev at Col Lines E and F	51A-DB0-IH00-00106-000-00A
IHF Reinforcing Plans and Sections	
Initial Handling Facility Reinf Plan at TOC EL 0'-0"	51A-DG0-IH00-00101-000-00A
Initial Handling Facility Reinf Plan at TOC EL 26'-9"	51A-DG0-IH00-00102-000-00A
Initial Handling Facility Reinf Plan at TOC EL 37'-0"	51A-DG0-IH00-00103-000-00A
Initial Handling Facility Wall Reinforcing Sections	51A-DG0-IH00-00104-000-00A
IHF Structural Steel Framing Plans and Elevations	
Initial Handling Facility Framing Plan at TOS EL 28'-0 5/8" & 25'-9"	51A-SS0-IH00-00101-000-00B
Initial Handling Facility Framing Plan at TOS EL 36'-11 5/8"	51A-SS0-IH00-00102-000-00B
Initial Handling Facility Framing Plans at TOS EL 53'-4" and 43'-8"	51A-SS0-IH00-00103-000-00B
Initial Handling Facility Framing Plans at TOS EL 86'-10" and 64'-6"	51A-SS0-IH00-00104-000-00B
Initial Handling Facility Roof Framing Plans	51A-SS0-IH00-00105-000-00B
Initial Handling Facility Elev at Col Lines A and B	51A-SS0-IH00-00106-000-00B
Initial Handling Facility Elev at Col Lines C and D	51A-SS0-IH00-00107-000-00B
Initial Handling Facility Elev at Col Lines G and H	51A-SS0-IH00-00108-000-00B
Initial Handling Facility Elev at Col Lines L and M	51A-SS0-IH00-00109-000-00B
Initial Handling Facility Elev at Col Lines 4 and 5	51A-SS0-IH00-00110-000-00B
Initial Handling Facility Elev at Col Lines 6 and 7	51A-SS0-IH00-00111-000-00B
Initial Handling Facility Elev at Col Lines 8, 9 and 10	51A-SS0-IH00-00112-000-00B

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Describe the geometrical relationships between the exhaust main for emplacement drift Panel 4 and the exhaust mains for Panel 1 and Panel 3-west, sufficient to show the shape and dimensions of the rock pillar between the exhaust mains.

In SAR Section 1.3.3.1.3 and Figure 1.3.3-8, DOE indicates that emplacement drift Panels 4, 3-west, and 1 have separate but closely spaced exhaust mains. The applicant explained that separate exhaust mains are needed to allow concurrent development in Panel 4 and waste emplacement in Panel 3-west or development in Panel 4 adjacent to a waste-loaded Panel 1. DOE, however, has not described the geometrical arrangement of openings in this area in detail.

1. RESPONSE

Figure 1 presents a plan view of the Panel 3-West and Panel 4 southern areas and the Panel 1 northern area, and illustrates that the majority of the length of the subject exhaust mains are parallel and have a centerline-to-centerline spacing of about 75 ft (Figure 3). The Panel 1 and Panel 4 (southern area) exhaust main diameters are 18 ft and 25 ft, respectively, and the resulting rock pillar thickness is about 53.5 ft (75.0 ft – 9.0 ft – 12.5 ft). Similarly, as shown in Figure 1 for the adjacent areas of Panel 3-West and Panel 4, north of Panel 1, the exhaust mains are parallel for the majority of their length, and are 25 ft in diameter, which results in a rock pillar thickness of about 50 ft in this area (75.0 ft – 12.5 ft – 12.5 ft). The 75-ft centerline-to-centerline spacing for the parallel exhaust mains in Panels 1 and 3-West, and for Panels 1 and 4 meet the drift separation criterion stated in SAR Section 1.3.3.3.1.

Figure 2 is an isometric illustration that depicts the geometric arrangement of the parallel exhaust main openings (shown in red in the center of the figure) in the Panels 1, 3-West, and 4 areas. This figure also illustrates that the Panel 3-West and Panel 4 exhaust mains intersect near exhaust shaft #1.

Figure 3 illustrates the typical cross sections of the parallel exhaust mains between Panels 3-West and 4, and between Panels 1 and 4, respectively.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2007. *Underground Layout Configuration for LA*. 800-KMC-SS00-00200-000-00B. Las Vegas, Nevada: Bechtel SAIC Company.
ACC: ENG.20070727.0004; ENG.20071214.0002; ENG.20080304.0021.

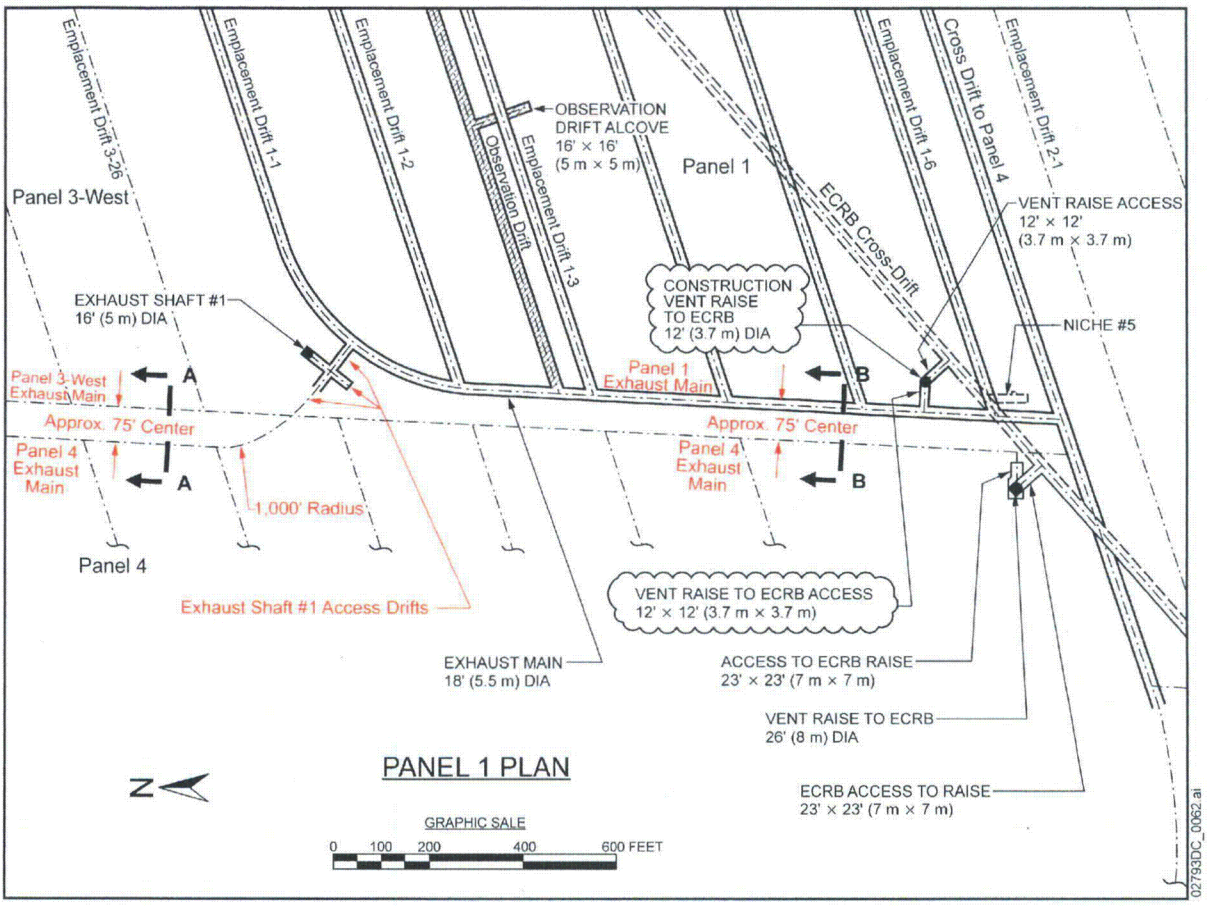

Figure 1. Plan View of the Areas of Panels 1, 3, and 4 with Parallel Exhaust Mains

NOTE: ECRB = Enhanced Characterization of the Repository Block.

Source: BSC 2007.

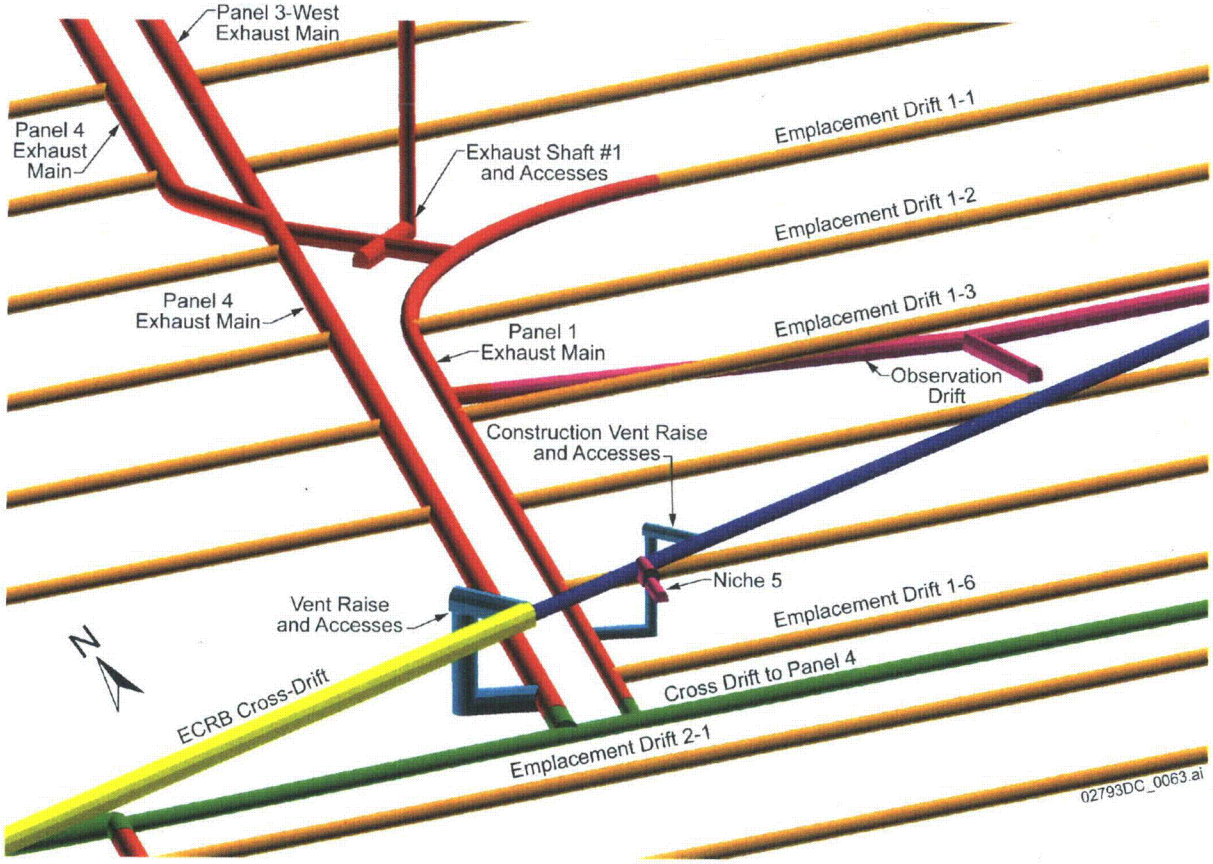

Figure 2. Isometric View of Areas in Panels 1, 3, and 4 with Parallel Exhaust Mains

NOTE: ECRB = Enhanced Characterization of the Repository Block.

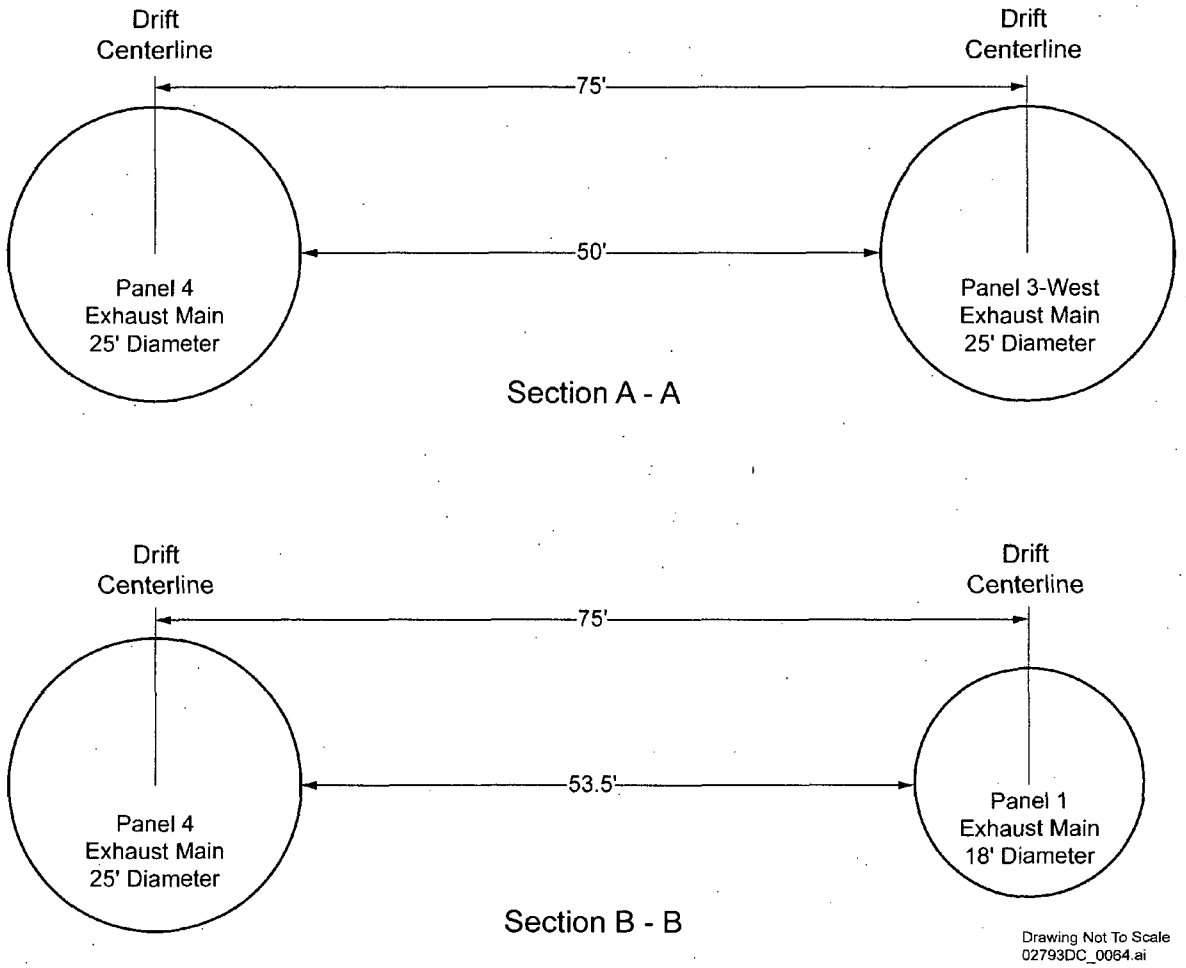

Figure 3. Typical Cross Sections for Parallel Exhaust Mains in Panels 1, 3, and 4