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YUCCA MOUNTAIN – REQUEST FOR ADDITIONAL INFORMATION – VOLUME 2, CHAPTER 2.1.1.2, SET 1 & SET 2; CHAPTER 2.1.1.5, SET 1 & SET 2; AND CHAPTER 2.1.1.6, SET 1

References:

1. Ltr, Jacobs to Williams, dtd 07/10/09, "Yucca Mountain - Request For Additional Information – Volume 2, Chapter 2.1.1.2, Set 1 (Department of Energy's Safety Analysis Report Sections 1.2.4, 1.2.5, 1.2.8, 1.3.4, 1.4.2, 1.14.2 and 1.14.3)"
2. 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)"
3. Ltr, Jacobs to Williams, dtd 07/22/09, "Yucca Mountain - Request For Additional Information – Volume 2, Chapter 2.1.1.5, Sets 1 & 2 (Department of Energy's Safety Analysis Report Section 1.8)"
4. Ltr, Jacobs to Williams, dtd 06/30/09, "Yucca Mountain - Request For Additional Information – Volume 2, Chapter 2.1.1.6, Set 1 (Department of Energy's Safety Analysis Report Sections 1.2 and 1.9)"

The purpose of this letter is to transmit eight (8) U.S. Department of Energy (DOE) responses to Requests for Additional Information (RAIs) provided by the NRC in the above-referenced letters. The following table describes which RAIs are included in this letter and the status of the other RAIs in the associated RAI sets.

RAI Set Number and Reference	RAI Set Description	Responses Included in this Letter	Status of Other RAIs in Set
VOLUME 2, CHAPTER 2.1.1.2, SET 1 (Reference 1)	Description of Structures, Systems, Components, Equipment, and Operational Process Activities	RAI No. 15	RAIs 6 and 7 were submitted on August 4, 2009. RAIs 1 - 5 and 10 were submitted on August 10, 2009. The remaining RAIs to be submitted on or before October 14, 2009.

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RAI Set Number and Reference	RAI Set Description	Responses Included in this Letter	Status of Other RAIs in Set
VOLUME 2, CHAPTER 2.1.1.2, SET 2 (Reference 2)	Description of Structures, Systems, Components, Equipment, and Operational Process Activities	RAI Nos. 1 and 7	RAIs 5-6 and 8-17 were submitted on August 13, 2009. The remaining RAIs to be submitted on or before October 28, 2009.
VOLUME 2, CHAPTER 2.1.1.5, SET 1 (Reference 3)	Consequence Analyses	RAI Nos. 5 and 7	Initial submittal for this set. The remaining RAIs to be submitted on or before November 5, 2009
VOLUME 2, CHAPTER 2.1.1.5, SET 2 (Reference 3)	Consequence Analyses	RAI No. 3	Initial submittal for this set. The remaining RAIs to be submitted on or before November 12, 2009
VOLUME 2, CHAPTER 2.1.1.6, SET 1 (Reference 4)	Identification of Structures, Systems, and Components Important to Safety, Safety Controls, and Measures to Ensure Availability of the Safety Systems	RAI Nos. 2 and 5	RAIs 1, 3, and 4 were submitted on August 3, 2009. The RAIs provided with this submittal complete the responses for this set.

Each RAI response is provided as a separate enclosure. Any DOE documents cited in the responses, which have not been previously provided to the U.S. Nuclear Regulatory Commission, will be submitted separately.

There are no commitments in the enclosed RAI responses. If you have any questions regarding this letter, please contact me at (202) 586-9620, or by email to jeff.williams@rw.doe.gov.

Steven E Gomberg (for)

Jeffrey R. Williams, Supervisor
Licensing Interactions Branch
Regulatory Affairs Division
Office of Technical Management

OTM: SEG-1011

Enclosures (8):
1. Response to RAI, Volume 2, Chapter 2.1.1.2, Set 1, Number 15
2. Response to RAI, Volume 2, Chapter 2.1.1.2, Set 2, Number 1
3. Response to RAI, Volume 2, Chapter 2.1.1.2, Set 2, Number 7
4. Response to RAI, Volume 2, Chapter 2.1.1.5, Set 1, Number 5
5. Response to RAI, Volume 2, Chapter 2.1.1.5, Set 1, Number 7
6. Response to RAI, Volume 2, Chapter 2.1.1.5, Set 2, Number 3
7. Response to RAI, Volume 2, Chapter 2.1.1.6, Set 1, Number 2
8. Response to RAI, Volume 2, Chapter 2.1.1.6, Set 1, Number 5

cc w/encl:
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<u>EIE Document Components:</u>

001_NRC_Trans_Ltr_Vol_2_Chaps_2_5_6.pdf	
002_Encl_15_2.2.1.1.2_Set_1.pdf	98 kB
003_Encl_1_7_2.2.1.1.2_Set_2.pdf	156 kB
004_Encl_5_7_2.2.1.1.5_Set_1.pdf	157 kB
005_Encl_3_2.2.1.1.5_Set_2.pdf	303 kB
006_Encl_5_2.2.1.1.6_Set_1.pdf	165 kB

RAI Volume 2, Chapter 2.1.1.2, First Set, Number 15:

> Confirm that the sensors/monitors used for temperature and humidity are Class 1E equipment as they could be used in a harsh and hostile environment.
>
> In SAR Section 1.4.2.3, DOE describes Environmental/Meteorological monitoring system. Meteorological instruments monitor wind speed, wind direction, temperature, humidity, barometric pressure, solar radiation, and precipitation. Figure 1.3.2-1 provides a functional block diagram of the system. However, it is not clear whether or not the environmental monitors/sensors used for temperature and humidity will be qualified to serve in the harsh and hostile environment conditions.

1. RESPONSE

SAR Section 1.4.2.3.1 states that the environmental/meteorological monitoring system is not important to safety (non-ITS); therefore, the environmental sensors/monitors used for temperature and humidity are not Class 1E equipment. The environmental monitors/sensors used for temperature and humidity monitoring perform no ITS functions and are not qualified by the equipment qualification program described in SAR Section 1.13 for harsh environments; however, the environmental monitors/sensors are designed to serve in their expected environmental locations.

The environmental/meteorological monitoring instruments that monitor wind speed, wind direction, temperature, humidity, barometric pressure, solar radiation, and precipitation are designed using the guidance in Regulatory Guide 1.23, Rev 1, *Meteorological Monitoring Programs for Nuclear Power Plants*, except as described in the last paragraph of SAR Section 1.4.2.3.1. Additional guidance for the environmental/meteorological monitoring system is adopted from ANSI/ANS-3.11-2005, *American National Standard for Determining Meteorological Information at Nuclear Facilities*, and *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA 2000).

SAR Figure 1.4.2-4 provides a functional block diagram of the environmental/meteorological monitoring system.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

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

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.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 1:

> Provide information on the codes and standards to be used for design of the pneumatic components of the Cask Transfer Trolley (SAR Section 1.2.2.2.1).
>
> In SAR section 1.2.2.2.1, DOE states that the cask transfer trolley is to be designed in accordance with the requirements of ASME NOG-1-2004 applicable to a Type I crane trolley, except for the unique features associated with the pneumatic components. However, DOE has not provided information on the codes or standards that will be used for design of the pneumatic components.

1. RESPONSE

The cask transfer trolley system includes various pneumatic components, consisting of valves (ball, gate, pressure relief, and throttle), air cylinders, air bearings/casters, air motors, and piping.

The design codes and standards for the valves and piping are as follows:

- ASME B16.34-2004, *Valves—Flanged, Threaded, and Welding End* (for ball, gate, and throttle valves)
- *ASME Boiler and Pressure Vessel Code*, Section VIII "Unfired Pressure Vessels" (Paragraph UG-131) (for safety relief valves)
- API Std. 526, *Flanged Steel Pressure Relief Valves*
- API Std. 527, *Seat Tightness of Pressure Relief Valves*
- ASME B31.3-2004, *Process Piping*.

Other commercial pneumatic components such as air cylinders, air motors, and air bearings/casters shall be in accordance with manufacturer's standards.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ASME (American Society of Mechanical Engineers) 2004. *2004 ASME Boiler and Pressure Vessel Code*. 2004 Edition. New York, New York: American Society of Mechanical Engineers. TIC: 256479.

ASME B16.34-2004. 2005. *Valves—Flanged, Threaded, and Welding End*. New York, New York: American Society of Mechanical Engineers. TIC: 258575.

ASME B31.3-2004. 2005. *Process Piping*. New York, New York: American Society of Mechanical Engineers. TIC: 258076.

API Std. 526. 2003. *Flanged Steel Pressure Relief Valves*. 5th Edition. Washington, D.C.: American Petroleum Institute. TIC: 254087.

API Std. 527. 2003. *Seat Tightness of Pressure Relief Valves*. 3rd Edition. Washington, D.C.: American Petroleum Institute. TIC: 254088.

RAI Volume 2, Chapter 2.1.1.2, Second Set, Number 7:

> Verify that the classification of Emergency Diesel Generator Facility (EDGF) subsystems (e.g. fuel oil storage tanks, fuel oil transfer pumps) as ITS in SAR Section 1.2.8.2 is consistent with the information shown in the Process and Instrumentation Diagrams (P&IDs). For example, the notes on the P&IDs (SAR Figure 1.2.8-17 through 1.2.8-19), appear to indicate that the entire subsystem may not be ITS.

1. RESPONSE

The important to safety (ITS) diesel generator system (SAR Figure 1.2.8-17) is comprised of the following ITS mechanical support systems. The ITS designations are provided in the SAR text and figures.

- ITS diesel generator fuel oil
- ITS diesel generator air start
- ITS diesel generator lubricating oil
- ITS diesel generator jacket water cooling
- ITS diesel generator air intake and exhaust.

As discussed in the clarification call on July 16, 2009, the ITS diesel generator and the mechanical support systems perform a safety function by providing electrical power to ITS surface nuclear confinement heating, ventilation, and air conditioning systems. The mean conditional probability for ITS electrical power failure, given the loss of offsite power, shall be less than or equal to 3×10^{-1} over a period of 720 hours following a radionuclide release, as provided in SAR Table 1.9-3. The listed conditional probability is for the diesel generator system (including the systems shown in column 3 of SAR Table 1.9-3).

The mechanical process equipment shown in SAR Figure 1.2.8-18 is ITS, including the diesel fuel oil storage tanks, diesel fuel oil transfer pumps, diesel fuel oil day tanks, and associated piping.

The notes on SAR Figures 1.2.8-18 and 1.2.8-19 mean that the instrumentation and control components and loops are specifically identified by an “ITS” marker adjacent to the component or loop on the piping and instrumentation diagram and logic diagram. The remaining instruments not marked as ITS on the same piping and instrumentation diagram or logic diagram are not relied upon to support the ITS diesel generators in the event of a loss of offsite power and are non-ITS.

SAR Figure 1.2.8-19 is an ITS diesel generator fuel oil transfer pump logic diagram. The ITS day tank low-level switch and the two ITS motor starters ensure that the ITS function of maintaining adequate fuel in the diesel fuel oil day tank is accomplished. Other components shown on the logic diagram are non-ITS.

SAR Figure 1.2.8-20 for the ITS diesel generator air start system shows an air start receiver equipped with a local non-ITS pressure indicator, a non-ITS pressure safety valve, and an ITS low-level pressure switch with a non-ITS low-level pressure alarm. The ITS function is performed by the ITS low-level pressure switch, which ensures that the air receiver tank is full and ready to provide air for the diesel generator startup when required. The local pressure indicator is correctly marked as non-ITS because it provides pressure indication for the air start receiver for maintenance and inspections.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

RAI Volume 2, Chapter 2.1.1.5, First Set, Number 5:

> In BSC (2008bo, Figure F-30), DOE has considered a potential of lifting a fuel assembly too high during pool transfer operations leading to direct exposure of individual radiation workers and thus indicating that workers will be present in the pool room during transfer operations. For this event sequence, provide the following Information:
>
> - Radionuclide releases into the pool from fuel assemblies during normal operations
> - Airborne source term above the pool for these underwater releases
> - Indoor radionuclide concentrations in air above the pool during normal operations
> - Worker access to the pool room during normal operations
> - Indoor worker exposure to airborne radionuclides in the pool room.

1. RESPONSE

During the NRC clarification call on July 21, 2009, the DOE explained that the response to this RAI would be limited to a discussion of the event sequence probability and consequences only. The NRC staff indicated that the DOE understood the request.

In Figure F-30 of *Wet Handling Facility Event Sequence Development Analysis* (BSC 2009a), WHF-1807 (i.e., a fuel assembly lifted too high during pool transfer operations) was identified as an initiating event for exposure of individual radiation workers to direct radiation. As described in *Wet Handling Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009b, Section A4.30.2), the maximum possible lift height of a spent fuel assembly due to lifting design height is approximately 10 ft below the surface of the pool water, which provides sufficient shielding to ensure that the dose rate above the pool is less than 0.25 mrem/hr. This event sequence does not result in any additional gaseous, particulate, or crud (radionuclide) release into the pool because there are no drops or impacts. During this Category 2 event sequence there is neither an airborne radionuclide release nor an increased airborne radionuclide source term above the pool.

The event sequence quantification results for event tree WHF-ESD30-FUEL are summarized in Table G-1 (BSC 2009b), which shows that the event resulting in lifting a spent fuel assembly too high in the pool is a Category 2 event sequence with a mean probability of approximately 5×10^{-2} over the preclosure period and, therefore, worker dose was not calculated.

During normal operations, workers will have access to the pool room. To protect workers against direct radiation resulting from lifting a spent fuel assembly too high, the spent fuel handling

machine is designed such that the maximum lift height is approximately 10 ft below the surface of the water, providing sufficient shielding for workers.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2009a. *Wet Handling Facility Event Sequence Development Analysis*. 050-PSA-WH00-00100-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20090112.0005.

BSC 2009b. *Wet Handling Facility Reliability and Event Sequence Categorization Analysis*. 050-PSA-WH00-00200-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20090112.0006.

RAI Volume 2, Chapter 2.1.1.5, First Set, Number 7

> Describe the effect of the assumption of a single canister in a transportation cask on dose estimates for radiation workers. In radiation shielding calculations, the applicant assumed that each transportation cask received in the Receipt Facility and Canister Receipt and Closure Facility will contain one canister of any type (BSC 2007, Section 3.1.7). SAR Table 1.7-5 indicates that transportation casks will contain more than one canister. For example, 5 to 9 DOE standardized canisters or 5 canisters of DOE high-level waste could be received in a single transportation cask at the CRCF.

1. RESPONSE

The assumption that the transportation casks received in the Receipt Facility (RF) and in a Canister Receipt and Closure Facility (CRCF) will contain only one canister of any type (BSC 2008, Section 3.1.7) does not affect the dose estimates for radiation workers in either the RF or a CRCF.

Casks containing more than one canister are not processed in the RF, as the facility will receive and process only transportation casks containing a single transportation, aging, and disposal (TAD) canister or a single dual-purpose canister (DPC). Therefore, the assumption does not affect RF worker doses as it is consistent with the waste form being received.

The assumption is used in CRCF worker dose estimates for those areas where a transportation cask or its canister is handled. The worker dose estimates are based on dose rate estimates, time and motion studies, and annual throughputs that are unaffected by the one canister assumption. A CRCF may receive transportation casks with waste forms that could contain multiple individual canisters such as DOE high-level radioactive waste (HLW) or DOE spent nuclear fuel (SNF) canisters. The stated assumption is used as a modeling simplification for estimating shielding requirements in the CRCF rooms: transportation cask vestibule (Room 1036), cask preparation room (Room 1026), and cask unloading rooms (Rooms 1023 and 1024) (SAR Figures 1.2.4-2 and 1.2.4-3). Dose rates used in CRCF radiation worker dose estimates are determined (1) for manual operations involving transportation cask processing, and (2) for remote operations performed behind shield barriers. Consequently, all manual operations wherein personnel are in proximity involve only loaded transportation casks meeting the 10 CFR Part 71 requirements. 10 CFR Part 71 requires that all transportation casks comply with dose rates of 200 mrem/hr at the accessible surface and 10 mrem/hr at a 2 m distance. These limits are independent of the number of canisters inside a particular transportation cask. The dose rates used for manual operations around a transportation cask are based on those limits as modeled by a representative transportation cask based on a FuelSolutions™ TS125 cask with a homogenized commercial SNF source.

Any operations involving handling of multiple canisters possibly contained within a transportation cask occur remotely in unoccupied, shielded rooms. The dose rates for remote operations performed behind shield barriers are not affected by the transportation cask assumption because the dose rates are limited by design requirements in occupied areas. The

shielding requirements for the bounding source terms are evaluated in *Shielding Calculation for Canister Receipt and Closure Facility 1 and Receipt Facility* (BSC 2008), Section 6.1.2). As stated in SAR Section 1.10.3.3, shielding source terms for design are based on bounding source terms handled in each area and these bounding source terms are used in the shielding calculations (e.g., BSC 2008). Individual waste form canisters are handled inside shielded rooms within a CRCF. These rooms are shielded based on the bounding shielding source terms to meet the external radiation zone dose rate design requirements as shown in SAR Tables 1.10-37 through 1.10-40. In the case of Room 2004 (canister transfer room) of a CRCF, the port slide gate shielding is, in part, determined by a 5-DHLW/DOE SNF waste package; however no personnel are located in Room 2004 during operations. Personnel who perform remote operations handling single or multiple canisters in a transportation cask are located in continuously accessible areas of low radiation levels that are shielded from major radiation sources.

The duration of worker exposure is based on time and motion studies of the individual steps to process waste forms received in transportation casks until eventually loaded into a transport and emplacement vehicle for emplacement. Those durations are independent of the assumption of the number of canisters inside a particular transportation cask. Because the worker dose estimates are determined per transportation cask processed by each work crew, only the number of casks processed annually affects that estimate. The CRCF transportation cask annual throughput accounts for the total numbers of TAD, DPC, DOE SNF, or DOE HLW canisters within each transportation cask processed. TAD canister and DPC throughput estimates use one canister per transportation cask. DOE HLW and DOE SNF canister throughput for dose calculations are based on five DOE HLW canisters and nine DOE SNF canisters per transportation cask.

In summary, the stated assumption is a modeling simplification for estimating shielding requirements and does not affect the dose estimates for radiation workers in either the RF or a CRCF. Dose estimates account for the total number of canisters that pass through each facility.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2008. *Shielding Calculation for Canister Receipt and Closure Facility 1 and Receipt Facility*. 100-00C-WHS0-00600-000-00C CACN 001. Las Vegas, Nevada: Bechtel SAIC Company. ACC ENG: 20080515.003; ENG.20080911.0014.

RAI Volume 2, Chapter 2.1.1.5, Second Set, Number 3:

> Provide information on the minimum distances from the surface waste handling facilities to the restricted area of the GROA used for developing χ/Q values in SAR Table 1.8-12 for the offsite public not within the general environment. Also, verify the values of minimum distances listed in SAR Table 1.8-10. For example, the distance used to calculate the χ/Q value for the SSE direction (from NNW) is listed as 18,500 meters in Table 18 of BSC (2007bp). However, in SAR Table 1.8-10, the same distance is listed as 10,200 meters.

1. RESPONSE

The minimum distances from the surface waste handling facilities to the restricted area of the geologic repository operations area (GROA), which is the site boundary used for developing the χ/Q values in SAR Table 1.8-12, are shown in SAR Table 1.8-10. These distances are taken from *General Public Atmospheric Dispersion Factors* (BSC 2007, Tables 9 and 15). The SAR Table 1.8-10 footnote indicates that sectors SSE (wind from NNW) clockwise to NW (wind from SE) intersect with the general environment, and the remaining sectors intersect with areas not within the general environment. SAR Figure 1.8-2 shows that members of the public in the general environment are located to the west or south of the repository and members of the public not in the general environment are located to the east or north of the repository. The minimum distances from the surface waste handling facilities to the offsite public not in the general environment, used for developing the χ/Q values, are shown in Table 1. Table 1 was prepared using the data from SAR Table 1.8-10 only for those sectors that intersect with areas not within the general environment.

For each of the 16 sectors in SAR Table 1.8-10, the minimum distance is the nearest point on the site boundary within a 45-degree sector centered on the direction of interest (BSC 2007, Section 6.3.2.2). Figure 1 shows the wind (from) direction sectors from the surface geologic repository operations area to the site boundary. For the 45-degree sector centered on the SSE direction (wind from NNW) (Figure 1), the lower sector boundary line (at an angle of 22.5 degrees clockwise from the SSE sector center line) intersects the south site boundary at a point within the general environment. The distance from the surface waste handling facilities within the GROA to this point of intersection on the south site boundary is 18,572 (rounded to 18,500) meters. The upper sector boundary line (at an angle of 22.5 degrees counter-clockwise from the SSE sector centerline) intersects the east site boundary at a point not within the general environment. The distance from the GROA boundary to this point of intersection on the east site boundary is 10,208 (rounded to 10,200) meters. The distance of 18,500 meters, used to calculate the χ/Q value for a dose receptor in the general environment (BSC 2007, Table 18), is not listed in SAR Table 1.8-10 for meteorological sector SSE. Only the minimum of the two distances for this sector (i.e., 10,200 meters) is provided in SAR Table 1.8-10. Offsite public doses in the general environment in this sector are calculated using 18,500 meters, and offsite public doses to members of the public not in the general environment in this sector are calculated using 10,200 meters.

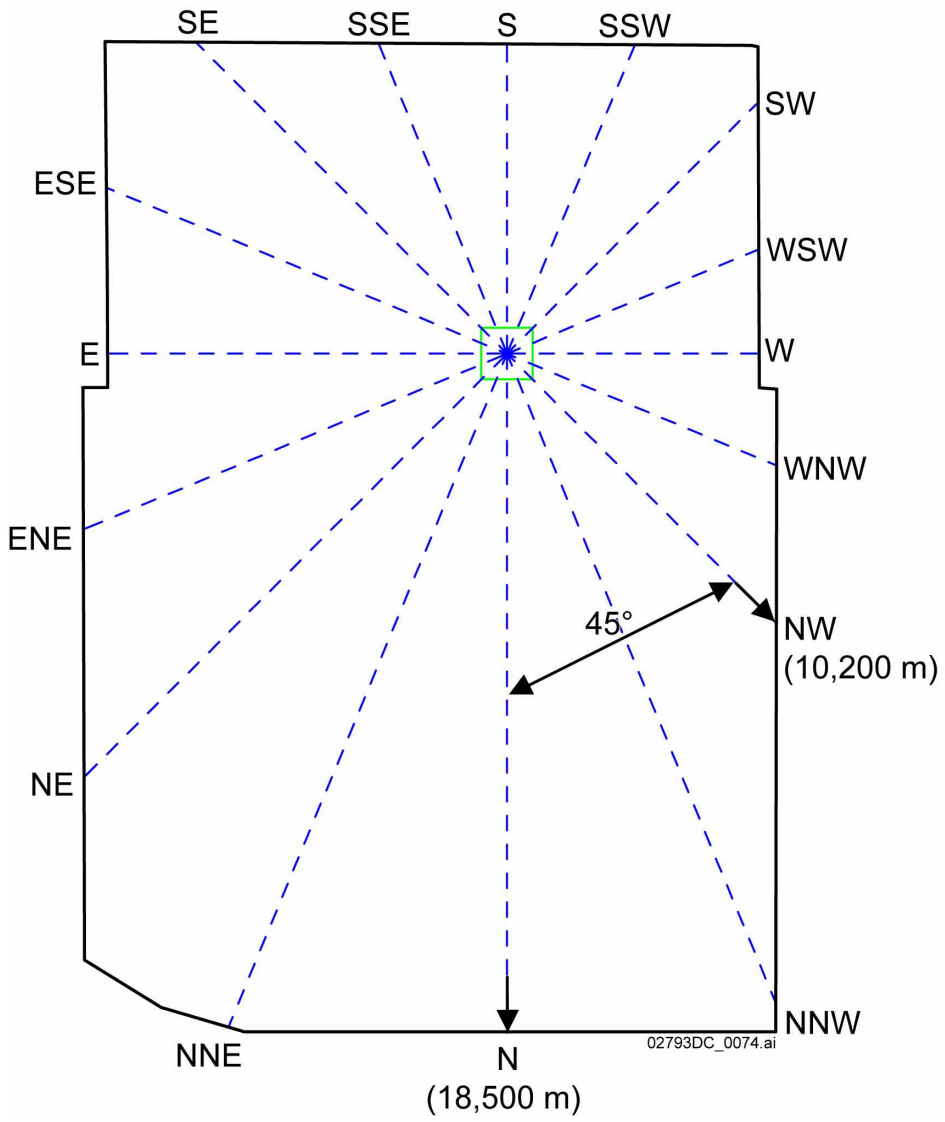

Figure 1. Minimum Distances from the Surface Waste Handling Facilities to Site Boundary

Table 1. Minimum Distances from the Surface Waste Handling Facilities to Each Sector Impacting the Offsite Public Not in the General Environment

Sector	Wind From	Distance (m)
NW	SE	9,100
NNW	SSE	8,400
N	S	8,400
NNE	SSW	8,400
NE	SW	7,200
ENE	WSW	6,700
E	W	6,700
ESE	WNW	6,700
SE	NW	7,800
SSE	NNW	10,200

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2007. *General Public Atmospheric Dispersion Factors*. 000-00C-MGR0-02800-000-00B CACN 001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070813.0003; ENG.20080303.0002.

RAI Volume 2, Chapter 2.1.1.6, First Set, Number 2:

Explain how DOE applied the criteria identified on SAR pages 1.9-6 and 1.9-7 to designate components within an ITS system or subsystem ITS or non-ITS. Some examples needing clarification follow:

- DOE identifies differential pressure switch, "PDS 0148 A" as ITS in SAR Figure 1.2.4-101 on page 1.2.4-317 and describes on SAR page 1.2.4-60 that the heating, ventilation, and air-conditioning (HVAC) exhaust system transfers to the standby fan automatically on detection of high or low differential pressure across the HEPA filter plenums. Explain how DOE accounts for this differential pressure switch when calculating the mean probability that the HVAC system becomes unavailable (SAR Table 1.9-3 on page 1.9-68).

- DOE describes on page E-117 of BSC, 2008ac that, "The ASD (*Adjustable Speed Drive*) is equipped with a semi-automated system for lifts." DOE continues on page E-117 of BSC, 2008ac by describing that, "In the canister lift mode, the operator sets the mode and pushes/holds the lift button; the ASD lifts to the proper height and stops." DOE shows in SAR Figure 1.2.4-51 (Sheet 2 of 3) on page 1.2.4-213 that the ASD is ITS and it receives a signal from the canister hoist position encoder. Explain if the encoder is ITS and explain if there is other equipment involved with lifting to the proper height and stopping that is also ITS but is not shown on the diagram.

1. RESPONSE

1.1 CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS

The process for classifying structures, systems, and components (SSCs) as important to safety (ITS) or non-ITS is summarized in SAR Sections 1.6.1, 1.6.2, and 1.9. SAR Table 1.9-1 presents the SSCs that have been classified as ITS in the preclosure safety analysis based on the criteria on SAR pages 1.9-6 and 1.9-7. This classification is based on the specific safety functions performed by the SSCs that are relied upon to preclude (i.e., reduce the probability of) the occurrence of an event sequence or mitigate the consequences of an event sequence, as demonstrated in the event sequence analyses. The safety functions relied upon by the ITS SSCs are presented in SAR Tables 1.9-2 through 1.9-7, along with their controlling parameters and values. The tables in SAR Section 1.9 list ITS SSCs at a high level of assembly; these SSCs are usually composed of many components. ITS components are not specifically designated as ITS in the fault trees. Instead, they are designated as ITS in the drawings, tables, and text of SAR Sections 1.2 through 1.5. The fault trees (or other sources) that form the basis for the controlling parameters and values are referenced in the column labeled "source" in Table 6.9-1 of each of the six facility reliability and event sequence categorization analyses. Only those components and supporting SSCs necessary to fulfill the safety function are classified as ITS.

For example, the canister transfer machine (CTM) is classified as ITS based on the analysis of this SSC. The safety functions designated in SAR Table 1.9-3 include, but are not limited to, protect against drop, protect against drop of a load onto a canister, and protect against spurious movement. The source analyses for these safety functions are fault tree models CTM-DROP---ALL-HEIGHTS, CTM-DROP-ONTO-CASK, and CTM-SHEAR, respectively, as indicated in Table 6.9-1 of *Canister Receipt and Closure Facility Reliability and Event Sequence Development Analysis* (BSC 2009a). These fault trees include those components that are relied upon to reduce the probability of drops, such as hard-wired interlocks and adjustable speed drives. Because these components are relied upon to reduce the frequency of an event sequence, they are classified as ITS in accordance with the criteria presented on page 1.9-6. The model also includes non-ITS programmable logic controllers because their spurious operation can result in inadvertent CTM movements. Because the correct operation of the programmable logic controllers is not relied on in the fault tree model to prevent an event sequence or mitigate the consequences of an event sequence, they are classified as non-ITS. The CTM components classified as ITS are annotated as such on the process and instrumentation diagram for this SSC, as shown in SAR Figure 1.2.4-51.

1.2 DIFFERENTIAL PRESSURE SWITCH AND HVAC SYSTEM UNAVAILABILITY

The Canister Receipt and Closure Facility (CRCF) heating, ventilation, and air-conditioning (HVAC) system fault trees are provided in Appendix B of *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009a). A transcription error has resulted in Figure B7.4-3 presenting an incorrect image. The fault tree for the ITS confinement HVAC system, titled "Delta Pressure Not Maintained in CRCF Facility," is correctly presented in Figure B7.4-3 of the *Wet Handling Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009b). The remainder of the figures identified in this response can be correctly obtained from *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis* (BSC 2009a). The gate to the right in this fault tree ("Loss of HEPA filtered exhaust from operating and standby trains" (gate HVC002)) is the gate of interest to determine the effect of the loss of differential pressure switch PDS 0148 A.

As seen in Figure B7.4-5, a loss of high-efficiency particulate air (HEPA) filtered exhaust occurs if there is a loss of flow from both the operating train (Train A), as shown under gate HVCA001, and the standby train (Train B), as shown under gate HVAC005. Following gate HVAC005 to Figure B7.4-6, one of the causes of the loss of HEPA-filtered flow from the standby train (Train B) is the failure of the standby train (Train B) to start. One of the causes of this failure is a mechanical or electrical failure (gate HVAC15). As seen in Figure B7.4-8, the causes of failure of Train B to start due to mechanical or electrical failures can be the Train B exhaust fan failing to start or the Train B exhaust fan controls failing to provide a start signal (gate HVC047). One of the three potential causes of failure of gate HVC047 is the basic event 050-VCT0-FANBASD-CTL-FOD, titled "Train B ASD start logic signal fails." This basic event encompasses the failure of differential pressure switch PDS 0148 A. Failure of the start logic signal to the Train B adjustable speed drive has a probability of 2×10^{-3} to one significant digit.

The contribution of basic event 050-VCT0-FANBASD-CTL-FOD to the "HEPA Filtered Flow Not Maintained" fault tree is found in Table B7.4-3 in Appendix B of *Canister Receipt and*

Closure Facility Reliability and Event Sequence Categorization Analysis (BSC 2009a). The basic event "Train B ASD start logic signal fails" (event 050-VCTO-FANBASD-CTL-FOD) is coupled in a cutset with the basic event titled "Exhaust fan in Train A fails" (event number 060-VCTO-FAN00A-FAN-FTR). This cutset has a probability of 1×10^{-4} (to one significant digit); the contribution of this cutset to the overall fault tree probability is 0.26%. The probability of this cutset is small because of the decision to rely on the adjustable speed drive (shown in SAR Figure 1.2.4-101) to reduce its probability.

1.3 CANISTER TRANSFER MACHINE LIFT ADJUSTABLE SPEED DRIVE AND CANISTER HOIST POSITION ENCODER

The logic for the CTM canister hoist is presented in SAR Figure 1.2.4-55. When a control signal is made to raise or lower the hoist, the adjustable speed drive "hoist raise command" or "hoist lower command" will be activated, provided that all the system interlocks for that command are in a permissive state (a permissive is a condition that must be met before a piece of equipment can be operated or a sequence step can be performed). When either the "hoist raise command" or "hoist lower command" is activated, the "hoist stop command" is deactivated, which in turn activates the "energize coil to release the holding brake" command to disengage the hoist holding brake. In the absence of any command to raise or lower the hoist, the adjustable speed drive "hoist stop command" remains active, which in turn keeps the holding brake solenoid in a de-energized state to keep the holding brake engaged. An optical sensor above the slide gate will cause the adjustable speed drive to issue a "hoist stop command." Failing that, ITS interlocks (or limit switches) for high and high-high lift levels will shut off power to the hoist and cause the brakes to engage.

The canister hoist position encoder is a direct input to the adjustable speed drive; it will stop the adjustable speed drive at a designated automatic speed drive stop point. This stop point is lower than that of the first upper travel limit switch. Therefore, if the encoder fails, the first upper travel limit switch will stop hoist movement. Failure of the adjustable speed drive is a basic event in the CTM drop fault trees found in Figures B4.4-7 and B4.4-18 in BSC 2009a. An adjustable speed drive has at least a factor of 10 higher probability of failure than an encoder (Table C4-1 of BSC 2009a) and failure would cause the encoder signal to be ignored. The encoder is not modeled in these fault trees and is classified as non-ITS because its success or failure is insignificant to the initiating event probability.

SAR Figure 1.2.4-51 (Sheet 2 of 3) on page 1.2.4-215 is a process and instrumentation diagram for the CTM; the set of 3 diagrams depicts the major pieces of equipment involved with CTM operations. This equipment includes both ITS and non-ITS components and subcomponents. Although the non-ITS canister hoist position encoder is not shown on Sheet 2, it is shown on Sheet 3 (SAR Figure 1.2.4-51 (Sheet 3 of 3) on page 1.2.4-217). The CTM components that are relied upon to preclude (reduce the probability of) the occurrence of an event sequence or mitigate the consequences of an event sequence are annotated as ITS on these figures. These components include adjustable speed drives, interlocks, sensors, and switches. There are no other CTM components associated with lifting a canister to the proper height and stopping the hoist that have been classified as ITS and are not shown on these diagrams.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2009a. *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis*. 060-PSA-CR00-00200-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20090112.0004.

BSC 2009b. *Wet Handling Facility Reliability and Event Sequence Categorization Analysis*. 050-PSA-WH00-00200-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20090112.0006.

RAI Volume 2, Chapter 2.1.1.6, First Set, Number 5:

> Explain how DOE quantified event sequences involving filtered and unfiltered radionuclide release in the Receipt Facility (RF). DOE identifies that the HVAC system in the RF is non-ITS (SAR page 1.2.6-17); however, DOE identifies event sequences involving filtered radionuclide release (e.g., ESD06-TAD-SEQ3-RRF in SAR Table 1.7-9 on page 1.7-78).

1. RESPONSE

As described in SAR Sections 1.6 and 1.7, event sequence analysis includes the identification and quantification of initiating events, pivotal events, and end states. Each event sequence, therefore, is associated with an end state even for event sequences that do not rely on all of the events to achieve a probability that is beyond Category 2. The event sequences for the Receipt Facility (RF) that involve radionuclide release (e.g., ESD06-TAD-SEQ3-RRF) have a probability that allows for categorization of these event sequences as beyond Category 2 without reliance on the confinement heating, ventilation, and air-conditioning (HVAC) system for filtration. The confinement HVAC system, therefore, is not classified as important to safety for the RF. However, the event sequences still display a filtered and unfiltered release depending on whether or not the confinement HVAC system fails.

As described in Section 4.3.2.1 of *Receipt Facility Event Sequence Development Analysis* (BSC 2008), event sequence diagrams depict the logical progression of event sequences from the initiating event up to, and including, an end state. Eight mutually exclusive end states are considered in the event sequence diagrams, two of which are radionuclide release–filtered and radionuclide release–unfiltered. The "CONFINEMENT" pivotal event in the RF event trees (provided in Attachment G of *Receipt Facility Event Sequence Development Analysis* (BSC 2008)) models the success or failure of the HVAC system to maintain confinement and perform filtering of the radionuclide release.

Event sequence ESD06-TAD-SEQ3-RRF has the highest probability, 4×10^{-5} over the preclosure period, of all event sequences involving a release of radioactive material (BSC 2009, Table G-2). This event sequence is associated with successful confinement HVAC system operation; the end state for this event sequence is radionuclide release–filtered. The event sequence ESD06-TAD-SEQ5-RRU includes failure of the confinement HVAC system and a radionuclide release–unfiltered end state. This event sequence has a probability of 1×10^{-6} over the preclosure period. If no credit is taken for the performance of the HVAC system (the probability of failure of the HVAC system is hypothetically assigned a value of unity), then the event sequence probability would be that of ESD06-TAD-SEQ3-RRF. Because ESD06-TAD-SEQ5-RRU has a probability that would be categorized as "Beyond Category 2" without relying on the confinement HVAC system, the confinement HVAC system in the RF is not classified as important to safety.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2008. *Receipt Facility Event Sequence Development Analysis*. 200-PSA-RF00-00100-000-00A CACN 002. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080211.0006; ENG.20080314.0004; ENG.20080828.0011.

BSC 2009. *Receipt Facility Reliability and Event Sequence Categorization Analysis*. 200-PSA-RF00-00200-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20090112.0010.