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ATTN: Document Control Desk
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YUCCA MOUNTAIN - REQUEST FOR ADDITIONAL INFORMATION (RAI) –VOLUME 2, CHAPTER 2.1.1.7, SET 8 (DEPARTMENT OF ENERGY'S SAFETY ANALYSIS REPORT SECTIONS 1.2.8, 1.3.3, and 1.4.3) – GROA Transportation

Reference: Ltr, Jacobs to Williams, dtd 5/13/09, "Yucca Mountain - Request for Additional Information – Volume 2, Chapter 2.1.1.7, Set 8 and Set 9 (Department of Energy's Safety Analysis Report Sections 1.2.8, 1.3.3, and 1.4.3)"

The purpose of this letter is to transmit the U.S. Department of Energy's (DOE) responses to ten RAI's to Set 8 identified in the above referenced letter regarding DOE's LA Sections 1.2.8, 1.3.3, and 1.4.3. Each RAI response is provided as a separate enclosure. In addition, five references that have not been previously submitted are enclosed. Enclosure 11, *Mechanical Handling Design Report: Waste Package Transport And Emplacement Vehicle*, contains information that DOE has determined to be Official Use Only (OUO) information. Such information is exempt from public disclosure under the Freedom of Information Act and 10 CFR 2.390 and is appropriately marked. Enclosures 12 through 15 are being provided on Optical Storage Media (OSM). Enclosure 15, *Transport and Emplacement Vehicle Envelope Calculation*, contains an electronic attachment, which is also included on the OSM.

There are no commitments made 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.

Jeffrey R. Williams, Supervisor
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Office of Technical Management

OTM:SEG-0796

NMSS25

Enclosures (15):
(1 through 10) Responses to Ten Requests for Additional Information
Volume 2, Chapter 2.1.1.7, Set 8, Numbers 1 through 10

(11) BSC (Bechtel SAIC Company) 2008. *Mechanical Handling Design Report: Waste Package Transport and Emplacement Vehicle*. 000-30R-HE00-00200-000 REV 003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080725.0012. (Official Use Only) (Provided in hard copy.)

(12) BSC 2008. *Waste Package Transport and Emplacement Vehicle ITS Standards Identification Study*. 800-30R-HE00-01200-000 REV 002. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080306.0003. (Provided on OSM.)

(13) BSC 2008. *Waste Package Transport and Emplacement Vehicle Gap Analysis Study*. 800-30R-HE00-01300-000 REV 004. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080306.0006. (Provided on OSM.)

(14) BSC 2008. *Waste Package Transport and Emplacement Vehicle Design Development Plan*. 800-30R-HE00-01600-000 REV 003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080306.0008. (Provided on OSM.)

(15) BSC (Bechtel SAIC Company) 2008. *Transport and Emplacement Vehicle Envelope Calculation*. 800-MQC-HE00-00100-000-00C. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20081110.0002. (And Attachment) (Provided on OSM.)

cc w/encls 1-10:
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Susan Durbin, California Attorney General's Office, Sacramento, CA
Charles Fitzpatrick, Egan, Fitzpatrick, Malsch, PLLC

EIE Document Components Provided on OSM:

Enclosure	File Name	File Size
12	Folder 01_800-30R-HE00-01200-000-REV 002 800_30R_HE00_01200_000_REV_002.pdf	1,510 kB
13	Folder 02_800-30R-HE00-01300-000-REV 004 800_30R_HE00_01300_000_REV_004.pdf	1,322 kB
14	Folder 03_800-30R-HE00-01600-000-REV 003 800_30R_HE00_01600_000_REV_003.pdf	1,044 kB
15	Folder 04_800-MQC-HE00-00100-000-00C 800_MQC_HE00_00100_000_00C.pdf TEV MEE Calculation.xmcd	10,901 kB 1,803 kB

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 1:

Provide the analyses that support the statement on page 1.3.3-31 of the SAR implying that the rotational drag of the high-gear-ratio gear units provides sufficient braking action to stop the Transport and Emplacement Vehicle (TEV). The applicant references "Mechanical Handling Design Report: Waste Package Transport and Emplacement Vehicle", cited in SAR Section 1.3.3.5.1.1, but this information was not provided. This information is needed for staff to verify compliance with 10 CFR 63.112(e).

1. RESPONSE

Transport and emplacement vehicle (TEV) braking processes and the use of high-ratio gearboxes are described in SAR Section 1.3.3.5 and in *Mechanical Handling Design Report: Waste Package Transport and Emplacement Vehicle* (BSC 2008), which is provided with this response. This document addresses performance and safety requirements and describes the design configuration for the TEV brake, drive motor, and gearbox systems. The rotational drag of the high-ratio gearbox units is expected to provide a means of braking for the TEV that will be supplemented by the brake system to slow and stop the TEV.

1.1 DRIVE SYSTEM MOTOR AND GEARBOX

The selection of drive motors and speed reduction gearboxes for the TEV is based on an operational performance requirement that the TEV be propelled at a maximum speed of 150 ft/min (1.7 mph). The main drive of the TEV will consist of eight motors and gearboxes. The performance parameters and operational characteristics for each motor and gearbox configuration include the following: 480 VAC-powered, 20 hp motor that includes an integral disc brake, a maximum output speed of 1,750 revolutions per minute, and is coupled to a dedicated gearbox that has an output speed of 17 revolutions per minute with a gearbox ratio of 100.75:1, and a maximum torque of 72,200 lb-in.

1.2 GEARBOX PERFORMANCE AS A FACTOR IN TEV BRAKING

The maximum speed of the TEV, with the motors fully powered during descent of the 2.15% grade (1.23 degree) slope of the North Ramp, which is the steepest grade that will be traveled by the TEV, is 150 ft/min (1.7 mph). When power is removed from the motors, the high gear ratio gearbox integrated into the TEV drive system applies reverse torque (or braking) to the load to facilitate deceleration of the TEV. In addition, inherent drive system inefficiencies (frictional losses) aid the deceleration processes. Different gearbox types have different degrees of efficiency that are dependent on factors such as gear ratio, gear geometry, rotational speed, and the properties of the gear lubricant. The higher end of efficiencies is obtained from helical bevel geared gearboxes which can attain 98% to 99% efficiency whereas worm geared units can have efficiencies lower than 50%.

The use of drive systems incorporating high gear ratio gearboxes as a means of crane braking (in place of conventional friction brakes) is a standard practice within the crane industry. Crane

Manufacturer's Association of America, Inc. code CMAA 70 refers to such drive system configurations as non-coasting drives and, are defined as:

> A drive with coasting characteristics such that it will stop the motion within a distance in feet equal to 10 percent of the rated speed in feet per minute when traveling at rated speed with rated load.

For example, for a maximum speed of 150 ft/min the stopping distance should be less than or equal to 15 ft.

Drive motor and high-ratio gearbox components that provide non-coasting drive characteristics, and satisfy drive system requirements of the TEV, are currently available through commercial vendors. Although typical application of such drive systems does not include operations on sloped rail, wide industrial usage of these drive systems confirms that drive motor and gearbox configurations have inherent braking capabilities that are applicable to the TEV operations. In addition, the integral disc brakes in the drive motors will supplement the braking capabilities of the drive system, if required, to slow and stop the TEV.

It should be noted that the *Mechanical Handling Design Report: Waste Package Transport and Emplacement Vehicle* (BSC 2008) describes a certain gearbox design and type. It is acknowledged that this gearbox type will be evaluated as part of the development process and specific design attributes may change in order to satisfy the performance requirements of the gearbox and drive train of the TEV as design progresses.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2008. *Mechanical Handling Design Report: Waste Package Transport and Emplacement Vehicle.* 000-30R-HE00-00200-000 REV 003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080725.0012.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 2:

Explain how the design of the primary braking system will account for the downhill grade towards the emplacement drifts. It is not clear whether or not the drive system utilizes E-braking to slow down the TEV. If regenerative braking is used, provide information on the mechanism to capture the electrical power regenerated. If regenerative braking is not used, provide information on the duty cycle of the friction brakes during the 2.15% downhill and the resultant heat generation and dissipation mechanism that will ensure friction brake cooling and functionality (SAR Section 1.3.3.5.1.1).

There are potential for loss of braking force in the case of friction brakes or fire of the resistive bank in the e-braking case that must be examined. This information is needed to verify compliance with 10 CFR 63.112(e).

1. RESPONSE

SAR Section 1.3.3.5.1.1 states that the transport and emplacement vehicle (TEV) drive system will utilize high torque motors and high ratio gearboxes to mechanically limit the TEV speed to a maximum of 150 ft/min (1.7 mph) when operating at full motor power and descending the 2.15% grade slope of the North Ramp, which is the steepest grade that will be traveled by the TEV. Under normal operations, the drive system design (drive motor and gearbox configuration) of the TEV will not allow it to exceed the specified maximum allowable speed including during descent of the North Ramp. It is not anticipated that braking will be required during the descent. If slowing of the TEV is required, power would be reduced to the motors to achieve and maintain a lower speed. More information regarding the TEV drive system and braking process is presented in the response to RAI 2.2.1.1.7-8-001.

The TEV incorporates two braking features: (1) friction disc brakes that are integral to the TEV drive motors (as described in the SAR Section 1.3.3.5.1.1); and (2) rail brakes (as described in SAR Section 1.3.3.5.1.1). The TEV design neither incorporates nor relies on the effects of dynamic braking, either regenerative or rheostatic.

The friction disc brakes (integral to each of the drive motor shafts) can be applied upon operator command, and are automatically applied upon loss of power to the motors. However, during descent of the 2.15% graded North Ramp, application of the integral disc brakes is not expected to be required since the TEV will not be capable of exceeding its maximum allowable speed. If slowing of the TEV is required during descent of the North Ramp, power could be reduced to the drive motors, and, if needed, the integral disc brakes would be applied, to achieve a lower speed.

With respect to heat generation (and the subsequent dissipation of the generated heat) and wear of the integral disc brakes during the descent of the North Ramp, it is not anticipated that application of the integral disc brakes will be required. However, drive motors selected will incorporate features to dissipate the heat generated during application of the integral disc brakes either by natural conduction, convection, and radiation heat transfer processes, or by forced cooling (taking into account predicted TEV speed prior to braking and braking duration) consistent with ASME NOG-1-2004, Section 6420. Similarly, assessing the degree of brake wear will be addressed based on the same operational scenarios. The drive motor integral disc brake duty cycle has not been fully developed, however the anticipated usage of these brakes will include slowing down and stopping at the following locations: the surface nuclear facilities loadout rooms, the checkpoint at the North Portal, the emplacement drift turnout, and in the emplacement drifts. Ultimately, the braking duty cycle and maintenance of the integral disc brakes (including inspection and replacement frequency) will be determined during the detailed design phase of the project and confirmed during the start-up and operational phases.

The rail brakes are only applied (directly to the rail) upon loss of power and when the TEV is stationary (to act as holding brakes). During normal operations, the rail brakes are not used for stopping or slowing the TEV during transfer of the waste package from the surface facilities to an emplacement drift. Testing of the rail brakes, drive motor integral disc brakes, and drive system configuration will be performed at the North Portal Access Control Point prior to entry into the subsurface areas in order to confirm that the TEV drive and braking systems have the capability to slow and stop the TEV.

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.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 3:

Clarify whether or not the design of the TEV will meet all sections of the ASME-NOG-1-2004, except for Section 4160-1 mentioned in the SAR Section 1.3.3.5.1. If not all Sections will be applied, provide clarification on which sections will not be used and the rationale for the exclusion. In addition, provide the following documentation referenced in SAR Section 1.3.3.5.1.1: "Waste Package Transport and Emplacement Vehicle ITS Standards Identification Study" and "Waste Package Transport and Emplacement Vehicle Gap Analysis Study." This information is needed to verify compliance with 10 CFR 63.21(c)(3), and 10 CFR 63.112(f).

1. RESPONSE

The *Waste Package Transport and Emplacement Vehicle ITS Standards Identification Study* (BSC 2008a), which is provided with this response, identifies those codes and standards which the project will apply to the design of the TEV components and subcomponents that are classified as ITS. To support the design development process, the results of the ITS standards identification study (BSC 2008a) were used to perform a follow-on gap analysis, *Waste Package Transport and Emplacement Vehicle Gap Analysis Study* (BSC 2008b), which is also provided with this response.

The following list identifies those sections of ASME NOG-1-2004 that do not apply to the design of the TEV. The rationale for identifying these sections as specific exceptions to application of ASME NOG-1-2004 is that the sections are related to typical crane attributes that are not applicable to the TEV design and include features for hoist ropes, hooks, drums, reeving, operator cabs, and pendant control.

- Section 4154, Nonlinear Time History for Slack Rope Condition
- Section 4160, Tolerances: Figure 4160-1 : Span, Elevation, and Rail-to-Rail Elevation
- Section 4470, Footwalks, Handrails, Platforms, Stairs, and Ladders
- Section 4480, Operator's Cab
- Section 5161, Drum Shell Design
- Section 5166, Reeving Efficiency
- Section 5169, Analytical Method for Hook of Approximate Trapezoidal Shape
- Section 5334, Pendant Hoist and Travel Speeds
- Section 5335, Powered Hook Rotation (Types I, II, and III Cranes)

- Section 5410, Hoist System
- Section 5411, Drum
- Section 5420, Reeving System
- Section 5421, Upper Block
- Section 5422, Load Block
- Section 5423, Equalizer Systems
- Section 5424, Sheave Pins
- Section 5425, Rope Construction, Loads, and Design Factors
- Section 5426, Fleet Angles
- Section 5427, Sheaves
- Section 5428, Hooks
- Section 5429, Reeving Efficiency (Types I, II, III Cranes)
- Section 5457.6, Guards for Hoisting Ropes (Types I, II, and III Cranes)
- Section 5477, Analytical Method for Hook of Approximate Trapezoidal Shape (Types I, II, and III Cranes)
- Section 5510, Pendant Hoist and Travel Drives (Types I, II, and III Cranes)
- Section 5511, Crane Pendant Mounting
- Section 5512, Messenger Track System
- Section 5513, Motorized Traversing
- Section 5514, Vertical Travel of Control Pendant
- Section 5515, Speeds
- Section 6445.2, Unbalanced Load Limits (Type I Cranes)
- Section 6446.1, Hoist Drum Rope Mis-Spooling Limits (Type I Cranes)
- Section 6446.2, Hoist Drum Rope Level Wind Limits (Types II and III Cranes)

- Section 6448, Restricted Handling Path (Type I Cranes).

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.

BSC (Bechtel SAIC Company) 2008a. *Waste Package Transport and Emplacement Vehicle ITS Standards Identification Study*. 800-30R-HE00-01200-000 REV 002. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080306.0003.

BSC 2008b. *Waste Package Transport and Emplacement Vehicle Gap Analysis Study*. 800-30R-HE00-01300-000 REV 004. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080306.0006.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 4:

Clarify whether or not the applicant will physically test the TEV system to verify its reliability, safety, and ability to meet performance objectives. In addition, provide the following documentation, "Waste Package Transport and Emplacement Vehicle Design Development Plan," referenced in SAR Section 1.3.3. This information is needed to verify compliance with 10 CFR 63.21(c)(3) and (16), and 10 CFR 63.112(f).

1. RESPONSE

The transport and emplacement vehicle (TEV) will be tested to verify its reliability, safety, and ability to meet performance objectives. The testing program plan will include functional tests of controls, interlocks, and load testing, as required by ASME NOG-1-2004 and addressed in SAR Section 5.5.12 and SAR Table 5.5-1. Plans for initial startup activities and testing are described in SAR Section 5.5 and in *Waste Package Transport and Emplacement Vehicle Design Development Plan* (BSC 2008) (hereinafter referred to as "the plan"), which is provided with this response.

The plan (BSC 2008) describes the basis for development of performance specifications, test specifications, and test procedures for the TEV. The plan identifies the means of demonstrating that the TEV can be relied upon to perform its nuclear safety design bases and describes the approach to be taken during final design development. Although the TEV design is based on proven and commercially available technology, the plan addresses areas where performance reliability cannot be readily achieved through the use of consensus codes and standards.

The TEV performance specification will define the codes, standards, and performance requirements for design, fabrication, and testing of the equipment. Testing will be in accordance with applicable codes and standards (e.g., ASME NOG-1-2004, IEEE Std 323-2003, IEEE Std 336-2005, and IEEE Std 383-2003), as well as the factory acceptance testing section of the performance specification. Test specifications will detail the requirements for each test, and testing procedures will prescribe how each test is to be performed. The plan further describes the process for ensuring the design of the TEV meets its safety functions and meets the reliability requirements for TEV performance for the following potential event sequences:

- TEV runaway
- TEV tipover due to seismic events
- Derailment due to seismic events
- Waste package ejection from the TEV
- Inadvertent TEV door opening.

The plan also includes an approach for extended factory acceptance testing, which requires testing the critical systems in an environment that simulates the actual operating environment as closely as possible. Extended factory acceptance testing will be performed at full scale because some components are unavailable at a reduced scale. Table 11-1 of the plan (BSC 2008) contains target reliability for the accelerated testing phase, which in some cases, differs from the reliability that must be met for each NSDB requirement at the completion of the design development, as shown in Appendix A, Table A-1 of the plan (BSC 2008). The NSDB requirements will provide the controlling values and limits for the development process.

As described in SAR Section 5.5, testing and startup activities for the TEV will be conducted. Testing activities will include component testing, systems functional testing, cold integrated systems testing, operational readiness review, and hot testing for initial startup (SAR Sections 5.5.5 through 5.5.8 and 5.5.10).

In addition, off-site integrated testing will be performed to demonstrate interfaces with various waste packages and pallets, and the subsurface facility. To the extent practicable, off-site integrated testing will be representative of real operations, with the exception of a radioactive environment.

Further, on-site dry runs and mock-up testing will also be performed to demonstrate the ability of the TEV to accept completed waste packages from the Initial Handling Facility and Canister Receipt and Closure Facility and to emplace waste packages in a drift (SAR Table 5.5-2).

Finally, during operation, system verification and inspection is performed at the North Portal Access Control Point prior to each waste delivery entry into the subsurface (SAR Section 1.3.3.5.2.1).

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.

BSC (Bechtel SAIC Company) 2008. *Waste Package Transport and Emplacement Vehicle Design Development Plan.* 800-30R-HE00-01600-000 REV 003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080306.0008.

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 336-2005. 2006. *IEEE Guide for Installation, Inspection, and Testing for Class 1E Power, Instrumentation, and Control Equipment at Nuclear Facilities*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258593.

IEEE Std 383-2003. 2004. *Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations.* New York, New York: Institute of Electrical and Electronics Engineers. TIC: 256201.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 5:

Justify the use of direct shafting between the electric motors and the gearbox of the TEV, rather than using options such as flexible couplings and floating shafts, as specified by the ASME NOG-1-2004 Code. The justification should include information regarding the impacts on durability, vibration, shaft alignment, and shaft fatigue fracture from the deviation of the code (SAR Section 1.3.3.5.1).

Section 5430 of the ASME-NOG-1-2004 Code requires that the connection between the electric motors and a gearbox be of a certain configuration and containing a number of elements that guarantees performance and minimizes failure. The applicant's description of the TEV drive and gearbox design implies, however, that the Code will not be followed precisely. This information is needed to verify compliance with 10 CFR 63.112(e).

1. RESPONSE

SAR Section 1.3.3.5.1 describes a direct connection between the transport and emplacement vehicle (TEV) wheels and gearbox. In this context, the term "directly" is used to signify that each wheel has a direct connection to its own gearbox; the term is not intended to infer a rigid, nonflexible connection between the gearbox and the wheel. This terminology was also used in ASME NOG-1-2004, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*. Section 5430 of that document, related to wheel-to-gearbox coupling, uses the word "directly", but similarly does not imply rigid, nonflexible connections.

The TEV drive system final design will take into consideration issues related to vibration, shaft alignment, and shaft fatigue that might have an adverse effect on the durability and safe operation of the equipment. The TEV final design will satisfy the requirements identified in SAR Tables 1.3.3-5 and 1.3.3-6 and provide standard coupling configurations among the wheel, gearbox, and motor in compliance with ASME NOG-1-2004 or alternate codes and standards deemed appropriate to address these design considerations. For such configurations that are not encompassed by ASME NOG-1-2004, alternate codes and standards that also address design issues related to vibration, shaft alignment, and fatigue will be applied. An example of a code that provides alternative approaches to these design considerations is NEMA MG 1-2006, *Motors and Generators*.

Further, *Mechanical Handling Design Report: Waste Package Transport and Emplacement Vehicle* (BSC 2008, Section 3.3.4), provided with the response to RAI 2.2.1.1.7-8-001, states that rigid shafts between the wheel and the gear reduction unit will be used. Because the TEV design is being refined, the aforementioned design report will be updated to provide additional details regarding the coupling between the wheel and gearbox as the TEV design is finalized.

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.

BSC (Bechtel SAIC Company) 2008. *Mechanical Handling Design Report: Waste Package Transport and Emplacement Vehicle*. 000-30R-HE00-00200-000 REV 003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080725.0012.

NEMA MG 1-2006. *Motors and Generators*. Rosslyn, Virginia: National Electrical Manufacturers Association. TIC: 258678.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 6:

Provide a design analysis that demonstrates the design adequacy of the TEV with respect to weight, horsepower requirements, lifting requirements, structural integrity, and motor speed determination. In addition, provide the documentation, "Transport and Emplacement Vehicle Envelope Calculation," referenced in SAR Section 1.3.3.5.1.1. This information is needed to verify compliance with 10 CFR 63. 21(c)(3).

1. RESPONSE

The requested document, *Transport and Emplacement Vehicle Envelope Calculation* (BSC 2008) is included as part of this response. This calculation demonstrates the design adequacy of the transport and emplacement vehicle (TEV) with respect to the weight, horsepower requirements, lifting requirements, structural integrity, and motor speeds requested in this RAI.

The calculation develops and identifies preliminary design characteristics for the following:

- Shielded enclosure envelope dimensions
- Shielded enclosure weight
- Beam size for the TEV chassis
- Lift mechanism capacity
- Total weight of the TEV, both loaded and unloaded
- Horizontal drive capacity
- Overall envelope for the TEV with doors open and doors closed.

The calculation develops preliminary dimensions and weights for various structural components of the TEV. The component weights and dimensions are then used to determine lift system weights, tractive forces, horsepower requirements, and gearbox characteristics that confirm the applicability of vendor-selected standard components.

The calculation's methodology is summarized as follows:

- The largest defined waste package and pallet dimensions are used as the basis for estimating the internal dimensions of the TEV shielded enclosure.

- An average shielding density is calculated, and the internal shielded enclosure dimensions and shielding thickness are added to develop the external shielded enclosure dimensions.

- The shielded enclosure dimensions and average density are used to estimate the weight of the shielded enclosure components (enclosure, doors, and base plate).

- The sizes of the lifting mechanisms and sizes of the lifting motors are confirmed using the shielded enclosure weight, the heaviest waste package, and the heaviest pallet.

- The shielded enclosure weight, the heaviest waste package and pallet, the chassis beams, shield lift component weights, and the linear drive motor and gearbox weights are used to estimate linear motion drive motor and gearbox capacity.
- Additional chassis weight is added for an electrical enclosure and miscellaneous frame components. The weight of the structural components, drive motors, and gearboxes is combined to provide a total TEV weight, both loaded and unloaded.
- The loaded TEV weight is rounded upward to provide a bounding weight.
- Tractive effort calculations provide TEV drive motor horsepower size and a corresponding output speed of the gearbox.
- The structural panel dimensions provide the overall bounding envelope dimensions for the TEV, both with doors open and doors closed.

In addition to evaluating the basic TEV structural components, the calculation considers normal and off-normal lift mechanism capacities and includes a factor of safety in the lift weight calculation.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2008. *Transport and Emplacement Vehicle Envelope Calculation*. 800-MQC-HE00-00100-000-00C. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20081110.0002.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 7:

Provide information on the design of the site transporter that contains information such as dimensions, lifting limits or limiting mechanisms/control, design assumptions, and analysis requirements (SAR Section 1.2.8.4.1). In addition, indicate which Sections of ASME-NOG-1-2004 Code address the following:

- fuel-tank explosion protection guidelines
- non-traditional crane lifting motion and mechanism (evident in Figure 1.2.8-49)
- guidelines on the design of brake systems for tracked-drive systems (such as motion due to backlash)

The site transporter is credited to protect against spurious movement. Since the tolerance in the movement is not provided, absolute motion prevention is implied. Since tracked systems can potentially have motion due to backlash, the information is needed to assess the applicability of the ASME-NOG-1-2004 Code to satisfy this requirement. In addition, the information is needed to determine the appropriateness of using a single standard such as ASME-NOG-1-2004 Code to design the site transporter to meet all intended safety functions. This information is needed to verify compliance with 10 CFR 63. 21(c)(3) and 63.112(f).

1. RESPONSE

The site transporter is a self-powered vehicle designed to haul the loaded transportation, aging, and disposal (TAD) canisters while within either a shielded transfer cask or vertical aging overpack between geologic repository operations area surface facilities. The site transporter performs functions at the repository that are analogous to the functions of similar vehicles at independent spent fuel storage installation sites. The repository site transporter is similar to commercially available equipment in common use. The safety features of the site transporter, including fuel tank explosion protection, lifting mechanisms, and braking systems, will comply with the performance specification in order to implement required safety functions and meet applicable codes and standards.

1.1 SITE TRANSPORTER DESIGN

Load dimensions and weight requirements will be dependent on interface with the individual TAD canister and overpack specifications provided in *Transportation, Aging and Disposal Canister System Performance Specification* (DOE 2008). Equipment that is important to safety, such as the site transporter, will be designed by qualified vendors and will be based on DOE performance specifications that will establish design requirements and criteria, applicable codes and standards, and operational requirements and limits. The DOE performance specifications will also include requirements related to engineering records and quality assurance. The DOE will require vendors to identify and use applicable sections of codes and standards provided in the DOE performance specifications that are directly applicable to any Yucca Mountain repository engineered system but will not apply those requirements in codes and standards that obviously apply only to structures, systems, and components (SSCs) at a nuclear power plant. Sections of ASME-NOG-1-2004, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*, related to lifting, allowable stresses, motors, and limit switches will be identified by DOE as part of the performance specification for the site transporter.

The combined size and weight of the loaded TAD canister-based system in a vertical aging overpack has been established as described below so as to ensure safe handling in the cask loading and unloading rooms at the Canister Receipt and Closure Facilities (CRCFs), the Wet Handling Facility (WHF), and the Receipt Facility (RF). The site transporter will accommodate the vertical aging overpack with a maximum overpack diameter of 144 in., a maximum overpack length of 264 in., and a maximum overpack weight (loaded) of 250 tons (DOE 2008).

Examples of design assumptions, analysis requirements, and preclosure nuclear safety design bases related to lifting limits; precluding fuel tank explosion; limiting speed; and protecting against spurious movement, sliding, and tipover are provided in *Basis of Design for the TAD Canister–Based Repository Design Concept* (BSC 2008a), *Project Design Criteria Document* (BSC 2007), and SAR Table 1.2.8-2.

1.1.1 Fuel Tank Explosion Protection

ASME-NOG-1-2004 does not address fuel tank explosion protection. The DOE response to RAI 2.2.1.1.3-2-013 addresses the issue related to fuel tank explosion protection for surface transportation equipment, including the site transporter.

1.1.2 Nontraditional Crane Lifting Motion and Mechanism

ASME-NOG-1-2004 is applicable to the site transporter lifting mechanism. SAR Section 1.2.4.8.1 and SAR Figure 1.2.8-49 indicate a potential design solution for the bottom crane lifting motion and mechanism that represents the analysis basis in the preclosure safety analyses. The design relies on providing unobstructed access to the top of the shielded transfer cask or vertical aging overpack. To permit this access, the interface between the site transporter and shielded transfer cask or vertical aging overpack is via two parallel rectangular lift slots that are provided at the bottom of the vertical aging overpack or shielded transfer cask, very similar to a pallet and forklift arrangement. The transport lift mechanism, along with the cask restraint system, provides stability to the shielded transfer cask or vertical aging overpack during a seismic event. The front support arms connect to the forward end of the rear lift forks to aid in supporting the load. Interlocks within the site transporter control system prevent the rear lift arms from lifting a shielded transfer cask or vertical aging overpack without the front arms being in the correct position. During the lift sequence, both the front support arms and the rear forks are monitored to ensure that the four lift motors are synchronized to share the load among the four drive units. The site transporter is designed to limit the lifted height of the vertical aging overpack or shielded transfer cask to about one foot. This lift limit constrains the effects of dropping the shielded transfer cask or vertical aging overpack.

1.1.3 Brake Systems for Tracked-Drive Systems to Prevent Motion Due to Backlash

ASME-NOG-1-2004 is applicable to the site transporter brake systems. The site transporter is designed to prevent spurious movement during loading or unloading of a canister. Operations in the CRCFs are representative of similar operations in the RF and the WHF. Inside the building, the site transporter moves to its destination. Final placement in the building location in the CRCF cask unloading room as well as the RF loading room and the WHF loading room is aided by means such as light beams and targets, laser beams, closed-circuit television, mechanical stops, or floor painting. The site transporter with the shielded transfer cask or vertical aging overpack is aligned with the cask port in the cask unloading room. The side restraint locking pins are disengaged, and side restraints are released. Once in position, the vertical aging overpack or shielded transfer cask is lowered to the floor while still supported by the site transporter during the entire duration of canister transfer. The operators disconnect the electrical umbilical power cable (PSC-2) (BSC 2008b). Thus, during canister transfer there is no electrical power supplied to the site transporter, precluding spurious movement. Motion induced by tread backlash cannot occur following the stoppage of the site transporter, due to its alignment with the cask port and disconnection from the power source. Gearing types, gear set efficiencies, material hardness, and heat treatment will be used to provide the close tolerances necessary to prevent tread backlash during cask unloading or loading and transport operations.

1.2 SELECTION OF RELEVANT CODES AND STANDARDS

Application of industry codes and standards, where available, provides established performance levels, accepted levels of reliability, and service factors based on equipment use and performance, which are addressed in the appropriate SAR sections. There are few industry consensus standards available for the development of the specialized SSCs used at the Yucca Mountain repository. The DOE has chosen to adopt applicable portions of standards that were written to provide criteria and requirements for safety-related SSCs in commercial nuclear power generating stations, to provide a proven and accepted means for the design of SSCs that are important to safety and important to waste isolation at the Yucca Mountain repository.

ASME-NOG-1-2004 is the principal code for site transporter design but other codes recommended by ASME-NOG-1-2004 will also be used. They include: (1) ASTM A 572/A 572M-04, *Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel* for car body, crawler frame, rear lift fork assembly, front support arms, and cask restraint system, which are constructed from steel; (2) AWS D14.1/D14.1M:2005, *Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment*; (3) ANSI/AGMA 2001-C95, *Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth* for machining tolerance, backlash, and inspection of gearing; (4) CMAA 70-2004, *Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes* for track-type limit switches; and (5) NEMA MG-1, *Motors and Generators* for motor size selection. Other major components of the site transporter include the motors and the site transporter controls, which are also designed in accordance with ASME-NOG-1-2004.

The car body structure has been evaluated for static and seismic loads corresponding to a design basis ground motion-2 seismic event using a finite element analysis model. The results show that the site transporter will meet the code requirements of ASME-NOG-1-2004 during a design basis ground motion-2 seismic event.

Safety features will be included in the site transporter that meet the safety functions provided in SAR Table 1.2.8-2. The final design and safety features of the site transporter will be verified through analysis to ensure compliance with the performance specification and the equipment will be tested during start up operations. In addition, at the time of final design any potential adverse effects associated with the fuel tank materials selection, lifting mechanism, brake systems, and control safety features will be analyzed and addressed.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ANSI/AGMA 2001-C95. *Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.* American Gear Manufacturers Association.

ASTM A 572/A 572M-04. 2004. *Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.* West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 258054.

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.

AWS D14.1/D14.1M:2005. *Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment.* 4th Edition. Miami, Florida: American Welding Society. TIC: 258667.

BSC (Bechtel SAIC Company) 2007. *Project Design Criteria Document.* 000-3DR-MGR0-00100-000-007 CBCN 013. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071016.0005; ENG.20071108.0001; ENG.20071220.0003; ENG.20080107.0001; ENG.20080107.0002; ENG.20080107.0016; ENG.20080107.0017; ENG.20080131.0006; ENG.20080305.0002; ENG.20080305.0011; ENG.20080305.0012; ENG.20080306.0009; ENG.20080313.0004; ENG.20080710.0001.

BSC 2008a. *Basis of Design for the TAD Canister-Based Repository Design Concept.* 000-3DR-MGR0-00300-000-003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20081006.0001.

BSC 2008b. *Preclosure Procedural Safety Controls*. 000-30R-MGR0-03600-000-001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080313.0002.

CMAA 70-2004. *Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes*. Charlotte, North Carolina: Crane Manufacturers Association of America. TIC: 258052.

DOE (U.S. Department of Energy) 2008. *Transportation, Aging and Disposal Canister System Performance Specification*. WMO-TADCS-000001, Rev. 1 ICN 1. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20080331.0001.

NEMA MG 1-2006. *Motors and Generators*. Rosslyn, Virginia: National Electrical Manufacturers Association. TIC: 258678.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 8:

Provide rationale for not following the ASME-NOG-1-2004 Code requirement of crane speed of 1.98 mph for loads weighing between zero and 49 tons for the site transporter. This information is needed to verify compliance with 10 CFR 63.21(c)(3) and 63.112(f).

1. RESPONSE

ASME-NOG-1-2004, *Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)*, is the principal standard for the design of the site transporter drive system, which includes design of the motors and speed control, gear system, and the maximum allowable stresses. Potential codes and standards to be applied to the drive mechanism and speed control are addressed in the response to RAI 2.2.1.1.7-8-007.

The maximum loaded weight carried by the site transporter is not the 49-ton maximum referenced in the RAI; rather, it is that of the vertical aging overpack, which is 250 tons (500,000 lbs) (DOE 2008). The site transporter speed limit is not derived from Table 5333.1-1, "Rated Load Recommended Bridge Speeds," of ASME-NOG-1-2004.

The site transporter 2.5 mph speed limit is based on *Intra-Site Operations and BOP Reliability and Event Sequence Categorization Analysis* (BSC 2008). The development of the maximum speed of the site transporter is determined through specific analyses, considering the hazards that the site transporter might encounter on its travel routes. Table 6.3-4 of *Intra-site Operations Reliability and Event Sequence Categorization Analysis* (BSC 2008) shows failure probabilities for collision events involving the site transporter at 2.5 mph at less than 1×10^{-8}. The analysis addressed the robustness of transportation casks that were required to survive a 40-in. horizontal drop onto an unyielding 6-in. diameter upright cylinder during an onsite transportation event. The analysis concluded that the maximum impact energy imparted to the transportation cask by a collision, at a maximum speed of 2.5 mph, is a factor of 90 less than the impact energy imparted to the transportation cask due to a 40-in. drop (BSC 2008). The analysis performed for the transportation cask is representative of the response of the aging overpack design which has been specified to satisfy the requirements of the transportation, aging, and disposal canister specification (DOE 2008).

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2008. *Intra-Site Operations and BOP Reliability and Event Sequence Categorization Analysis*. 000-PSA-MGR0-00900-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080312.0032.

DOE (U.S. Department of Energy) 2008. *Transportation, Aging and Disposal Canister System Performance Specification*. WMO-TADCS-000001, Rev. 1 ICN 1. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20080331.0001.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 9:

The following questions pertain to applicant's Cask Tractor and Cask Transfer Trailer designs described in SAR Sections 1.2.8.4.2. This information is needed to verify compliance with 10 CFR 63.21(c)(3) and 63.112(f).

(a) Provide information on which portions of the ANSI/ITSDF B56.9-2007 Standard have been applied for designing physical speed controls of the cask tractor.

(b) Provide guidelines used for designing fuel tank explosion control features. In addition, clarify the rationale for the design criteria in Table 1.2.8-2 to preclude a cask transfer tank fuel explosion.

(c) Provide envelope drawings with dimensions and accurate component location, component motion limits (max ram travel, max pulling and pushing force), trailer height, source of power to drive the hydraulic power system, operating pressures, and force sensors. Also, provide an analysis that demonstrates that the hydraulic ram force is below expected forces that can damage the waste package and other important SSCs operating nearby.

1. RESPONSE

The cask tractor and cask transfer trailer perform functions at the repository that are analogous to functions performed by similar vehicles at independent spent fuel storage installation sites. The repository cask tractor and cask transfer trailer are similar to commercially available equipment in common use in the nuclear power industry. The safety features of the cask tractor and cask transfer trailer that are important to safety (ITS), including fuel tank explosion protection and speed control, will comply with the performance specification in order to implement required safety functions and meet applicable codes and standards.

1.1 STANDARDS FOR DESIGNING PHYSICAL SPEED CONTROLS OF THE CASK TRACTOR

ANSI/ITSDF B56.9-2006, Section 7.13, "Travel Controls—Internal Combustion Powered Tow Tractors, Sit Down Rider," addresses physical speed control. The cask tractor is designed to have a top travel speed of no greater than 2.5 mph. In order to prevent potential runaway events, the cask tractor and cask transfer trailer are equipped with braking systems that operate in tandem when connected. These braking systems are designed to automatically apply the brakes on both the tractor and the trailer should they become uncoupled or the 2.5 mph speed limit is exceeded.

1.2 GUIDELINES FOR DESIGNING FUEL TANK EXPLOSION CONTROL FEATURES AND RATIONALE FOR CRITERIA USED TO PRECLUDE A CAST TRANSFER TANK FUEL EXPLOSION

ASME-NOG-1-2004 does not address fuel tank explosion protection. The response to RAI 2.2.1.1.3-2-013 addresses the issue related to fuel tank explosion protection for surface transportation equipment, including the cask tractor and cask transfer trailer.

The preclosure safety analyses of the cask transfer trailer includes analysis of a fuel tank that runs a diesel generator, which provides the hydraulic power for (1) vertical jacking units used to raise, level, and stabilize the cask transfer trailer; (2) an alignment system for the ram hydraulic cylinder, which provides for the range of vertical and lateral motion necessary to align the dual-purpose canister (DPC), transportation cask, and the horizontal aging module; and (3) a ram unit, which provides for the range of flows and pressures as required to insert or extract the DPC under normal to maximum load conditions at safe design speeds.

1.3 THE HYDRAULIC RAM FORCE IS BELOW EXPECTED FORCES THAT CAN DAMAGE THE WASTE PACKAGE AND OTHER IMPORTANT STRUCTURES, SYSTEMS, AND COMPONENTS OPERATING NEARBY

The cask tractor performs two functions. The first is to pull a cask transfer trailer carrying a transportation cask with a horizontal DPC from the Receipt Facility to the aging pad. At the aging pad, the DPC is inserted into a horizontal aging module. The second function is to pull a cask transfer trailer carrying a horizontal shielded transfer cask containing a horizontal DPC from the aging pad to the Wet Handling Facility (WHF). Horizontal DPCs are handled only in the WHF without the use of the hydraulic ram. The waste package is not processed at the aging pad (where the hydraulic ram is used), the Receipt Facility, or the WHF. The waste package is processed only in the Initial Handling Facility and the Canister Receipt and Closure Facilities. Therefore, there is no potential of a hydraulic ram damaging a loaded waste package.

Nevertheless, the design will demonstrate that the maximum force produced by the hydraulic ram will not damage the DPC or any other important to safety structures, systems, and components and will be within its design bases. This is because the design of the hydraulic ram includes a relief valve that prevents overpressure and diverts excess hydraulic fluid back to the hydraulic power unit. This design limits the maximum push and pull forces, and prevents the hydraulic ram from causing damage to DPCs.

Design envelope drawings with dimensions and accurate component location, component motion limits (i.e., maximum ram travel, maximum pulling and pushing force), trailer height, operating pressures, and force sensors will be developed.

In summary, ITS safety features will be included in the design of the cask tractor and cask transfer trailer that meet the safety functions provided in SAR Table 1.2.8-2. The final design and safety features of the cask tractor and cask transfer trailer will be verified through analysis to ensure compliance with the safety functions and controlling parameters. In addition, at the time of final design any adverse effects associated with the fuel tank materials selection, brake and hydraulic systems, and control safety features will be analyzed and addressed. Finally, the equipment will be tested during startup operations to demonstrate that the selected acceptance criteria are satisfied.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ANSI/ITSDF B56.9-2006. *Safety Standard for Operator Controlled Industrial Tow Tractors*. Washington, D.C.: Industrial Truck Standards Development Foundation. TIC: 259777.

RAI Volume 2, Chapter 2.1.1.7, Eighth Set, Number 10:

The following questions pertain to applicant's Prime Mover design described in SAR Sections 1.2.8.4.3. This information is needed to assess whether or not DOE has demonstrated compliance with 10 CFR 63.21(c)(3) and 63.112(f).

(a) Provide information on the design and analyses of a representative prime mover. It should include dimensions, loaded and unloaded weights.

(b) Provide the sections of the Manual of Railway Engineering (AREMA 2007) that addresses the braking and speed limit control requirements of the rail-based movers and that ensure the reliability of the speed control.

(c) For each prime mover, provide the codes and standards that specifically address the design of the fire explosion protection of the prime movers' fuel tank.

(d) Provide clarification for use of 49 CFR 571.108. The application of this section is not clear. Also, provide clarification regarding the rationale for not using other Sections of the 49 CFR 571 code such as brakes, brake hoses, fuel system, etc.

1. RESPONSE

The site prime movers are diesel, self-powered vehicles designed to move railcars or truck trailers loaded with transportation casks from the Cask Receipt Security Station (Gate 30B) to the rail and truck buffer areas, and from the buffer areas to the Wet Handling Facility, the Receipt Facility, the Initial Handling Facility, and the Canister Receipt and Closure Facilities. Rail transportation casks arrive at the site on railcars. Truck transportation casks arrive on site by tractor-trailer. The site prime movers perform functions at the repository that are analogous to those performed by similar vehicles at commercial and military industrial facilities. The repository site prime movers are expected to be similar to commercially available equipment in common use. The features of the site prime movers that are important to safety (ITS), including fuel tank explosion protection and speed control, will comply with the performance specification in order to implement required functions and meet applicable codes and standards.

1.1 INFORMATION ON THE DESIGN AND ANALYSES OF SITE PRIME MOVERS

There are three types of site prime movers:

1. **Rubber-tired truck tractor**—This prime mover pulls truck cask trailers carrying transportation casks. A diesel engine/electric motor would be used for motive power, and a 100-gallon diesel fuel tank is enclosed in the truck tractor. The truck tractor utilizes a diesel engine for intrasite operations and electric power through an umbilical cord when inside a facility. The truck tractor is equipped with air compressors that support the air braking system. Site prime movers are provided with speed control

features that limit speed to 9 mph. The site prime movers and cask trailers are equipped with braking systems that operate in tandem when connected. These braking systems are designed to automatically apply the brakes whenever the 9 mph speed limit is reached.

2. **Steel-wheeled locomotive**—This prime mover pulls rail cars carrying transportation casks. A diesel electric drive mechanism and a 100-gallon diesel fuel tank are enclosed in the locomotive. The locomotive uses a diesel engine for intrasite operations. Before moving the rail car carrying the transportation cask into waste handling facilities, the locomotive is replaced with either the truck tractor or hybrid prime mover. The locomotive is equipped with air compressors that support the air braking system. Site prime movers are provided with speed control features that limit speed to 9 mph. The site prime movers and rail cars are equipped with braking systems that operate in tandem when connected. These braking systems are designed to automatically apply the brakes whenever the 9 mph speed limit is reached.

3. **Hybrid prime mover**—This prime mover can run on either rubber tires or on tracks with steel wheels and would be driven by either a diesel engine or by electric motors.

The legal-weight truck or overweight truck cask trailer has a maximum width of 102 in. and a maximum length of 53 ft. The width of the rail carrier is 128 in., and the railcar outside length is 90 ft. The railcar can accommodate the maximum combined naval transportation cask and rail carrier weight of 394.5 tons (789,000 lb). The maximum loaded weight of the naval transportation cask is 295 tons (590,000 lb) (BSC 2008a, Section 3.2.1.9).

A representative site prime mover has been analyzed by the preclosure safety analysis (PCSA), considering a maximum speed that does not exceed 9 mph, and the probability of failure due to collisions when entering facilities is provided in Section B1.5 of *Intra-Site Operations and BOP Reliability and Event Sequence Categorization Analysis* (BSC 2008b). The as-built site prime movers will have specifications that are bounded by the PCSA analyzed representative site prime mover.

1.2 CONTROL OF MAXIMUM SPEED OF THE SITE PRIME MOVER

Runaway situations on any site prime mover are prevented by design features. The maximum speed of the site prime mover is controlled by a governor on the diesel engine during outside movement. The drive system contains both a governor and a transmission constraint that limits the maximum speed of the site prime mover to 9 mph. The speed control on the site prime mover for in-facility operations is controlled by the physical limitations of the drive system. In addition, the site prime mover gearing also prevents the site prime mover from exceeding 9 mph.

The *Manual of Railway Engineering* (AREMA 2007) is primarily used in the design of rail rolling stock. The design will apply *Manual of Standards and Recommended Practices* (AAR 2004, Section M) to address the braking and speed limit control features of the rail-based site prime mover. The design will apply ANSI/ITSDF B56.9-2006, Section 7.13, *Travel Controls—Internal Combustion Powered Tow Tractors, Sit Down Rider* to address physical speed control features for the truck-based site prime mover. The hybrid prime mover is expected to be designed to include applicable portions of both standards.

1.3 DESIGN OF FUEL TANKS TO PREVENT FUEL TANK EXPLOSION

ASME NOG-1-2004 does not address fuel tank explosion protection. The DOE response to RAI 2.2.1.1.3-2-013 addresses the issue related to fuel tank explosion protection for surface transportation equipment including the site prime movers.

1.4 CLARIFICATION OF APPLICABILITY OF 49 CFR 571

49 CFR 571.108 and 49 CFR 571.121 are cited in SAR Section 1.2.8.4.3.8. Sections 5.5.3 to 5.5.5 of 49 CFR 571.108, *Lamps, reflective devices, and associated equipment*, provide requirements related to activation of tail lamps, activation of stop lamps upon application of service brakes, and independent operation of the vehicular hazard warning signal operating units. The representative site prime mover is designed to include air brakes; therefore, 49 CFR 571.121, *Air brake systems*, is applied. 49 CFR 571.106, *Brake hoses*, and 49 CFR 571.301, *Fuel system integrity*, are relevant as well and will be applied to the site prime mover design.

ITS features will be included in the site prime movers that meet the functions provided in SAR Table 1.2.8-2. The final design and safety features of the site prime movers will be verified through analysis to ensure compliance with the performance specification, and the equipment will be tested during start up operations. In addition, at the time of final design, any potential adverse effects associated with the fuel tank materials selection, brake systems, and speed control features will be analyzed and addressed.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

AAR (Association of American Railroads) 2004. Section M, *Manual of Standards and Recommended Practices*. Washington, D.C.: Association of American Railroads. TIC: 256289

ANSI/ITSDF B56.9-2006. 2006. *Safety Standard for Operator Controlled Industrial Tow Tractors*. Washington, D.C.: Industrial Truck Standards Development Foundation. TIC: 259777.

AREMA (American Railway Engineering and Maintenance-of-Way Association) 2007. *Manual for Railway Engineering*. Four volumes. Lanham, Maryland: American Railway Engineering and Maintenance-of-Way Association. TIC: 259784.

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.

BSC (Bechtel SAIC Company) 2008. *Basis of Design for the TAD Canister-Based Repository Design Concept.* 000-3DR-MGR0-00300-000-003. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20081006.0001.

BSC 2008b. *Intra-Site Operations and BOP Reliability and Event Sequence Categorization Analysis*. 000-PSA-MGR0-00900-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080312.0032.