RAI Volume 2, Chapter 2.2.1.1.7, Tenth Set, Number 1:

a) Provide the following information: A description of the specific portions of the guidance and standards that are used in the design of:

   i) HEPA filter plenums,
   ii) adjustable speed drives, and
   iii) air handling units (e.g., for the air handling units described on page B8-16 of BSC, 2008ac for the CRCF and page 1.2.8-23 of the SAR for the EDGF).

   DOE identifies principal codes and standards in Table 1.2.2-12 of the SAR starting on page 1.2.2-64 and regulatory guidance documents in Table 1.2.2-9 of the SAR starting on page 1.2.2-53 but it is not clear what parts of these codes and standards that DOE intends to use for design of the above equipment.

b) The design methodologies for ITS structures, systems, and components (SSCs) such as exhaust fans, dampers, HEPA filter plenums, including an explanation on how the design methodologies are in accordance with the codes and standards. For example, for the CRCF, see page 1.2.4-64 of the SAR.

c) An explanation of the extent to which the standards identified in Table 1.2.2.-12 of the SAR are used in the design of the ITS HVAC systems. For example, ANSI/ANS-57.9-1992, Section 6.5 pertains to HVAC systems. Explain if this section is being applied to the HVAC system design for the surface facilities in its entirety or if only portions of the section are being applied.

d) A description of the design of the ducts to maintain sufficient transport velocities. DOE identifies on page 1.2.4-59 of the SAR that the ducts are sized to maintain sufficient transport velocities and minimize particulates settling out.

e) Justification of the rated capacities and ventilation flow rates shown in Figure 1.2.5-87 of the SAR on page 1.2.5-311 for the WHF ITS HVAC electrical and battery rooms' ventilation flow diagram. For example, DOE shows exhaust fans having rated capacities of 1000 CFM and fan coil units having rated capacities of 6000 CFM. Explain how DOE determined the ventilation flow rates shown in the figure and designed the components to support the rated capacities shown in the figure.

1. RESPONSE

1.1 PROVIDE A DESCRIPTION OF THE SPECIFIC PORTIONS OF THE GUIDANCE AND STANDARDS THAT ARE USED IN THE DESIGN OF HEPA FILTER PLENUMS, ADJUSTABLE SPEED DRIVES AND AIR HANDLING UNITS

1.1.1 HEPA Filter Plenums

The exhaust high-efficiency particulate air (HEPA) filter plenums are designed in accordance with ASME AG-1-2003, *Code on Nuclear Air and Gas Treatment,* including the 2004 addendum (ASME AG-1a-2004). HEPA filters are required to be in compliance with UL 586-2004, *High-Efficiency, Particulate, Air Filter Units*. The HEPA filtration efficiency is at least 99.97% for particulates 0.3 micron and larger in accordance with ASME AG-1a-2004, Section FC and consistent with the preclosure safety analysis (PCSA) consequence analysis. The HEPA filters are preceded by 90% efficient prefilters evaluated in accordance with ANSI/ASHRAE 52.1-1992, *Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter*.

The HEPA filter plenums are sized in accordance with DOE-STD-3022-98, *DOE HEPA Filter Test Program*; DOE-STD-3020-2005, *Specification for HEPA Filters Used by DOE Contractors*, Table 1; and ASME AG-1a-2004, Table FC-4110. The exhaust HEPA filter plenums are sized to include a 20% air flow design margin. The exhaust HEPA filter plenums include two filter sections of 3-filter units high by 3-filter units wide, where each HEPA filter is 24 in. × 24 in. × 11.5 in. with an airflow capacity between 1,000 cubic feet per minute (cfm) and 2,000 cfm at a maximum clean filter resistance of 1.3-in. water gage in accordance with ASME AG-1a-2004, Section FC. The maximum flow of an exhaust HEPA filter plenum is limited to 30,000 cfm in accordance with the guidance provided in Regulatory Guide 1.52, *Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants*, Paragraph 3.6; Regulatory Guide 1.140, *Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants*, Paragraph 3.2; and DOE HDBK-1169-2003, *Nuclear Air Cleaning Handbook*, Chapter 2, Section 2.7.2.1. The important to safety (ITS) exhaust HEPA filter plenums are provided with fire suppression systems, including automatic and manual water deluge systems in accordance with the guidance provided in DOE-STD-1066-99, Section 14.8, and Regulatory Guide 1.189, *Fire Protection for Operating Nuclear Power Plants,* Section C.4.1.4. However, the ITS HVAC subsystem is not relied upon during fire event sequences and, therefore, has no safety requirements to operate during fire event sequences. The ITS exhaust HEPA filter plenums are designed and tested to withstand up to 700°F ± 50°F in accordance with UL-586*,* Section 9.4. The HEPA filter elements are Type B, consisting of glass fiber media that conforms to the requirements of ASME N509-2002, *Nuclear Power Plant Air-Cleaning Units and Components*, Article 5.1, and ASME AG-1a-2004, Section FC.

SAR Figure 1.2.2-20 provides a typical HVAC system HEPA filter arrangement including sections for demisters (moisture separator), prefilter, HEPA filters, and testing. Descriptions for portions of the sections shown in SAR Figure 1.2.2-20 are provided in SAR Section 1.2.2.3.1 and elaborated here for clarity. The demister pads are designed in accordance with ASME N509-2002, Article 5.4, and ASME AG-1a-2004, Section FA. The demister pads are constructed of corrosion resistant wire (e.g., stainless steel) with a stainless steel frame and are capable of removing at least 99% by weight of the entrained moisture in an air stream (at least 99% by count of 5 to 10 μm diameter droplets without visible carryover) in accordance with ASME AG-1a-2004, Table FA-4210 . The prefilters are designed in accordance with ASME AG-1a-2004, Section FB, and UL 900, *Air Filter Units*. The design and construction of the air cleaning unit housing is in accordance with ASME AG-1a-2004, Section HA and consists of continuously welded stainless steel suitable for the "bag-in-bag-out" arrangement with service access doors, explosion-proof lights, filter test connections (test ports) for pressure gauges, and drain connections.

1.1.2 Adjustable Speed Drives

The ITS exhaust fans are equipped with ITS adjustable speed drives to provide modulation in the system airflow, to maintain the required air flows in the confinement areas, compensate for filter dust loading, and maintain a proper differential pressure based on the guidance provided in DOE-HDBK-1169, Section 2.3.8, Regulatory Guide 1.52; and Regulatory Guide 1.140.

Adjustable speed drives are designed in accordance with NEMA ICS 7-2006, *Industrial Control and Systems: Adjustable-Speed Drives*, and NEMA ICS 7. 1-2000, *Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems*. The associated adjustable speed motors are designed for inverter duty per NEMA MG 1-2006, *Motors and Generators*, Parts 30 and 31. The associated adjustable speed motors are tested in accordance with IEEE Std 112-2004, *IEEE Standard Test Procedure for Polyphase Induction Motor*s *and Generators*. The adjustable speed drive electrical system characteristics, including motor sizing, overload protection, over-temperature protection, and fault current protection are designed in accordance with NFPA 70-2005, *National Electrical Code*, Article 430, Part X.

1.1.3 Air Handling Units

The surface HVAC subsystem air handling units, serving the confinement and the occupied areas of the facilities, are equipped with prefilters, high-efficiency filters, and as required, heating coils, cooling coils, and humidifiers to condition the supply air to these areas. The prefilters (25 to 40% efficiency), and high efficiency filters (80 to 95% efficiency) are as recommended in ASHRAE 2004, *ASHRAE® Handbook, Heating, Ventilating, and Air-Conditioning Systems and Equipment*, Chapter 24, Table 2. The recommended sizing criteria for the filters and coils is as described in *2005 ASHRAE Handbook, Fundamentals*, Chapter 35, Table 10. The cooling coils and heating coils are designed in accordance with ARI Std 410-2001, *Forced-Circulation Air-Cooling and Air-Heating Coils, with Addendum*. The efficiency of the prefilters and high-efficiency filters is in accordance with ANSI/ASHRAE 52.1-1992.

Per NFPA 90A-2005, *Standard for the Installation of Air-Conditioning and Ventilating Systems, with Errata*, Section 4.3.9.2, electric actuated smoke dampers are installed in systems with capacity greater than 15,000 cfm to isolate air handling equipment including filters from the remainder of the system to prevent propagation of smoke. Exception to this is taken for fan coil units recirculating air located in the same room.

1.2 PROVIDE THE DESIGN METHODOLOGIES FOR ITS STRUCTURES, SYSTEMS, AND COMPONENTS, SUCH AS EXHAUST FANS, DAMPERS, HEPA FILTER PLENUMS

The design methodologies used for ITS components, such as exhaust fans, dampers, and HEPA filter plenums, are consistent with the codes and standards identified in SAR Section 1.2.2.3, and the performance-based, risk-informed philosophy described in SAR Sections 1.6.3 and 1.9.1. The design methodologies generally provided in codes and standards are analytical methods to be used in the design of an ITS SSC. It is expected that the implementation of the appropriate methodologies in applicable design codes and standards will meet the component reliability provided in the nuclear safety design basis. SSCs determined to be ITS are relied upon to prevent or mitigate an event sequence. In general, components associated with a support system function necessary for the safety function of ITS systems are also classified as ITS. As discussed in SAR Section 1.9, the results of the PCSA are used to define nuclear safety design bases for repository SSCs to prevent, to the extent practical, or mitigate event sequences that could lead to the release of radioactive material or result in radiological exposure of workers or the public. If prevention measures alone do not reduce an event sequence frequency to beyond Category 2, then mitigation measures are developed (e.g., ITS HVAC) to reduce the worker and public exposure to radiation to comply with 10 CFR 63.111. This is achieved by including the PCSA as an integral part of the design process in a manner consistent with a performance-based, risk-informed philosophy. This integral design approach ensures that the ITS design features and procedural safety controls are selected in a manner that provides reasonable assurance of safety. Using this strategy, design rules in SAR Section 1.9 are developed to provide guidance on the safety classification of SSCs. As such, the reliability analyses performed for the PCSA evaluates the design described in the SAR in explicit fault tree and event tree models described in SAR Section 1.7. The reliability source data for typical HVAC components accounts for the variability across industry applications. Industry-wide data is used in the SAR because there is not yet specific repository operating experience.

The ITS HVAC functions for the repository facilities are similar to the safety-related HVAC functions for auxiliary buildings and fuel handling buildings of nuclear power plants. The adopted standards provide criteria and requirements for safety-related SSCs in commercial nuclear power generating stations and provide a proven and accepted means for the design of repository HVAC SSCs that are ITS. Using the methods and practices of industry codes and standards provides established performance levels, accepted levels of reliability, and service factors based on equipment usage and performance. Based on the results of the PCSA and detailed design, appropriate sections of nuclear related codes and standards will be applied.

1.3 PROVIDE AN EXPLANATION OF THE EXTENT TO WHICH THE STANDARDS IDENTIFIED IN TABLE 1.2.2-12 ARE USED IN THE DESIGN OF THE ITS HVAC SYSTEMS

SAR Table 1.2.2-12 provides the principal codes and standards for HVAC components that are expected to meet the reliability requirements established by the PCSA.

ANSI/ANS-57.9-1992, *American National Standard, Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type),* Section 6.5, is being applied to the HVAC system design for the surface facilities in its entirety.

Other examples (not inclusive) of the sections applied to the codes and standards listed in SAR Table 1.2.2-12 for the HVAC confinement subsystem and indoor environmental conditions are provided below.

The design of the confinement HVAC system:

- Provides a cascading ventilation system in accordance with ANSI/ANS-57.7-1988, Section 6.6.2.2.3.1, and ANSI/ANS-57.9-1992, Section 6.5.1.2.3.

- Maintains a controlled airflow path directed from areas of low potential for radioactive contamination to areas of higher potential for radioactive contamination based on the general requirement of ASHRAE DG-1-93, *Heating, Ventilating, and Air-Conditioning Design Guide for Department of Energy Nuclear Facilities*, Figure 1-1, and in accordance with ANSI/ANS-57.7-1988, Section 6.6.2.1.2; and ANSI/ANS-57.9-1992, Section 6.5.1.1.3.

- Recirculation system for any contamination confinement area shall include at least one stage of HEPA filters in accordance with ANSI/ANS-57.7-1988, Section 6.6.2.2.2.2; and ANSI/ANS-57.9-1992, Section 6.5.1.2.2(2).

- Maintains the differential pressures between contamination confinement areas of the facilities in accordance with ASHRAE DG-1-93, *Heating, Ventilating, and Air-Conditioning Design Guide for Department of Energy Nuclear Facilities*, Sections 1 and 2, and DOE HDBK-1169-2003, Chapter 2.

- Provides the necessary instrumentation and control hardware in accordance with the recommendation of DOE-HDBK-1169-2003, Section 5.6; ASHRAE DG-1-1993; ASME AG-1a-2004, Section IA and non-mandatory Appendix IA-C; Regulatory Guide 1.140, Section 3.3; and Regulatory Guide 1.52, Section 3.7.

- Exhaust duct or stack is located to prevent recirculation of exhaust effluents to any of the facilities, air intakes and provides an exhaust with elevated release in accordance with the guidance provided in *2007 ASHRAE Handbook, Heating, Ventilating, and Air-Conditioning Applications,* Chapter 44.

- Discharge (exit) velocity through the exhaust duct or stack is in accordance with the recommendation of DOE-HDBK-1169-2003, Section 5.5.

The surface HVAC subsystem maintains indoor environmental conditions in accordance with:

- ANSI/ASHRAE Std 55-2004, *Thermal Environmental Conditions for Human Occupancy.*
- ASHRAE 2005, *2005 ASHRAE® Handbook, Fundamentals*, Chapter 8.
- ASHRAE 2007, *2007 ASHRAE® Handbook, Heating, Ventilating, and Air-Conditioning Applications*, Chapter 17 and 25.
- ANSI/ANS-57.7-1988, *American National Standard, Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)*, Appendix E.
- ACGIH 2004, *Industrial Ventilation, A Manual of Recommended Practice.*
- ACGIH 2006, *Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*.

Surface HVAC subsystems are designed to provide for filtration of inlet (outdoor) air to prevent the accumulation of dust or other particulate matter in the facility in accordance with ANSI/ANS-57.7-1988, Section 6.6.2.1.1; ANSI/ANS-57.9-1992, Section 6.5.1.1.2, and DOE-HDBK-1169-2003.

Additional information regarding the explanation of the extent to which codes and standards identified in the SAR are used in the design of the ITS HVAC subsystems is provided in Section 1.2 of this RAI response.

1.4 PROVIDE A DESCRIPTION OF THE DESIGN OF THE DUCTS TO MAINTAIN SUFFICIENT TRANSPORT VELOCITIES

The only ducts through which radioactive particles are to be transported are the confinement HVAC subsystem ducts, because no other system exhausts air from a space where radioactive material may be present during normal or off-normal conditions. Accordingly, this response discusses only the confinement HVAC subsystem ducts.

The confinement HVAC subsystem maintains the differential pressures between the contamination confinement areas of the facilities in accordance with Sections 1 and 2 of ASHRAE DG-1-93, and DOE-HDBK-1169-2003. To minimize particulates settling out of the air stream, the ITS HVAC ducts are sized for a velocity of 2,500 fpm in accordance with the DOE-HDBK-1169-2003, Section 5.2.2. The duct friction pressure drop is conservatively assumed to be 0.2 in. water gage per 100 feet of duct. Actual duct sizes and flow rates are determined in detailed design.

Ductwork conveying air that is potentially contaminated with airborne radioactive contaminants is designed to minimize accumulation or trapping of such contaminants in accordance with the guidance provided in Regulatory Guide 1.52. Ductwork is designed and constructed in accordance with ASME AG-1a-2004, Section SA. The duct and housing leak tests are performed in accordance with ASME AG-1a-2004, Section TA.

1.5 PROVIDE JUSTIFICATION OF THE RATED CAPACITIES AND VENTILATION FLOW RATES SHOWN IN FIGURE 1.2.5-87

SAR Figure 1.2.5-87 and Table 1.2.5-4 show the rated capacities and flow rates for components of the ITS HVAC subsystem in the Wet Handling Facility (WHF) electrical and battery rooms. The rated capacities and flow rate values are derived through the combined analysis of cooling loads, heating loads, airflow rates, pressure drops, and equipment selection.

The WHF ITS electrical and battery rooms rated capacities and ventilation flow rates are determined using the following approach:

- Gather detailed room information from the WHF General Arrangement drawings shown in SAR Figure 1.2.5-2 for the ITS electrical and battery rooms (Rooms 1002, 1003, 1019, and 1020). Additionally, determine the coefficient of heat transmission or U-values for any roofs, walls, partitions, ceilings, and floors in accordance with *2005 ASHRAE® Handbook, Fundamentals*, Chapter 25.

- Determine the room-by-room cooling loads using *Cooling and Heating Load Calculation Manual* (Rudoy and Cuba 1979). For conservatism, a 20% design margin is added to room peak sensible and latent loads.

- Determine the air flow rates required to satisfy each room's cooling load for both normal and off-normal conditions (e.g., loss of non-ITS HVAC subsystem in the surrounding areas). The supply airflow rates for the ITS electrical room are approximately 4,900 cfm for normal conditions and 6,000 cfm for off-normal conditions. The ITS battery rooms, supply airflow rates are 400 cfm for normal conditions and 600 cfm for off-normal conditions. Each subsystem's airflow rate is determined by summing all the peak space airflow rates belonging to each subsystem. This is a conservative approach since the room's peak cooling loads do not occur at the same time. The size of the fan coil unit is based on HEPA filter standard ratings, (e.g., increments of 2,000 cfm) shown in UL 586-2004, *High-Efficiency, Particulate, Air Filter Units*, Table 3.1.

- Satisfy the normal cooling load and air flow rates by providing a standard 6,000 cfm unit with temperature control, distributing 5,400 cfm to the electrical room and 600 cfm to the battery room.

- Derive the minimum required outdoor air ventilation rates using Table 6-1 of ANSI/ASHRAE 62.1-2004, *Ventilation for Acceptable Indoor Air Quality*. Spaces that are normally unoccupied such as electrical rooms and battery rooms are treated

similar to corridors and are given an "area outdoor air rate" of 0.06 cfm / square foot. The design temperatures for the electrical rooms and battery rooms are also treated as being similar to normally unoccupied corridors.

- Analyze the exhaust air flow rates, room-by-room, based on subsystem requirements. The required airflow rate to maintain the ITS battery room at the indoor design temperature of 77 °F is 600 cfm. The total exhaust airflow rate from the battery room is 600 cfm plus 250 cfm to account for the in-leakage of transfer air from the adjoining electrical room, totaling 850 cfm.

- Determine the cooling coil load from the properties of mixed air entering the cooling coil and imposing a 52°F dry bulb air temperature for air leaving the cooling coil. The mixed air includes return air and the transferred air from the corridors. The total cooling load during normal operation for each train of the ITS electrical and battery rooms is approximately 160,000 British Thermal Units per hour. During off-normal conditions, such as the loss of non-ITS HVAC subsystem in the surrounding areas, the cooling load is approximately 36,000 British Thermal Units per hour higher. To better manage the off-normal cooling load, the standby unit may be used to supplement the operating unit as needed.

- Determine the reheat load for the ITS battery room by calculating the required load during normal operations to increase the supply air temperature from 52°F to the room design temperature and then adding the ITS battery room load. The maximum total reheat load required for the ITS battery room is approximately 6.5 kilowatts.

- Determine the longest duct for use as the subsystem pressure drop. The pressure drop analysis considered the length of the longest duct run, number of fittings and dampers, and the airflow path components. For straight duct runs, pressure drop rates of 0.1 in. water gage for supply and 0.2 in. water gage for exhaust per 100 feet are used. A 20% design margin is applied, and total pressure drop is rounded up to the nearest 0.1 in. water gage.

- Determine the required horsepower of the fan coil unit assembly using *2005 ASHRAE® Handbook, Fundamentals,* Chapter 30, followed by selecting and matching an air-cooled condensing unit from manufacturer's literature.

- The exhaust airflow per ITS battery room is 850 cfm; the exhaust HEPA filter plenum is designed for 1-filter wide by 1-filter high resulting in a rated capacity of 1,000 cfm. The exhaust fan is selected to match the 1,000 cfm rated capacity of the HEPA filter.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

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RAI Volume 2, Chapter 2.2.1.1.7, Tenth Set, Number 2:

The following questions pertain to DOE's design of the surface heating, ventilation, and air-conditioning (HVAC) important-to-safety (ITS) systems. These systems are described in SAR Section 1.2.2.3, Section 1.2.4.4 for the Canister Receipt and Closure Facility (CRCF), Section 1.2.5.5 for the Wet Handling Facility (WHF), and Section 1.2.8.3 for the Emergency Diesel Generator Facility (EDGF). This information is required to determine compliance with 10 CFR 63.21(c) and 63.112(f).

Provide the design bases, design criteria, relationship to preclosure safety analysis, and HVAC design (including design assumptions) pertaining to the following:

a) Hydrogen removal requirements for hydrogen generated while charging batteries for the WHF, CRCF, and EDGF. For example, DOE identifies on page 1.2.4-60 of the SAR for the CRCF that the battery room exhaust has sufficient volume changes per hour to preclude the accumulation of hydrogen. Explain what is meant by sufficient volume changes and how the system was designed to preclude the accumulation of hydrogen.

b) Cooling requirements to meet the temperature criteria for ITS electrical equipment for the WHF, CRCF, and EDGF. For example, DOE identifies indoor design temperatures in Table 1.2.4-8 of the SAR on page 1.2.4-97 for the CRCF. Explain how DOE determined the temperature criteria, and how the HVAC system is designed to meet the temperature criteria.

c) Overall filtration efficiency for the surface nuclear confinement HVAC system in the WHF and CRCF for the event sequences involving a filtered radionuclide release.

d) DOE describes on page 1.2.8-22 of the SAR that the generator rooms in the EDGF are each provided with temperature-activated ITS exhaust fans to maintain the temperature below 120 °F. Explain how DOE determined this temperature criterion and explain how the HVAC subsystem is designed to meet this requirement.

1. RESPONSE

1.1 PROVIDE HYDROGEN REMOVAL REQUIREMENTS FOR HYDROGEN GENERATED WHILE CHARGING BATTERIES IN THE WHF, CRCF, AND EDGF

Hydrogen removal design criteria for hydrogen generated while charging batteries in the Canister Receipt and Closure Facility (CRCF), Wet Handling Facility (WHF), and Emergency Diesel Generator Facility (EDGF), are defined in IEEE Std 484-2002, *IEEE Recommended Practice for Installation Design and Installation of Vented Lead- Acid Batteries for Stationary Applications*; and ASHRAE-2007, *ASHRAE® Handbook, Heating, Ventilating, and Air-Conditioning Applications.* IEEE Std 484-2002, Section 5.4; and ASHRAE-2007, page 26.9, recommend that the hydrogen concentration in battery rooms be 2% or less of room volume. Additionally, ASHRAE-2007 states that if battery design information is unavailable, the exhaust system should be designed to provide a minimum of five air changes per hour to preclude hydrogen accumulation below the lower explosive limit. The attached Table 1 summarizes the air changes per hour for the important to safety (ITS) battery rooms located in the CRCF, WHF, and EDGF. In all three facilities, the number of air changes per hour is substantially above the ASHRAE-2007 and IEEE Std 484-2002 minimum requirements, thereby precluding the accumulation of hydrogen.

The design criteria to limit hydrogen concentration and provide a minimum number of air changes per hour applies to all repository battery systems regardless of safety classification, voltage level, or facility.

The relationship to the preclosure safety analysis design is shown in SAR Table 1.9-1 for classification of structures, systems, and components. SAR Tables 1.9-3 and 1.9.4 show the preclosure nuclear safety design bases for the heating, ventilation, and air conditioning (HVAC) systems in the CRCF, WHF, and EDGF (VC.CR.02, VN.CR.01, VC.WH.03, VC.WH.04, and VN.WH.01) that remove hydrogen from battery rooms. SAR Table 1.9-10 identifies that one train of the ITS HVAC system serving ITS electrical and battery rooms in the WHF, CRCF, and EDGF, must be operating, and the other train in standby, before commencing waste handling operations (Procedural Safety Control 7). No nuclear safety design bases or procedural safety controls exist related to maintaining a hydrogen gas concentration other than the reliable operation of the HVAC systems for the ITS electrical and battery rooms.

1.2 PROVIDE COOLING REQUIREMENTS TO MEET TEMPERATURE CRITERIA FOR ITS ELECTRICAL EQUIPMENT FOR THE WHF, CRCF, AND EDGF

The HVAC systems are designed to meet the temperature criteria based on cooling loads, heating loads, airflow rates, and pressure drops using an approach described in SAR Section 1.2.4.4.6, and the response to RAI 2.2.1.1.7-10-001, e).

Temperature criteria for ITS electrical equipment rooms in the WHF, CRCF, and EDGF ranges from a low of 65°F, to a high of 90°F. Temperature criteria are derived from the range of

recommended values for human entry to normally unoccupied areas in accordance with ANSI/ANS-57.7-1988, *American National Standard, Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type),* Appendix E. Also, an indoor temperature of 90°F is within the normal equipment rating temperature of 104°F for typical HVAC and electrical equipment. For any short term occupancy of service personnel, the 90°F temperature also meets the screening criteria for heat stress exposure as stated in ACGIH-2007; TLVs® and BEIs®*, Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices*.

The more restrictive battery room temperature criteria of 77°F (summer), and 72°F (winter) provided in SAR Table 1.2.4-8 are in accordance with ASHRAE-2007. The temperature range set for the battery rooms contributes to optimum battery life, performance, cost of operation, and is in accordance with IEEE Std 484-2002, Section 5.

SAR Table 1.9-10 identifies that one train of the ITS HVAC system serving the WHF, CRCF, and EDGF must be operating, and the other train in standby, before commencing waste handling operations (Procedural Safety Control 7).

1.3 PROVIDE OVERALL FILTRATION EFFICIENCY FOR THE SURFACE NUCLEAR CONFINEMENT HVAC SYSTEM IN THE WHF AND CRCF

The HVAC systems in the WHF and CRCF facilities credited to remove air particulates are designed with two stages of high-efficiency particulate air filters in series, protected by prefilters (90% roughing filter), sprinklers, and demisters. The minimum particle removal efficiency for each stage of the high-efficiency particulate air filters is no less than 99.97% for 0.3-µm particles. This removal efficiency is consistent with the analysis of radiological consequences presented in SAR Section 1.8. The combined removal efficiency used in the consequence analysis is stated in SAR Section 1.8.1.3 as 99.99%.

SAR Tables 1.9-3 and 1.9-4 show the preclosure nuclear safety design bases for the HVAC systems in the CRCF and WHF (VC.CR.01, VC.WH.01, and VC.WH.02).

1.4 EXPLAIN HOW DOE DETERMINED THE TEMPERATURE CRITERION FOR THE GENERATOR ROOMS IN THE EDGF AND HOW THE HVAC SUBSYSTEM IS DESIGNED

The design maximum temperature for the generator rooms is 120°F. Chapter 6 of the Cummins Power Generation 2004 Application Manual, *Liquid Cooled Generator Sets*, states a good design goal for standby applications is to maintain the generator room at no more than 125°F.

The ITS HVAC system is designed for the maximum generator room temperature by assuming the ITS diesel generator is operating at full load with the maximum outside ambient air temperature of 116°F as stated in SAR Table 1.2.2-1.

The train-oriented ITS ventilation fans for the EDGF generator rooms are in the first load group connected to the ITS power supply. The ITS ventilation units are sized to maintain steady-state temperatures in the generator rooms less than or equal to 120°F during ITS diesel generator operation. Each train is equipped with four 22,000 cubic feet per minute ITS ventilation fans, which includes a 20% design margin for maintaining room temperatures at less than or equal to 120°F.

SAR Table 1.9-10 identifies that both ITS diesel generators start and run 720 hours to support the operation of the surface nuclear confinement HVAC system (Procedural Safety Control 8).

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ACGIH-2007. TLVs® and BEIs®, *Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices*. American Conference of Governmental Industrial Hygienists. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists. TIC: 258916.

ANSI/ANS-57.7-1988. 1997. *American National Standard, Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)*. La Grange Park, Illinois: American Nuclear Society. TIC: 258660.

ASHRAE-2007. *ASHRAE® Handbook, Heating, Ventilating, and Air-Conditioning Applications*. Inch-Pound Edition. Atlanta, Georgia: American Society of Heating, Refrigerating and Air-Conditioning Engineers. TIC: 260028.

Cummins Power Generation 2004. *Application Manual - Liquid Cooled Generator Sets*. Columbus, Indiana: Cummins Power Generation. TIC: 259243.

IEEE Std 484-2002. *IEEE Recommended Practice for Installation Design and Installation of Vented Lead- Acid Batteries for Stationary Applications*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 256025.

Table 1. ITS Battery Room Air Changes

Facility	ITS Battery Room Volume in ft^3 (Approximate)	Equipment Exhaust Capacity in cfm/unit	Air Change per Hour (Approximate)
CRCF	2,760 (230 ft^2 × 12 ft height) SAR Fig. A-22	1,000 SAR Table-1.2.4-7	21
WHF	2,760 (230 ft^2 × 12 ft height) SAR Fig. A-39	1,000 SAR Table-1.2.5-4	21
EDGF	1,200 (120 ft^2 ×10 ft height) SAR Fig. A-84	450 SAR Table-1.2.8-4	22

NOTE: cfm = cubic feet per minute.

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

> Explain how DOE accounts for loss of cooling to ITS electrical equipment and battery rooms in the CRCF, WHF, and EDGF in terms of its effect on equipment other than failure of HVAC system exhaust fans. For example, explain how loss of cooling to ITS electrical equipment and battery rooms can affect interlocks, radiation monitors, or other equipment that operators may rely on to prevent them from performing an unsafe action.

1. RESPONSE

During the May 27, 2009, clarification call between the NRC and the DOE, the NRC clarified the response to RAI 2.2.1.1.7-10-008 should concentrate on why the loss of cooling to any piece of equipment, either within or outside the boundaries of the important to safety (ITS) electrical and battery rooms, will not lead to unsafe operator actions.

ITS cooling is provided for rooms containing ITS electrical and mechanical components necessary for the filtration function following a breach of a waste form coinciding with a loss of off-site power. No other safety functions or system interactions require cooling.

Regarding the ITS cooling function, two independent trains of ITS mechanical and electrical equipment are provided to ensure that at least one train operates for 720 hours after a breach of a waste form with the necessary reliability. Failure of both trains is beyond a Category 2 event sequence.

ITS structures, systems, and components (SSCs) credited with mitigating an event sequence do not rely on or provide for operator involvement; therefore, ITS interlocks and other safeguards are not susceptible to operator error. The human reliability analysis described in SAR Section 1.7.2.5, in conjunction with the fault tree analysis described in SAR Sections 1.7.1 and 1.7.2, includes the dependencies associated with human errors and equipment malfunctions. Furthermore, no event sequences have been identified that rely on non-ITS equipment, or are affected by a loss of cooling to such equipment. For example, the failure of the interlock (1×10^{-4}) concurrent with human error (1×10^{-3}) is 1×10^{-7}, which is beyond Category 2.

To account for the loss of cooling to ITS electrical equipment and battery rooms in the Canister Receipt and Closure Facility, Wet Handling Facility, and Emergency Diesel Generator Facility, the active ITS electrical equipment in the ITS electrical and battery rooms is designed in accordance with the equipment qualification program, as described in SAR Section 1.13. This equipment is capable of performing its nuclear safety design basis function defined in SAR Table 1.4.1-1, under normal operations, off-normal operations (e.g., loss of cooling), and event sequence environments. Furthermore, the equipment qualification program accounts for elevated temperatures and is applicable to all active ITS electrical and ITS mechanical equipment in the Canister Receipt and Closure Facility, Wet Handling Facility, and Emergency Diesel Generator Facility. The equipment qualification process for active ITS electrical and ITS mechanical equipment located in a harsh environment is consistent with the guidelines contained in Regulatory Guide 1.89, *Environmental Qualification of Certain Electric Equipment Important to*

Safety for Nuclear Power Plants, and IEEE Std 323-2003, *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations*. The equipment qualification program will be used to implement these requirements through a combination of design specifications, analyses, tests, and inspections. The nuclear safety design basis requirements will be integrated with processes for procurement, installation, startup testing, maintenance, surveillance, aging management, and condition monitoring to ensure ITS SSCs in the equipment qualification program perform their intended safety functions as described in SAR Section 1.13.2.5. The figures in SAR Section 1.13 identify areas of harsh and mild environments following an event sequence.

Active ITS components are qualified to perform their safety functions during a loss of cooling. Non-ITS SSCs are not required to function during the loss of cooling. Components whose malfunction could cause an ITS SSC to fail to perform its safety function are also classified as ITS, as well as any design feature that may be implemented to prevent the unacceptable interaction. Non-ITS SSCs may malfunction or provide erroneous information to an operator; however, neither an operator, nor a non-ITS SSC, can override or cause the failure of an ITS safety function. As long as waste forms are being handled, operators are prevented from performing an unsafe action causing a release of radioactive material or resulting in radiological exposure of workers or the public. For example, SAR Figure 1.2.4-103 shows that commands from the digital control and management information system, process requests, or operator actions, can not override the safety function of the ITS adjustable speed drive.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

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

Regulatory Guide 1.89, Rev. 1. 1984. *Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 238593.