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TABLE OF CONTENTS

1. PURPOSE

The purpose of this HVAC design analysis is to provide a reasonable basis for the Viability Assessment (VA) design of the Heating, Ventilation, and Air Conditioning (HVAC) systems serving the Waste Handling Building (WHB), the Waste Treatment Building (WTB), and the Carrier Preparation Building (CPB).

The objective of this design analysis is to establish the ventilation air required to maintain proper indoor air quality standards, comfort in normally occupied areas, and establish ventilation confinement zones for the protection of the operating personnel and the environment. In addition, this design analysis will perform a preliminary sizing of the major HVAC components and provide air flow diagrams of the HVAC systems.

2. QUALITY ASSURANCE

An activity evaluation has been performed in accordance with QAP-2-0 and has determined that the QA program is applicable to this analysis. The classification of permanent items described in QAP-2-3 *Classification of Permanent Items* has not been performed for the waste handling systems and facilities. However, waste handling systems and facilities are identified as "Q" in the project *Q-List* (Reference 5.1) by direct inclusion. Therefore, items addressed in this analysis are to be considered "Q" items, and are subject to the requirements of the *Quality Assurance Requirements and Description* (QARD) (Reference 5.2). Therefore, as specified in NLP-3-18, this analysis shall be documented as being subject to QA controls.

Although the results from this analysis will define the space requirements and equipment sizes for the waste handling systems in the WHB, they are considered preliminary and will not be used for procurement, fabrication or construction. Therefore, the formal TBV and TBD tracking system described in NLP-3-15, To Be Verified (TBV) and To Be Determined (TBD) Monitoring System, is not applicable. Any data from this analysis that is used as design input must be treated as unconfirmed (TBV) and tracked per NLP-3-15 prior to inclusion in documents supporting fabrication, procurement, or construction.

3. METHOD

The HVAC design analysis is applied independently to each of the buildings listed in this analysis. This analysis begins with an evaluation of the functions presented in the mechanical and process flow diagrams (References 5.3 and 5.4) in order to design an HVAC system that considers important features such as contamination confinement, safety, and comfort. The evaluation provides a preliminary idea of how the HVAC system is to be compartmentalized to serve areas of the facility identified to have similar requirements.

Calculations for ventilation air requirements for the facilities are based on the air change frequency method. Air flow quantities are calculated by using selected air change frequencies with room volumes that are derived from the tabulated room areas and room heights as shown in Reference 5.5. The air change frequency selection is based on the HVAC design experiences for nuclear facilities of similar functions and sizes. The selection of the air change frequency for each specific room is determined on a case-by-case basis. Considerations such as occupants' comfort, health and safety, process equipment optimum performance, process equipment exhaust, ventilation confinement, and zone pressurization are also included. Building air leakage is expected to be insignificant since the buildings are most likely to be windowless structures with few exterior doors. It is for this reason, and for the fact that the general arrangement drawings are not yet available to be used for this analysis, that building air leakage calculation is not performed. Building air leakage calculation will be performed later when further relevant information becomes available.

The HVAC calculations will be reevaluated and updated to reflect the new design information after the general arrangement drawings of the facilities have been completed, the location of internal heat loads have been identified, radiological bases and loads have been determined, and requirements for HEPA filter performance have been identified. The new design capacities will be reflected also on the air flow diagrams.

The calculations included in Attachments I, II, and III were performed on spreadsheets by using LOTUS 1-2-3, Release 5 computer software program. User formulas are referenced in each associated spreadsheet for the calculations.

The sizing of HVAC equipment in this analysis is preliminary, using manufacturers' equipment selection data as guides. Manufacturers' equipment selection data are included in the associated calculation sections in Attachments I, II, and III.

4. DESIGN INPUT

The information shown as (TBV) identifies unqualified data . Consequently, the use of any data from this analysis for input into documents supporting procurement, fabrication, or construction is required to be controlled and tracked as TBV or TBD in accordance with NLP-3-15 or other appropriate procedures.

4.1 DESIGN PARAMETERS

4.1.1 The building spaces used in the preparation of this design analysis are those described in Interoffice Correspondence (Reference 5.5) (TBV).

4.1.2 The local climatological data presented in this analysis is based on an average result from the four closest and most representative stations operated by the Management and Operating Contractors (M&O) Radiological and Environmental Field Program Department (R/EFPO) in the Yucca Mountain vicinity (Reference 5.6) (TBV). The climatological data presented in the RIB Document (YMP/93-02, Rev. 3, ICN 1) are not used as the basis for this analysis because the data presented therein are not current information and are comprised of results from the Yucca Flats weather station 25 miles away. The data from the R/EFPO are more current and obtained from results of weather stations operated by the M&O as close as 3 miles away from the location of the North Portal.

4.2 CRITERIA

The following criteria are directly applicable to the design subject and are restated in terms of that portion of the criterion which is addressed within this analysis.

4.2.1 The WHB and WTB ventilation systems are to accomplish the following confinement functions in accordance with DOE Order 6430.1A, Section 1550-99.0 (Reference 5.13):

4.2.1.1 Minimize the spread of radioactive and other hazardous materials within the unoccupied process areas.

4.2.1.2 Prevent, if possible, or else minimiz, the spread of radioactive and other hazardous materials to occupied areas.

4.2.1.3 Minimize the release of radioactive and other hazardous materials in facility effluents during normal operation and anticipated operational occurrences.

4.2.1.4 Limit the release of radioactive and other hazardous materials resulting from DBEs, including severe natural phenomena and man-made events.

4.2.2 Functions of the WHB whose failure could adversely affect the environment or the safety and health of the public will be provided with special facility components, systems, and structures that meet requirements for safety class. Safety class ventilation is generally designed to operate in conjunction with physical barriers to form a confinement system to limit release of radioactive or other hazardous material to the environment and to prevent or minimize the spread of contamination within the facility. [DOE Order 6430.1A. Section 1550-99.0] (Reference 5.13).

4.2.3 The ventilation system will provide quantities of air with enough outside air makeup for the effective removal of noxious odors, hazardous gases, vapors, fumes, dusts, and mists; for the provision of fresh air for the health and safety of occupants, and to satisfy the building heating and cooling load requirements. [DOE Order 6430.1A, Section 1550] (Reference 5.13)

4.2.4 The HVAC equipment in the facilities shall be sized to conform with the guidelines in NUREG 0700 Section 6.1.5, MIL-STD-1472D Section 5.8.1, and the applicable ASHRAE standard may be used as reference. [RDRD 3.2.4.2.2] (Reference 5.7).

4.2.5 Elevated stacks will be used for the WHB and WTB confinement exhaust air discharge.[DOE Order 6430.1A, Section 1550-99.0.2] (Reference 5.13).

4.2.6 The following criteria are used for the HVAC ventilation areas for the Waste Handling Building and Waste Treatment Building:

4.2.6.1 Surface nuclear facilities ventilation systems which support transfer, inspection, decontamination, processing, or packaging shall be designed to provide protection against radiation exposures and off-site releases. [RDRD 3.7.4.1.C] (Reference 5.7)

4.2.6.2 The control and protection from airborne radioactive material shall be as referenced in the RDRD. [RDRD 3.2.2.3, 3.7.4.1.A.7, and 3.7.7.A.1] (Reference 5.7). It should be noted that RDRD 3.7.4.1.A.7 refers to documents that have been superseded, are obsolete, or are not applicable to this analysis.

4.3 ASSUMPTIONS

4.3.1 This analysis assumes that HEPA filtration will be required for the ventilation air exhaust until determined otherwise by safety analyses. The HEPA filtration housings shown in Attachments IV and V shall be of the walk-in type HEPA housings similar to those used in the PF-4 Facility in the TA-55 Area in Los Alamos, NM. The HEPA housings shall be configured based on the requirements of ASME AG-1-1994 (Reference 5.8). (TBV)

4.3.2 The overall design of the ventilation confinement zoning philosophy described in Section 7.1.1 considers that the nuclear material received has aged and very little of the radioactivity present is available in a dispersible form, and that there is no mechanism present in the nuclear material to cause the release of radioactive material in significant quantities. The age of the nuclear material is described in the CDA, Key Assumptions 002, 004, and Key 005 (Reference 5.9). (TBV)

4.3.3 Nuclear facilities are normally designed to be reasonably air tight with few exterior doors and windows . It is for this reason that the facilities included in this analysis are assumed to be reasonably air tight. Consequently, no special provisions or extra capacity in the ventilation systems will be required to account for air in-leakage. (TBV)

4.3.4 For this level of detail, and due to the fact that internal heat loads have not been identified, the air change frequencies discussed for the rooms in the WHB, Section 7.2, and the WTB, Section 7.3, are assumed to be adequate to satisfy the requirements of their internal heat loads. (TBV)

4.3.5 The climatological conditions presented in this analysis are comprised of the average results from the four closest and most representative stations operated by the Management and Operating (M&O) contractor. (Reference 5.6). (TBV)

4.3.6 The height and location of the stacks described in 4.2.5 shall consider location of physical obstructions and ventilation air intakes of other facilities to preclude recycle of exhaust air and to limit on-site and off-site doses by enhancing atmospheric dispersion. The stack shall be located so that it cannot fall on nuclear materials in transit to the Repository or fall on the adjacent facility. (TBV)

4.3.7 The building spaces used in the preparation of this design analysis are those described in Interoffice Correspondence (Reference 5.5) and are used in Section 7.2 for the WHB, Section 7.3 for the WTB, and Section 7.4 for the CPB. These design inputs are being used because they are the best available, even though they have not been formally qualified per the QA program. (TBV)

4.3.8 The indoor temperature design conditions used in this analysis are selected from rooms that appear to have similar functions in ANSI/ANS-57.7, Appendix E. (TBV)

4.3.9 The design of the ventilation system is intended to meet applicable requirements described in Reg. Guides 1.52, 1.140, and NUREG-0800. However, the applicable sections are not listed in this design analysis but will be identified during the License Application Design. (TBV)

4.3.10 The design of the HVAC outside air filtration for dust loading due to sandstorm and the inlet configuration for protection from wind generated missiles shall consider the Design Basis Tornado (DBT) based on the "Parameters of Design Basis Tornadoes (DBTs) for NTS". These parameters are given in the Reference Information Base (RIB), Section 1.3b, Table 2. Even though tornadoes have never been observed on the Nevada Test Site (NTS) or within 150 miles of the NTS, the design of the surface facilities will be consistent with that used at the NTS. (CDA, Key Assumptions 006 and 007 (Reference 5.9)). (TBV)

4.3.11 The ventilation system shall be provided with an exhaust volume rate of at least 10% of the actual room air volume per minute for the effective removal of noxious odors, hazardous gases, vapors, fumes, dusts, mists, and for the provision of fresh air for the health and safety of occupants per the *Health Physics Manual of Good Practices for Reducing Radiation Exposure to Levels that are ALARA* (Reference 5.12) (TBV). For this analysis, exhaust rates as high as 100% are used in some areas to prevent cross-contamination or recycling of decontamination process or welding fumes. The non-rad or occupied areas are provided with 20% exhaust rates to comply with minimum requirements of air quality ASHRAE standard 62-1989 (Reference 5.14). (TBV)

4.4 CODES AND STANDARDS

The following codes and standards apply to this design analysis:

4.4.1 United States Department of Energy (DOE) Order

DOE 6430.1A General Design Criteria, April 6, 1989.

4.4.2 Industry Standards

4.4.2.1 American National Standard Design Criteria for an Independent Spent Fuel Storage Installation, ANSI/ANS-57.7, 1981, Appendix E.

4.4.2.2 Code on Nuclear Air and Gas Treatment, ASME AG-1-1994

4.4.2.3 ASHRAE Handbooks (Fundamentals, Systems, and Equipment), 1993

4.4.2.4 ASHRAE Standard 62-89

4.4.2.5 SMACNA HVAC Systems Duct Design - 1990 edition.

4.4.3 Code of Federal Regulations (CFR)

Title 10 Energy, Part 60 - Disposal of High-Level Wastes in Geologic Repositories, 1997 Edition.

5. REFERENCES

5.1 *Q-List,* U.S. Department of Energy, YMP/90-55Q, REV 4.

5.2 *Quality Assurance Requirements and Description* (QARD), U. S. Department of Energy, DOE/RW-0333P, REV 7.

5.3 *Repository Surface Design MFDs*, M&O Document Identifier (DI): BCBD00000-01717-2700-67000 through -67014, Rev. 00. (TBV)

5.4 *Repository Surface Design PFDs,* DI: BCBD00000-01717-2700-67500 through -67519, Rev. 00. (TBV)

5.5 Interoffice Correspondence, S. J. Meyers to E. S. Segura, *Estimated Volumes for Nuclear Facility HVAC Design*, LV.SD.SJM.7/97-026, Civilian Radioactive Waste Management System, August 20, 1997.

5.6 *Engineering Design Climatology and Regional Meteorological Conditions Report,* DI: B00000000-01717-5707-00066, REV 00.

5.7 *Repository Design Requirement Document* (RDRD), Yucca Mountain Site Characterization Project, YMP/CM-0023, REV. 0, ICN 1.

5.8 *Code on Nuclear Air and Gas Treatment,* ASME AG-1-1994 (Formerly ASME N509 and N510).

5.9 *Controlled Design Assumptions* (CDA) *Document,* DI: B00000000-01717-4600-00032 REV 04, ICN 2.

5.10 *ASHRAE Handbooks* (Fundamentals, Systems, and Equipment) - 1993.

5.11 *SMACNA HVAC Systems Duct Design* - 1990 Edition.

5.12 *Health Physics Manual Of Good Practices For Reducing Radiation Exposure to Levels That Are As Low As Reasonably Achievable (*ALARA*)*, DE89-000406.

5.13 *General Design Criteria,* DOE 6430.1A, April 6, 1989.

5.14 *ASHRAE Standard* 62-89

5.15 *American National Standard Design Criteria for an Independent Spent Fuel Storage Installation,* ANSI/ANS-57.7, 1981, Appendix E.

6. USE OF COMPUTER SOFTWARE

The computation/support software used for this analysis is *LOTUS 1-2-3 Release 5.* This is an acquired software spreadsheet program as defined in QAP-SI-0. User defined formulas and/or algorithms, inputs and results are documented in Attachments I, II, and III.

7. DESIGN ANALYSIS

7.1 INTRODUCTION

The tasks in this design analysis are for the WHB (Section 7.2), the WTB (Section 7.3), and the CPB (Section 7.4). The development of the HVAC system is based on consideration of health and safety, interface with process and mechanical functions, and initial and operating costs. Included are concepts for ventilation contamination confinement, and modes of operation (e.g., normal and emergency). The air flow calculations to satisfy the requirements for heat gain, heat loss, and facility design conditions are defined to size the major HVAC equipment, as shown on the HVAC air flow diagrams.

7.1.1 Contamination Confinement

The HVAC system shall be provided with features that operate in conjunction with physical barriers to control the spread of contamination within the facility and to mitigate consequences of design basis events (DBEs). The contamination confinement ventilation systems for nuclear facilities are determined on a case-by-case basis. The degree of ventilation confinement will suit the most restrictive hazard anticipated. Therefore careful consideration will be given to the type, quantity, physical and chemical form, and packaging of the material to be handled in the facility. Safety analyses to be performed are expected to require some form of HEPA filtration for WHB operations. The three confinement ventilation systems will be used based on the potential level of dispersible radionuclides. The design of the ventilation system ensures the ability to maintain a desired airflow characteristic from one ventilation zone to another based primarily on their potential for airborne contamination. The airflow direction will be established by controlling the room pressures to permit the air to flow from the outside environment to areas with lower potential for contamination through to areas of higher potential for contamination and discharged to the environment after cleaning through a final HEPA exhaust system.

The ventilation areas for contamination confinement are classified as follows:

7.1.1.1 Primary Confinement Ventilation Zone

Primary confinement ventilation zones are maintained at the lowest negative pressure differential relative to the secondary confinement ventilation zone. These are the normally contaminated areas consisting of areas where the nuclear material is exposed and not protected by any qualified process enclosure, sealed shipping or disposal container, or the transfer pool water, and the associated ventilation system.

7.1.1.2 Secondary Confinement Ventilation Zone

Secondary confinement ventilation zones are maintained at a lower negative pressure differential relative to the outside environment. These are the areas with high potential for contamination and consist of areas where the handled nuclear material is in a process enclosure, in unloading preparation stages, in lid welding stages, or in the transfer pool, and the associated ventilation system.

7.1.1.3 Tertiary Confinement Ventilation Zones

Tertiary confinement ventilation zones are maintained at a lower negative pressure differential relative to the outside environment, but higher than the secondary confinement ventilation zone pressure. These areas are usually free of radioactive material, except only in approved containers, and the associated ventilation system. These areas, however, may be subject to an unplanned low level of airborne radioactive contamination.

7.1.1.4 Non-Contaminated Areas

These are areas of the facilities that are considered normally clean and do not have potential for contamination will be maintained at a higher differential pressure than the adjacent tertiary confinement zones.

7.1.2 Ventilation Air

As described in Section 4.3.11, the ventilation system shall be provided with exhaust air volumes for the effective removal of noxious odors, hazardous gases, vapors, fumes, dusts, and for the provision of fresh air for the health and safety of occupants. Additionally, higher exhaust rates will be used in some areas to prevent cross-contamination or recycling of decon process or welding fumes. The non-rad or occupied areas are provided exhaust rates to comply with minimum air quality standards.

7.1.2.1 Primary Confinement Ventilation Zone

Primary confinement ventilation zones are provided with an air change frequency of 8 air changes/hour to preclude a buildup of contamination during normal operation. However, an air frequency of up to 10 air changes/hour will be provided if the area has high internal heat loads. Access to these areas is normally restricted.

7.1.2.2 Secondary Confinement Ventilation Zone

The ventilation rates of the secondary confinement ventilation zone areas are similar to the primary confinement ventilation zone. Some of these areas may be occupied intermittently by operating personnel.

7.1.2.3 Tertiary Confinement Ventilation Zone

These areas are normally occupied by operating personnel and are provided with a range of 4 to 8 air changes per hour to meet minimum requirements for air quality standards. If the area is normally unoccupied and has low internal heat gain it is provided with an air change frequency of 4 air changes/hour. However, an air frequency of up to 10 air changes/hour will be provided if the area has high internal heat loads.

7.1.2.4 Adjustment for Effective Room Height

The air change frequencies in Sections 7.1.2.1 through 7.1.2.3 apply to an approximate effective room height of 20 feet, and the portion of the room height exceeding 20 feet will be estimated at an air change frequency of two air changes per hour. This air change frequency adjustment does not affect occupant comfort and equipment performance and is good engineering practice since it reduces the monitored effluents from nuclear facilities. Additionally, it is done for economical reasons due to the use of more HEPA filtration units.

7.1.2.5 Non-Contaminated Areas

Areas where there is no potential for contamination are not ventilated for radiological confinement but will be ventilated based on industrial or commercial standards as applicable.

7.1.3 Water-cooled vs. Air-cooled System Selection

Water-cooled vs. Air-cooled system selection is normally based on the life-cycle cost (LCC) analysis procedures outlined in DOE 6430.1A, Section 0110-12.7 (Reference 5.13). Water-cooled systems will be considered where two or more adjacent buildings are to be air conditioned per DOE 6430.1A, Section 1550-2.1 (Reference 5.13). Large cooling systems that operate year round due to high internal heat loads, considered in this analysis, are normally water-cooled. In the absence of an LCC analysis, a series of assumptions are evaluated to determine if a central water-cooled system is the appropriate system for this design analysis. It should be noted that even if the LCC analysis (not part of this analysis) determines that air-cooled is the appropriate system, the HVAC chiller and air-side equipment sizes and layout will not be changed either with a water-cooled system or with an air-cooled system.

7.1.3.1 Advantages of Water-Cooled System

- The site ambient low wet bulb temperature and high dry bulb temperature are more suitable for cooling tower performance.

- The water-cooled system (cooling tower) energy consumption gets better the lower the ambient wet bulb temperature. The air-cooled system for the same condition is higher. This is very significant when the system capacity is very large.

- Equipment for water-cooled systems is available in modules as large as 3,000 tons of refrigeration, which will suit the large cooling requirement in this analysis. The air-cooled system would require many smaller capacity modules at higher unit cost.

- Water-cooled equipment (cooling towers) that is located outdoors is quieter than the air-cooled equipment and does not impact the environment as the outdoor air-cooled equipment does.

- Lower maintenance cost is incurred with the water-cooled system due to less equipment to maintain.

- The water-cooled system, except for the cooling tower, is located indoors, reducing deterioration due to exposure to weather.

7.1.3.2 Disadvantage of Water-cooled System

- The water-cooled system requires water, whereas the air-cooled system has no requirement for water.

7.1.4 Ventilation Shutdown v.s. Continuous Ventilation Operation

The main objective for the design modes of operation for the ventilation exhaust system for the WHB is to protect the public and the facility operating personnel from exposure to radioactive and other hazardous materials as a result of anticipated operational occurrences and DBE conditions, including the effect of natural phenomena. For this design analysis, in addition to the normal ventilation exhaust system, the areas expected to be designated safety class, as described in Reference 5.5, will be provided with an additional, separate and independent safety class ventilation exhaust system. The normal exhaust ventilation system for the confinement zones of the WHB will prevent airborne contamination from being released to the atmosphere. In the event a DBE causes a failure of the normal ventilation exhaust system, the standby ventilation exhaust system will automatically activate and provide exhaust and filtration for the primary confinement areas. The standby ventilation exhaust system will be provided with a backup power source for use in the event of a loss-of-electrical-power DBE. The standby ventilation exhaust system is designed with enough capacity to maintain negative pressures and air flow through the facility, and to provide air clean-up prior to discharge to the atmosphere.

Maintaining the facility's negative pressures and inward air flow through the facility at all times ensures that the air flow is from the atmosphere to areas with least potential for contamination, then to areas of greater potential for contamination, and through HEPA filters prior to discharge from the facility. The HVAC system is sized to ensure inward air flow through the facility and to prevent unfiltered air from leaving the facility through any exterior door in the facility that fails to close during and after a design basis event.

7.1.5 Calculation Design Basis

7.1.5.1 Indoor Temperature Conditions

The indoor design conditions used in this analysis are selected from functional areas that appear to be similar to those shown in ANSI/ANS-57.7, Appendix E (Reference 5.15).

Functional Area	Summer (°F)	Winter (°F)
Carrier bay, empty DC prep	90	65
Cask prep, pool areas, decon	90	65
Transfer corridors, WP remediation	90	65
Operating galleries, corridors	76	72
Hot maintenance	76	72
Cold maintenance	76	72
HVAC equipment room (with fan coil unit)	76	72

HVAC equipment room (without fan coil unit)	90	65
Welder maintenance and service bay	76	72
Radwaste packaging	90	65
Administrative, offices	76	72

Winter humidification will not be provided unless substantiated by engineering computation or records that the relative humidity will be less than 30 percent. Summer humidification for personnel comfort will not be provided. The cooling system will be designed to maintain space relative humidity conditions through the normal cooling process and will not have controls to limit the maximum relative humidity unless project specific criteria dictate otherwise [6430.1A, Section 1550-1.2.2 (Reference 5.13)].

7.1.5.2 Outdoor Temperature Conditions

The local climatological data presented in this analysis represent an average result from the four closest and most representative stations operated by the Management and Operating Contractors (M&O) Radiological and Environmental Field Program Department (R/EFPO) in the Yucca Mountain vicinity (See Reference 5.6). See Site Data Calculation in Attachment I. The percentage dry bulb (db) and wet bulb (wb) refers to sources of tabulated weather data for a particular application as directed in DOE 6430.1A, Table 1550-1.2.3.

Application	Winter	Summer
Process areas	99% db	1% db and mean coincident wb
Non process areas	97 ½ % db	2-1/2 % db and mean coincident wb

7.1.5.3 Room Cooling Temperature Rise

Room Cooling Temperature Differential = 15°F (for rooms with normal internal heat loads)
= 30°F (for rooms with high internal heat loads)

During the cooling mode, to maintain a comfort environment in an office-type area with typical internal heat loads, a supply air temperature that ranges from 55 to 60 degrees F is provided to maintain a room temperature of 75 degrees F. The cooling temperature differential is the difference between the room temperature (75°F) and supply air temperature (assume 60°F), which is 15 degrees F.

For process areas that are expected to have high internal heat loads, a room cooling temperature differential of 30 degrees F is sufficient to handle the high room sensible load.

7.1.5.4 Room Heating Temperature Rise

Room Heating Temperature Differential = 20 °F (for rooms with low internal heat loads)
= 5 °F (for rooms with high internal heat loads)

During winter, a normal supply air temperature to maintain a comfort environment in office-type areas with a typical building envelope heat loss ranges from 90 to 95 degrees F. To maintain a room temperature of 72 degrees F, the required room heating temperature differential is the difference between the room temperature (72°F) and the supply air temperature (assume 92°F), which is 20 degrees F.

During operation in winter, some or all of the heat generated inside the process areas is lost through the building envelope. Capability for 5-degree F room heating temperature differential is provided for zone reheat due to different heating demands in various zones.

7.2 WASTE HANDLING BUILDING (WHB) VENTILATION SYSTEM

The task in this design analysis for the WHB is to develop an HVAC system that operates continuously to provide the necessary environmental conditions for the comfort and safety of operating personnel, for the safety of operating equipment, and ensures the confinement of the material handled in the facility. Included are concepts for the ventilation system that operate in conjunction with physical barriers to establish a contamination confinement boundary, safety modes of operation (e.g., emergency), and air flow calculations for sizing the major HVAC equipment, as shown on the WHB HVAC Air Flow Diagrams in Attachment IV.

7.2.1 Ventilation Confinement

The ventilation confinement for the WHB is determined based on the requirements described in Section 7.1.1 and their function as indicated in the Mechanical Flow Diagrams (Reference 5.3).

7.2.1.1 Primary Confinement Ventilation Zone

The primary confinement ventilation zone consists of rooms where the nuclear material has been removed from its approved container, or is out of the material transfer pool, such as the three assembly cells and the three DC load cells, and the associated ventilation system.

7.2.1.2 Secondary Confinement Ventilation Zone

The secondary confinement ventilation zone consists of rooms where the potential for contamination exists because the nuclear material is being unloaded out of its approved protective container under water, the approved container is breached during the unloading preparation stages, or the nuclear material is being moved in its approved disposal container prior to welding of the lids. Included are cask prep rooms, DC decon cells, DC welding cell, DC staging, WP remediation, pool areas, canister transfer cells, and the associated ventilation system.

7.2.1.3 Tertiary Confinement Ventilation Zone

The tertiary confinement ventilation zone consists of rooms where the potential for contamination is very low because the nuclear material in these areas is always in the sealed containers. Included are the pool equipment room, maintenance bays, transfer corridors, operating galleries, welder bays, welder maintenance and service bay, WP transfer/decon, and the associated ventilation system.

7.2.1.4 Non-Contaminated Areas

The remaining areas of the facility have no potential for contamination.

7.2.2 Emergency Operation Mode

The HVAC system will be designed with adequate support equipment and electric power to ensure continuous operation of the safety class HVAC system dedicated to the safety related areas of the facility to mitigate the consequences of DBEs as described in Section 7.1.4. For this design analysis, as a minimum, the areas expected to be designated as safety class in the Interoffice Correspondence (Reference 5.5), such as the pool areas, assembly cell and DC load cell, DC decon cells, cask prep and decon cells, canister transfer cells, DC weld cell, DC staging cell, and WP remediation cell will be provided with a separate HEPA filtration exhaust system with sufficient capacity to ensure adequate inward ventilation flow and to maintain the desired negative pressure differentials. The emergency electrical power source is to be determined later.

7.2.3 HVAC Calculations

The WHB HVAC calculations shown in Attachment I include air flow calculations for sizing the major HVAC equipment, as shown on the HVAC air flow diagrams.

7.2.4 HVAC Air Flow Diagrams

The WHB HVAC Air Flow Diagrams are shown in Attachment IV.

7.3 WASTE TREATMENT BUILDING (WTB) VENTILATION SYSTEM

The task in this design analysis for the WTB is to develop an HVAC system that operates continuously to provide the necessary environmental conditions for the comfort and safety of operating personnel, for the safety of operating equipment, and ensures the confinement of the material handled in the facility. Included are concepts for the ventilation system that operate in conjunction with physical barriers to establish a contamination confinement boundary, and air flow calculations for sizing the major HVAC equipment, as shown on the WTB HVAC Air Flow Diagrams in Attachment V.

7.3.1 Ventilation Confinement

The WTB handles the low level wastes produced in the WHB. The ventilation confinement for the WTB is determined based on the potential for contamination from the operation indicated in the Process Flow Diagrams (Reference 5.4).

7.3.1.1 Primary Confinement Ventilation Zone

The primary confinement ventilation zones in the WTB consists of the process enclosures and equipment. These process enclosures and equipment are not ventilated by the HVAC system. Vents from these enclosures may be exhausted by the ventilation HEPA exhaust system after they have been treated to remove any hazardous or corrosive fumes.

7.3.1.2 Secondary Confinement Ventilation Zone

The secondary confinement ventilation zone consists of rooms where the process enclosures and equipment are located. Included are recyclable liquid LLW processing, chemical liquid LLW processing, solid LLW processing, mixed waste staging, and the associated ventilation system.

7.3.1.3 Tertiary Confinement Ventilation Zone

The tertiary confinement ventilation zone consists of rooms through which the contaminated material is transferred into the processing areas, and the associated ventilation system.

7.3.1.4 Non-Contaminated Area

The remaining areas of the facility have no potential for contamination.

7.3.2 Emergency Operation Mode

Safety related process functions have not been identified in the WTB.

7.3.3 HVAC Calculations

The WTB HVAC calculations shown in Attachment II include air flow calculations for sizing the major HVAC equipment, as shown on the HVAC air flow diagrams.

7.3.4 HVAC Air Flow Diagrams

The WTB HVAC Air Flow Diagrams are shown in Attachment V.

7.4 CARRIER PREPARATION BUILDING (CPB) VENTILATION SYSTEM

7.4.1 Ventilation

The CPB is a high bay, warehouse-type constriction building. It consists of an operations area (high bay) and a low-ceiling support office and toilet area within the building. The ventilation of the building is provided by rooftop exhaust fans and air intake wall through louvers located strategically at low points around the building perimeter. The ventilation system is sized to provide a minimum of 10 air changes per hour. The louvers and associated dampers are interlocked with the exhaust fans.

Their operation is thermostatically controlled by indoor thermostats. The heating system is provided by high intensity infrared heaters (electric). The heaters are mounted near the top of the room or as recommended by the heater manufacturer. The office or support area HVAC is provided by either window air-conditioning units with electric heating coils or heat-pump units. The toilet ventilation is provided by an exhaust fan to provide a 12 air change per hour ventilation rate, and the heating is provided by an electric baseboard or wall heater.

7.4.2 HVAC Air Flow Diagrams

The CPB HVAC Air Flow Diagrams are shown in Attachment VI.

7.4.3 HVAC Calculations

The CPB HVAC calculations shown in Attachment III include air flow calculations for sizing the HVAC equipment, as shown on the HVAC Air Flow Diagrams.

8. CONCLUSIONS

Due to the unqualified/unconfirmed input data used in this analysis the output/data from this analysis cannot be used as input into documents supporting procurement, fabrication, or construction unless they are controlled and tracked as TBV or TBD in accordance with NLP-3-15.

The design analysis presented the conceptual design for the heating, ventilation, and air conditioning for the WHB, WTB, and the CPB. It provided a reasonable basis for the Viability Assessment (VA) for the HVAC systems serving the WHB, WTB, and CPB. The HVAC systems conceptual design for the WHB and the WTB established the minimum volume of ventilation air necessary to maintain air quality standards and comfort in normally occupied areas, and determined ventilation confinement for the protection of operating personnel and the environment from releases of nuclear contamination or other hazardous materials. Included were the calculations for preliminary sizing and determination of the quantity of the major HVAC equipment shown on the air flow diagrams. Also, the chilled water, cooling water, and heating water flow diagrams were produced. The HVAC conceptual design for the CPB established the use of industrial type system design that determined the minimum requirements for summer ventilation with outside air and winter heating with radiant heaters.

In the course of preparation of this design analysis, several aspects were identified that require additional investigation. The scope of this design analysis, and the fact that general arrangement drawings have not been completed, process equipment heat loads have not been determined, radiological bases and source terms have not been identified, precluded investigation of the impact of these aspects during preparation of this design analysis. These aspects are discussed below:

1. Based on the remote and arid location of the facility, the proper comparison of a water-cooled system vs. an air-cooled system should not be limited only to life-cycle analysis procedures

as outlined in DOE 6430.1A , Section 0110-12.7, Building Analysis Procedures, but should include studies of availability of water, water quality, and water treatment. The effect of sandstorms on both the cooling tower and the air-cooled equipment should also be evaluated.

2. The recommendation of using a ventilation system that is designed to operate continuously during normal operating conditions and is provided with a separate and independent safety class HEPA exhaust system with emergency power designed to operate continuously during and after a design basis event vs. a ventilation system that is allowed to shut down or is manually shut down should be verified by safety analysis procedures.

3. Upon completion of the facilities' general arrangement drawings, facility air in-leakage calculation should be developed to determine the impact on the HVAC system capacities, and to verify capability to maintain negative pressure differentials.

4. Determination of HEPA filtration stages required for WHB exhaust system to meet radiological dose limits.

5. Evaluation of HEPA bypass mode of operation based on potential radiological dose limits.

9. ATTACHMENTS

ATTACHMENT	DESCRIPTION
I	WHB HVAC Calculations
II	WTB HVAC Calculations
III	CPB HVAC Calculations
IV	WHB HVAC Air Flow Diagrams
V	WTB HVAC Air Flow Diagrams
VI	CPB HVAC Air Flow Diagrams
VII	Hydronic Diagrams
VIII	Carrier Psychrometric Formulas and Altitude Effects