**BSC**

# Design Calculation or Analysis Cover Sheet

*Complete only applicable items.*

1. QA: QA

2. Page 1

| 3. System | 4. Document Identifier |
|---|---|
| Surface Nuclear Confinement HVAC System | 050-M8C-VC00-00500-000-00B |

5. Title

WHF Equipment Sizing and Selection Calculation (ITS)

ENG.20071031.0001

6. Group

Engineering/Mechanical/HVAC

7. Document Status Designation

☐ Preliminary ☒ Committed ☐ Confirmed ☐ Cancelled/Superseded

8. Notes/Comments

Change bars are not shown due to editorial changes throughout the document.

| Attachments | Total Number of Pages |
|---|---|
| None | |
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**RECORD OF REVISIONS**

| 9. No. | 10. Reason For Revision | 11. Total # of Pgs. | 12. Last Pg. # | 13. Originator (Print/Sign/Date) | 14. Checker (Print/Sign/Date) | 15. EGS (Print/Sign/Date) | 16. Approved/Accepted (Print/Sign/Date) |
|---|---|---|---|---|---|---|---|
| 00A | Initial Issue. | 21 | 21 | Gin C. Cababa 5-23-07 | Orlando Asuncion 5-23-07 | Tracy Johnson 5-25-07 | Hadi Jalali 5-27-07 |
| 00B | Issued to update this calculation based on the current WHF Heating and Cooling Load Calculation (Confinement Non ITS), 050-M8C-VC00-00400-000-00B (Trend ENG-FY07-085). | 20 | 20 | Gin C. Cababa 10/30/07 | Orlando Asuncion 10/30/07 | Tracy Johnson T Johnson 10/31/07 | Hadi Jalali 10/31/07 |

## DISCLAIMER

The calculations contained in this document were developed by Bechtel SAIC Company, LLC (BSC) and are intended solely for the use of BSC in its work for the Yucca Mountain Project.

## CONTENTS

# TABLES

# ACRONYMS AND ABBREVIATIONS

Acronyms

| | |
|---|---|
| ALARA | as low as is reasonably achievable |
| ASD | adjustable speed drive |
| HEPA | high-efficiency particulate air (filter) |
| HVAC | heating, ventilation, and air-conditioning |
| ITS | important to safety |
| WHF | Wet Handling Facility |

Abbreviations

| | |
|---|---|
| cfm | cubic feet per minute |
| HP | horsepower |
| in. | inch or inches |
| in. w.g. | inches of water gauge |
| lbs | pounds |

# 1. PURPOSE

The purpose of this calculation is to determine envelope dimensions and select the quantities, weights, configuration, and motor horsepower (if applicable) for the following equipment supporting the Wet Handling Facility (WHF) heating, ventilation, and air-conditioning (HVAC) confinement important to safety (ITS) system:

- Exhaust high-efficiency particulate air (HEPA) filter plenum including the housing, plenum for the deluge system, roughing filter/demister, HEPA test sections, and HEPA filter banks

- Exhaust fans for Train A and Train B.

This calculation does not address any equipment clearance and service envelope requirements.

# 2. REFERENCES

## 2.1 PROCEDURES/DIRECTIVES

2.1.1 EG-PRO-3DP-G04B-00037, Rev. 09. *Calculations and Analyses.* Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070717.0004.

## 2.2 DESIGN INPUTS

2.2.1 BSC (Bechtel SAIC Company) 2007. *Basis of Design for the TAD Canister-Based Repository Design Concept.* 000-3DR-MGR0-00300-000-001. Las Vegas, Nevada: Bechtel SAIC Company. ACCs: ENG.20071002.0042 and ENG.20071026.0033.

2.2.2 BSC 2007. *Preliminary Preclosure Nuclear Safety Design Bases.* 000-PSA-MGR0-01000-000-001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071015.0008.

2.2.3 ASHRAE (American Society of Heating, Refrigerating & Air-Conditioning Engineers) 2005. *2005 ASHRAE® Handbook, Fundamentals.* Inch-Pound Edition. Atlanta, Georgia: American Society of Heating, Refrigerating and Air Conditioning Engineers. ISBN 1-931862-70-2.

2.2.4 BSC 2007. *WHF Heating and Cooling Load Calculation (Confinement Non ITS).* 050-M8C-VC00-00400-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071027.0023.

2.2.5 BSC 2007. *WHF Air Pressure Drop Calculation (ITS)*. 050-M8C-VC00-00600-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20070503.0009.

2.2.6 BSC 2007. *Wet Handling Facility General Arrangement Ground Floor Plan*. 050-P10-WH00-00102-000 REV 00A. ACC: ENG.20070703.0030.

2.2.7 Flanders/CSC Corporation 2004. General Products Bulletin. PB-2006-0103, Rev. 2. Bath, North Carolina: Flanders/CSC Corporation. TIC: 257744. (DIRS 175576)

2.2.8 Twin City Fan & Blower Company (n.d.). Twin City Commercial Products Binder. Minneapolis, Minnesota: Twin City Fan & Blower Company, A Twin City Fan Company. TIC: 257748. (DIRS 175551)

2.2.9 NEMA MG 1-2006, 2006. *Motors and Generators*. Rosslyn, Virginia: National Electrical Manufacturers Association. TIC: 258678. (DIRS 177612)

2.2.10 ANSI/ASHRAE/IESNA Std 90.1-2004. 2004. *Energy Standard for Buildings Except Low-Rise Residential Buildings.* I-P Edition. Atlanta, Georgia: American Society of Heating, Refrigerating and Air-Conditioning Engineers. ISSN 1041-2336.

2.2.11 AISC (American Institute of Steel Construction) 2005. *Steel Construction Manual.* 13th Edition. Chicago, Illinois: American Institute of Steel Construction. ISBN 1-56424-055-X.

2.2.12 BSC 2007. *Project Design Criteria Document.* 000-3DR-MGR0-00100-000-007. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071016.0005.

2.2.13 Camfil Farr (n.d.). General Products Catalog. Riverdale, New Jersey: Camfil Farr. TIC 257752. (DIRS 175575)

2.2.14 BSC 2007. *WHF Building Confinement Areas Air Leakage Calculation.* 050-M8C-VC00-00100-000-00B. Las Vegas, Nevada: BSC SAIC Company. ACC. ENG. 20070924.0030.

## 2.3 DESIGN CONSTRAINTS

None

## 2.4 DESIGN OUTPUTS

2.4.1 *Wet Handling Facility Composite Vent Flow Diagram HVAC Supply & ITS Exhaust.* Engineering drawing. 050-M50-VC00-00101-000.

# 3. ASSUMPTIONS

## 3.1 ASSUMPTIONS REQUIRING VERIFICATION

### 3.1.1 Exhaust HEPA Filter Plenum Dimensions and Weights

It is assumed that the exhaust HEPA filter plenum components dimensions and weights, as derived from Flanders/CSC (Reference 2.2.7, In Place Test Containment Housing, PB-2011-1099, p. 11, and PB-2001-0403, p. 17), are suitable for use as equipment/component information.

**Rationale**–The exhaust HEPA filter plenum component dimensions and weights from Flanders/CSC provide representative information of the typical vendor information used for similar components. This information will be used only for space envelope and weight determination. Approved vendors data will be used during the detailed engineering design phase and this calculation will be revised accordingly.

### 3.1.2 Exhaust Fan Dimensions and Weights

It is assumed that the exhaust fan dimensions and weights are derived from Twin City Fan & Blower (Reference 2.2.8, Sub-catalog Backward Inclined & Airfoil Fans, Bulletin 300-E, Model BC SWSI 445, Class III, pp. 15, 23, and 43), are suitable for use as equipment information.

**Rationale**–The exhaust fan dimensions and weights from Twin City Fan & Blower provide representative information of typical vendor information used for similar components. This information will be used only for space envelope and weight determination. Approved vendor data will be used during the detailed engineering design phase and this calculation will be revised accordingly.

### 3.1.3 Exhaust Fan Motor Dimensions and Weight

The exhaust fan motor dimensions and weight are assumed to be as shown in Appendix B, Section B-3, of this calculation.

**Rationale**–The exhaust fan motor dimensions and weight are derived from various motor manufacturers based on the NEMA MG 1-2006 (Reference 2.2.9, Part 13, p. 3) recommended motor frame for totally enclosed fan cooled, 1800 RPM motor. These dimensions and weight provide representative information of typical motor information used in similar application. The width and height include junction box and lifting lugs respectively. The weight includes 15% variation between motor manufacturers. Approved vendor data will be used during the detailed engineering phase and this calculation will be revised accordingly.

### 3.1.4 Total Pressure Drops for Exhaust Fans

The total pressure drops for the exhaust fans for the HVAC system serving the Confinement ITS areas of the WHF are assumed to be 14.6 in. w.g.

**Rationale**–The total pressure required for the exhaust fans previously discussed are taken from committed calculation *WHF Air Pressure Drop Calculation (ITS)* (Reference 2.2.5, Section 7). The fans' total pressure requirement will be verified during detail design based on the final approved calculation.

### 3.1.5 Fan, Motor, and Drive Efficiencies

The following efficiencies are assumed:

- Fan efficiency equal to 70%
- Premium motor (100 to 200 HP) efficiency equal to 95%
- Adjustable speed drive (ASD) losses to be negligible
- Belt drive efficiency equal to 95% (NA)
- Belt drive losses equal to 3% of fan power (NA).

**Rationale**–Fan motor efficiencies range from 80% to 95% (Reference 2.2.10, Table 10.8), fan efficiencies range from 50% to 70% and belt drive losses are 3% of fan power (Reference 2.2.3, pp. 30.30 and 30.31). Also, belt drive efficiencies typically range from 80% to 95%. The actual efficiencies and losses will be verified during the detailed design based upon vendor submittals.

### 3.1.6 Airflow Rates

The airflow rates at actual elevation for the HVAC system serving the Confinement ITS areas of the WHF are assumed to be as shown in *WHF Heating and Cooling Load Calculation (Confinement Non ITS)* (Reference 2.2.4).

**Rationale**–The airflow rates, as indicated in Appendix A, are taken from committed calculation *WHF Heating and Cooling Load Calculation (Confinement Non ITS)* (Reference 2.2.4, Table 4). The ITS exhaust system has two modes of operation: (1) Normal Non ITS Operation and (2) Emergency ITS Operation. The equipment sizing for the ITS exhaust system is based on Non ITS Normal Operation (38,910 cfm). The total capacity of system is the sum of the supply air requirement from the C2 non ITS cooling load and the in-leakage (confinement from the non ITS C2 areas). This non ITS airflow rate is much higher than the ITS leakage requirement of 15,100 cfm (Reference 2.2.14, p. 25) based on confinement. Normal Non ITS Operation airflow rate is used for conservatism. The airflow rates will be verified during detailed design based on the final approved calculation.

## 3.2 ASSUMPTIONS NOT REQUIRING VERIFICATION

### 3.2.1 Exhaust HEPA Filter Plenum Components

The exhaust HEPA filter plenum will contain the following components: inlet plenum, plenum for the deluge system, demister, roughing filter, inlet test section, HEPA filter bank, combination test section, HEPA filter bank, outlet test section, and discharge plenum.

**Rationale**–The standard components listed for this assumption are necessary for an exhaust HEPA filter plenum to be able to perform its intended function. Bag-in/bag-out is used to replace the HEPA filters. The maximum capacity of the unit is selected based on space limitation and as low as is reasonably achievable (ALARA) consideration.

### 3.2.2 Exhaust HEPA Filter Plenum Size Dimensions

The exhaust HEPA filter plenum shall be sized for a maximum 3-filter unit high by 3-filter unit wide. Each filter is sized for a maximum flow of 1,500 cfm (Reference 2.2.12, Section 4.9.2.2.7).

**Rationale**–Bag-in/bag-out is used to replace the HEPA filters. To meet ALARA requirements (Reference 2.2.12, Sections 4.9.2.3.8 and 4.9.2.3.9), the height of the plenum is limited to 3-filter high to be able to replace the HEPA filters without the use of extra tools, such as ladders and scaffoldings. This will minimize the time spend by maintenance replacing the HEPA filters. The 3-filter unit high by 3-filter unit wide is the maximum arrangement for optimum space allocation for one side access. Units having more than 3-filters wide will require both sides of the unit for access.

### 3.2.3 Use of Adjustable Speed Drive

The exhaust fans will be sized to match the HEPA filter plenum capacity. The exhaust fans will be direct drive fans and will be provided with ASD.

**Rationale**–Matching fan airflows and HEPA filter plenum capacity is a logical and conservative approach. The ASDs are necessary to compensate for the increase in static pressure as the filters get dirty.

### 3.2.4 Air Density

The equipment selections for fans and motors are based on standard air conditions (sea level) with an air density of 0.075 $lbs/ft^3$.

**Rationale**–This assumption is acceptable and does not require verification because the manufacturer performance data for fan and motor selection are based on standard air conditions. This assumption is bounding because the actual air density is less at a higher site elevation of 3,310 ft, using the density at sea level will result in higher, more conservative, total air pressure and motor brake horsepower requirements.

# 4. METHODOLOGY

## 4.1 QUALITY ASSURANCE

This calculation was prepared in accordance with EG-PRO-3DP-G04B-00037 (Reference 2.1.1). The surface nuclear confinement HVAC system serving this facility is classified as ITS per *Preliminary Preclosure Nuclear Safety Design Bases* (Reference 2.2.2, Appendix A, Table A-1, p. 61) and in *Basis of Design for the TAD Canister-Based Repository Design Concept* (Reference 2.2.1, Section 19.1.2). Therefore, the approved version is designated QA: QA.

## 4.2 USE OF SOFTWARE

This calculation was prepared using hand calculation and therefore computer software was not used.

## 4.3 DESCRIPTION OF CALCULATION APPROACH

The equipment sizing and selection calculation is completed by hand calculation using the following approach.

### 4.3.1 Exhaust HEPA Filter Plenum

1. Determine the amount of airflow that will be exhausted (Assumptions 3.1.6) from the confinement ITS zone.

2. Determine the quantity of filters required using the maximum flow per filter (Assumption 3.2.2).

3. Determine the size of filter units using the maximum plenum from Assumption 3.2.2 based on the space allocation of the room.

4. Select and size the equipment using applicable criteria and assumed vendor data.

### 4.3.2 Exhaust Fans

1. Obtain all design inputs and assumptions (see Assumptions 3.1.4, 3.1.5, and 3.1.6) for the confinement ITS zone.

2. Determine the quantity of fans required based on HEPA filter plenum capacity and space limitation of the room.

3. Determine the required HP of the exhaust fan by using the following formula (Reference 2.2.3, Chapter 30, p. 30.30): Add 15% to the calculated motor horsepower due to motor starting torque and use the next higher standard motor size.

$$P_A = 0.000157\ Vp \qquad \text{(Eq. 1)}$$

$$P_F = P_A / \eta_F \qquad \text{(Eq. 2)}$$

$$P_M = (1+DL)P_F/E_ME_D \quad \text{(Eq. 3)}$$

Substituting Equation 1 in Equation 2, $P_F = 0.000157\ Vp/\eta_F$ (Eq. 4)

Substituting Equation 4 in Equation 3,

$$P_M = (1+DL)\ 0.000157\ Vp/\eta_F E_M E_D \quad \text{(Eq. 5)}$$

where

$P_M$ = power required at input to motor, HP
$P_A$ = air power, HP
$V$ = flow rate, cfm
$p$ = pressure, in. w.g.
$P_F$ = power required at the fan shaft, HP
$\eta_F$ = fan efficiency, dimensionless
$E_M$ = fan motor efficiency, dimensionless
$E_D$ = belt drive efficiency, dimensionless
$DL$ = drive loss, dimensionless
0.000157 = conversion factor at standard air conditions

For direct drive fans, $E_D$ = 1.0, $DL$ = 0

4. Select and size the equipment using applicable criteria and assumed vendor data.

## 5. LIST OF ATTACHMENTS

None

# 6. BODY OF THE CALCULATION

## 6.1 DETERMINATION OF EQUIPMENT QUANTITIES

### 6.1.1 Exhaust HEPA Filter Plenum

The exhaust filter plenums are ITS units and will serve the loading/unloading room, cask transfer machine maintenance and gas sampling, pool equipment room, pool basement, and cask preparation area. The filter plenums are provided to maintain confinement in these areas in case of a breach.

1. Exhaust Airflow

   Airflow rates = 38,910 cfm (Assumption 3.1.6 and Appendix A).

2. Determination of Quantity of Filters Required

   Each filter is sized for a maximum flow of 1,500 cfm (Assumption 3.2.2).

   Quantity of Filters Required = 38,910 / 1500 = 25.94 filters.

3. Filter Housing Sizing

   Maximum Filter Plenum size = 3-filter high by 3-filter wide (Assumption 3.2.2).

   = 9 filters @ 13,500 cfm

   Quantity of Filter Plenum = 25.94 / 9 = 2.88 (Use three filters: 3H × 3W)

   Filter Plenum capacity = 3 × 13,500 = 40,500 cfm

The equipment arrangement shown in Appendix B, Section B-1, is developed using the dimensions from Appendix B, Section B-2. A second set of three filters 3 ft high by 3 ft wide is provided for redundancy (Reference 2.2.12, Section 4.9.2.2.14). One train is normally operating and the other is a standby.

### 6.1.2 Exhaust Fan

Exhaust Fan capacity = 40,500 cfm (Assumption 3.2.3). Due to space limitation in the mechanical equipment room, use one exhaust fan with a capacity of 40,500 cfm for each train (Train A and Train B). One train will be operating and the other as standby.

From Equation 5, the power required at input to the motor is calculated as follows:

$$P_M = (1+DL)\ 0.000157\ Vp/\eta_F E_M E_D$$

where

$P_M$ = power required at input to motor, HP

$V$ = flow rate = 40,500 cfm (Assumption 3.1.6 and Appendix A)
$p$ = pressure = 14.6 in. w.g. (Assumption 3.1.4)
$\eta_F$ = fan efficiency = 0.70 (Assumption 3.1.5)
$E_M$ = fan motor efficiency = 0.95 (Assumption 3.1.5)
$E_D$ = belt drive efficiency = 1.0 (no losses, fan is direct drive)
$DL$ = drive loss = 0 (fan is direct drive)

$$P_M = (1+0)* 0.000157*(40{,}500)*(14.6)/[(0.70)*(0.95)]$$

$$= 139.6 \text{ HP}$$

$$139.6 \times 1.15 = 160.6 \text{ HP} \qquad \text{(Use 200 HP)}$$

Envelope sizing of the exhaust fan is provided in Appendix B, Section B-3.

## 6.2 EQUIPMENT ARRANGEMENT

For proposed equipment arrangement, see Appendix B, Section B-1

# 7. RESULTS AND CONCLUSIONS

The results of this calculation are presented in Tables 7-1 and 7-2. The configuration dimensions and weights are assumed in Appendix B, Sections B-1, B-2, and B-3. It is concluded that they are acceptable to meet the capacities required by the design inputs provided. Hence, they are suitable for use as the basis for equipment layout in the WHF general arrangement drawings.

**Table** 7-1. HEPA Filter Plenum Sizing

| Zone/Area | Filter Arrange-ment | Rated Flow, cfm | Number of Units | | Plenum Dimension | Weight |
|---|---|---|---|---|---|---|
| | | | Operating | Standby | L × W x H | lbs. |
| HEPA Filter Unit #1 (Train A) | 3H × 2W | 9,000 | 1 | — | 24'-6" × 7'-0" × 8'-6" | 12,000 |
| HEPA Filter Unit #2 (Train A) | 3H × 3W | 13,500 | 1 | — | 24'-6" × 7'-0" × 8'-6" | 18,000 |
| HEPA Filter Unit #3 (Train A) | 3H × 3W | 13,500 | 1 | — | 24'-6" × 7'-0" × 8'-6" | 18,000 |
| HEPA Filter Unit #5 (Train B) | 3H × 2W | 9,000 | — | 1 | 24'-6" × 7'-0" × 8'-6" | 12,000 |
| HEPA Filter Unit #6 (Train B) | 3H × 3W | 13,500 | — | 1 | 24'-6" × 7'-0" × 8'-6" | 18,000 |
| HEPA Filter Unit #7 (Train B) | 3H × 3W | 13,500 | — | 1 | 24'-6" × 7'-0" × 8'-6" | 18,000 |

**Table** 7-2. Exhaust Fan Sizing

| Zone/Area | Rated Flow, cfm | Total Pressure in. w.g. | Number of Units | | Motor HP | Plenum Dimension | Weight |
|---|---|---|---|---|---|---|---|
| | | | Operating | Standby | | L x W x H | lbs. |
| Secondary Confinement Exhaust Fan (Train A) | 40,500 | 14.6 | 1 | — | 200 | 13'-1" × 8'-9" × 6'-10" | 5,800 |
| Secondary Confinement Exhaust Fan (Train B) | 40,500 | 14.6 | — | 1 | 200 | 13'-1" × 8'-9" × 6'-10" | 5,800 |

# APPENDIX A. AIRFLOW RATES

The airflow rates are from calculation *WHF Heating and Cooling Load Calculation (Confinement Non ITS)* (Reference 2.2.4, Table 4 and Assumption 3.1.6)

Table A-1. Design Airflow

Secondary Confinement / Breach Areas

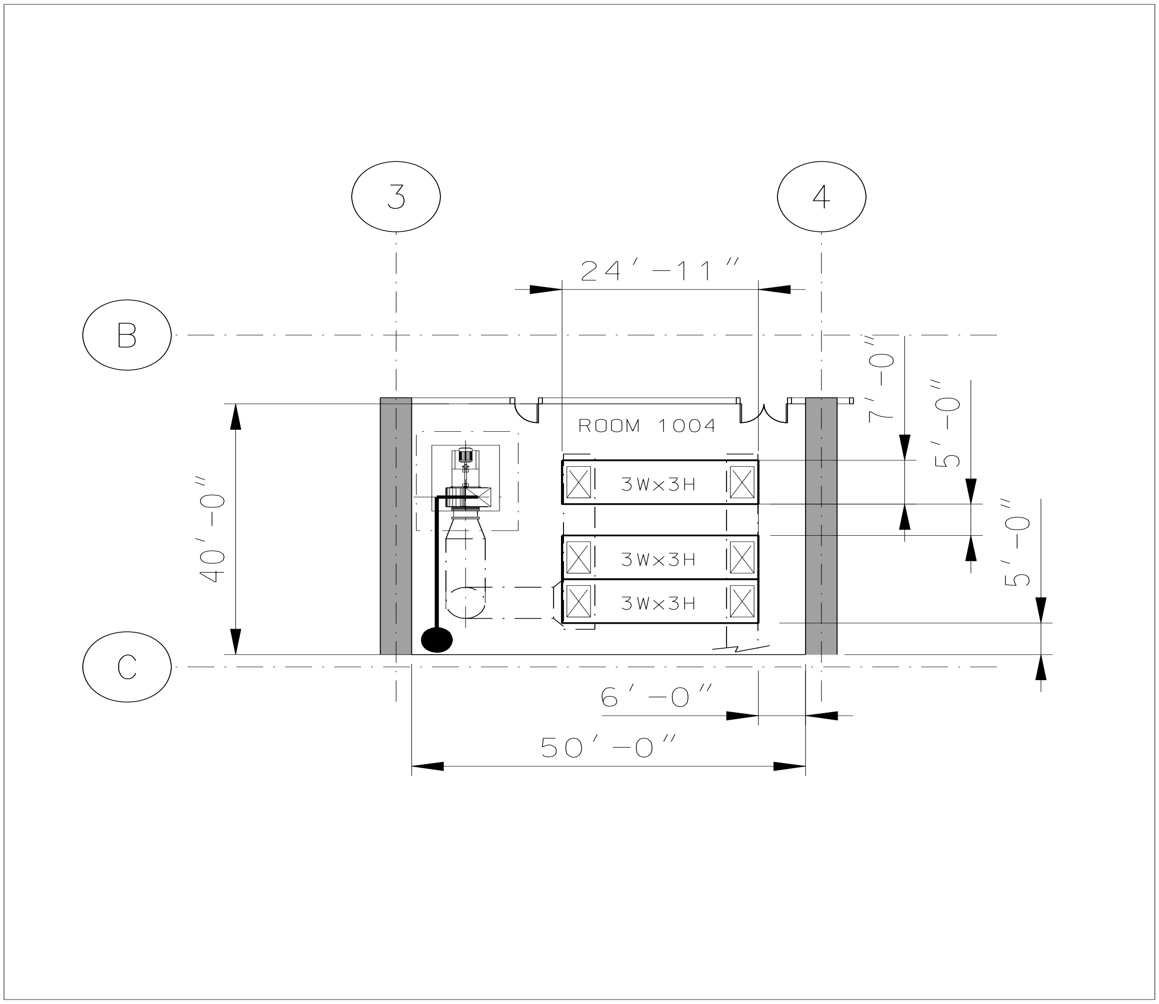
| Room Number | Room Name | Required Exhaust (cfm) | Remarks |
|---|---|---|---|
| 1007 | Loading Room | 0 | Breach area |
| 1008 | Cask Unloading Room | 0 | Breach area |
| 1009 | CTM Maintenance Room | 0 | Breach area |
| 1010 | Gas Sampling Room | 0 | Breach area |
| M001 | HVAC/Pool Equipment Rm | 1,880 | Secondary confinement area |
| 1016 & 2008 | Cask Preparation Room | 9,155 | Secondary confinement area |
| 1042A, B & C | Pool Pump Room | 8,200 | Secondary confinement area |
| 1043A, B & C | Pool Filter Room | 1,775 | Secondary confinement area |
| 1044A, B & C | Pool Ion Exchanger Room | 1,500 | Secondary confinement area |
| 1045A, B, C & D | Corridor | 3,900 | Secondary confinement area |
| B001 to B009 | Pool Basement Area | 8,000 | Secondary confinement area |
| P002 | Decon Pit | 4,500 | Secondary confinement area |
| | Total | 38,910 cfm | |

NOTE: The above rooms are exhausted through the ITS HEPA filter exhaust system (Assumption 3.1.6).

# APPENDIX B. EQUIPMENT ARRANGEMENT & SELECTION

## B1 EQUIPMENT ARRANGEMENT

The room dimensions are from *Wet Handling Facility General Arrangement, Ground Floor Plan* (Reference 2.2.6).



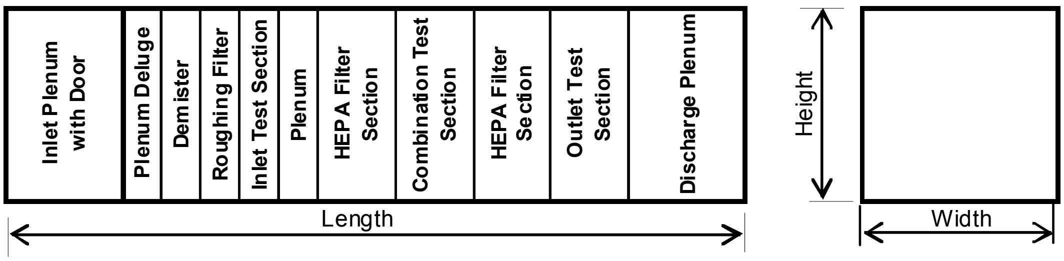

NOTES: 1. Exhaust HEPA Filter Plenum and the Exhaust Fan arrangement for the Train A in Room 1004 are similar to Train B in Room 1021.

2. While the general arrangement drawing (Reference 2.2.6) shows four units, the correct quantity of three units should be incorporated into the next revision of the general arrangement.

## B2 HEPA FILTER UNIT SELECTION

**EXHAUST HEPA FILTER PLENUM**

**Rated Capacity = 13,500 cfm**
**Arrangement : 3 Filters High x 3 Filter wide (2)**




| *Component Description (8)* | *Length, (inch)* | *Estimated Weight (3) per inch length (lbs)* | *Weight, (4) (lbs)* |
|---|---|---|---|
| Inlet Plenum with door (5) | 48 | 60 | 2,880 |
| Plenum Deluge (1) | 12 | 60 | 720 |
| Demister (6) | 12 | 60 | 720 |
| Roughing Filter (7) | 12 | 60 | 720 |
| Inlet Test Section (1) | 28 | 60 | 1,680 |
| Plenum (1) | 12 | 60 | 720 |
| HEPA Filter Section (1) | 25 | 60 | 1,500 |
| Combination Test Section (1) | 28 | 60 | 1,680 |
| HEPA Filter Section (1) | 25 | 60 | 1,500 |
| Outlet Test Section (1) | 24 | 60 | 1,440 |
| Discharge Plenum (5) | 63 | 60 | 3,780 |
| | 289 | or 24'-1" | 17,340 |
| | | | Use: 18,000 lbs |

For 3H x 3W Filter Arrangement: Height (1) = 8'-2"(including 8" base) Use: 8'-6"
Width (1) = 6'-11" Use: 7'-0"
Length = 24'-1" Use: 24'-6"

Notes:
1 Dimensions and weights are based on Flanders/CSC (Assumption 3.1.1)
2 See Assumption 3.2.2
3 From Flanders/CSC In-Place Test Housing, PB-2011-1099 (Reference 2.2.7, page 32), for a 30" high by 75" wide by 20" deep housing, the weight of the section is 280 lbs. This equates 14.0 lbs per inch of length for 30" x 75" housing. By proportion, for a 3H x 3W (102" high by 84" wide) housing, weight per inch of length of this section is approximate 52.7 lbs. Round-up the weight of this housing to be 60 lb. per inch of length to include the media inside and the base channel.
4 Product of length x estimated weight per inch length.
5 Length of component to accommodate the attachment of the intake and exhaust ducts into/from the filter plenum of 3H x 3W.
6 From Camfil Farr General Products. Product Sheet 2408-0302 (Reference 2.2.13)
7 From Camfil Farr General Products. Product Sheet 2405-0302 (Reference 2.2.13)
8 See assumption 3.2.1

# B3 EXHAUST FAN SELECTION

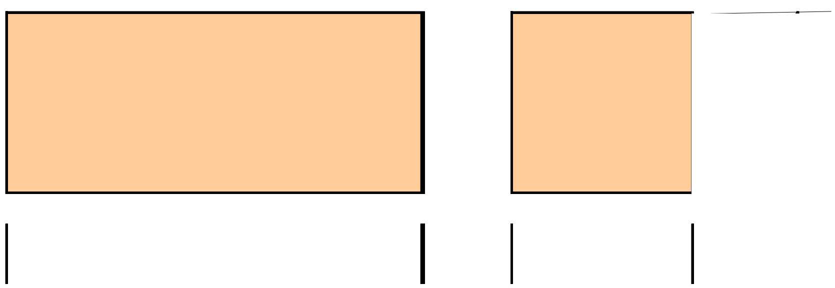
**EXHAUST FAN AND MOTOR**

Exhaust Fan: (1)

| Capacity | | Dimension | | | Weight, lbs |
|---|---|---|---|---|---|
| Airflow, cfm | TSP, in.wg. | Length inch | Width inch | Height inch | |
| 40,500 | 14.6 | 83 | 81 | 76 | 2,112 |

Fan Motor: (2)

| Motor Size | | Dimension | | | Weight, lbs |
|---|---|---|---|---|---|
| HP | Frame | Length inch | Width inch | Height inch | |
| 200 | 447T | 50 | 34 | 27 | 2,070 |



Length = Fan + Motor + 6" both sides base + 6" both sides concrete pad
= 83" + 50" + 12" + 12" = 157 Use: 13'-1"

Width = Use the larger width of the fan + 6" both sides base + 6" both sides concrete pad
= 81" + 12" + 12" = 105" Use: 8'-9"

Height = Use height of fan + 6" base channel
= 76" + 6" = 82" Use: 6'-10"

Weight = Fan + Motor + Steel Base (total length = 60' at 10.5 lbs per ft.)
= 2112 + 2070 + 630 = 4,812 lbs.
with 20% safety factor, Use: 5,800 lbs

**Notes:**
1. Dimensions and weight of Exhaust Fan is based on Twin City Fan & Blower (Reference 2.2.8 and Assumption 3.1.2)
2. Dimensions and weight of motor is based NEMA recommended motor frame (Reference 2.2.9 and Assumption 3.1.3). Length based on frame #445T due to unavailable dimension of frame #447T. Ten percent is added to length for conservatism.
3. Approximate weight of steel based (lbs per foot) on 6" steel channel (Reference 2.2.11, Page 1-40, Channels American Standard Dimensions and Properties).

| BSC | Calculation/Analysis Change Notice<br>*Complete only applicable items.* | 1. QA: Q/A<br>2. Page 1 of 1 |
|---|---|---|

| 3. Document Identifier: | 4. Rev.: | 5. CACN: |
|---|---|---|
| 050-M8C-VC00-00500-000 | 00B | 001 |

6. Title:
WHF Equipment Sizing and Selection Calculation (ITS)

7. Reason for Change:
A typographical issue was discovered in the WHF Equipment Sizing and Selection Calculation (ITS), 050-M8C-VC00-00500-000-00B. Section 7, Results and Conclusion, displayed the incorrect filter arrangement, rated flow (cfm), and weights (lbs.) for HEPA Filter Unit #1 (Train A) and HEPA Filter Unit #5 (Train B). This CACN will resolve CR 12425.

8. Supersedes Change Notice: ☐ Yes  If, Yes, CACN No.: ______ ☒ No

9. Change Impact:

| | | | | | |
|---|---|---|---|---|---|
| Inputs Changed: | ☐ Yes | ☒ No | Results Impacted: | ☐ Yes | ☒ No |
| Assumptions Changed: | ☐ Yes | ☒ No | Design Impacted: | ☐ Yes | ☒ No |

10. Description of Change:

- In Section 7, Results and Conclusion, Table 7-1, for HEPA Filter Unit #1 (Train A) change the following:
  - The filter arrangement from "3H x 2W" to "3H x 3W"
  - The rated airflow from, cfm, "9,000" to "13,500"
  - The weight from, lbs., "12,000" to "18,000"
- In Section 7, Results and Conclusion, Table 7-1, for HEPA Filter Unit #5 (Train B) change the following:
  - The filter arrangement from "3H x 2W" to "3H x 3W"
  - The rated airflow from, cfm, "9,000" to "13,500"
  - The weight from, lbs., "12,000" to "18,000"

**11. REVIEWS AND APPROVAL**

| Printed Name | Signature | Date |
|---|---|---|
| 11a. Originator: Luis Durani | [signature] | 07-29-2008 |
| 11b. Checker: Gin Cababa | [signature] | 7-29-08 |
| 11c. EGS: Maurice LaFountain | N Varamasnan for M. LaFountain | 7-29-08 |
| 11d. DEM: Hang Yang | [signature] | 07-29-2008 |
| 11e. Design Authority: ~~Barbara Rusinko~~ RS 29JUL08 R.C. SLOVIC | [signature] | 29 JULY 2008 |