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QA: N/A
Project No. WM-00011

SEP 19 2003

OVERNIGHT MAIL

ATTN: Document Control Desk
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TRANSMITTAL OF AN EXAMPLE OF THE LEVEL OF DETAIL TO BE FOUND IN SECTIONS OF THE YUCCA MOUNTAIN REPOSITORY LICENSE APPLICATION

The September 16, 2003, letter, the subject of which was "Transmittal of an Example of the Level of Detail to be Found in Sections of the Yucca Mountain Repository License Application," enclosed an incorrect enclosure. The correct enclosure on the heating, ventilation, and air-conditioning system is enclosed. Please replace the enclosure from the September 16 transmittal with this enclosure.

There are no new regulatory commitments in the body of, or enclosure to, this letter. Please direct any questions regarding this letter to Joe C. Price at (702) 794-1441 or Paul G. Harrington at (702) 794-5415.

Joseph D. Ziegler, Director
Office of Licensing Application & Strategy

OLA&S:JCP-1961

Enclosure:
Example of Level of Design Detail

NMSS07

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ENCLOSURE

To

Letter 0918038827

EXAMPLE OF LEVEL OF DESIGN DETAIL

Contains:
- 14 pages of text
- 6 pages of tables
- 10 figures (11" X17" sheets)

EXAMPLE OF LEVEL OF DESIGN DETAIL

1.0 Dry Transfer Facility 1 Heating, Ventilation, and Air-Conditioning System

1.1 System Description

System Functions–The heating, ventilation, and air-conditioning (HVAC) system that serves the Dry Transfer Facility 1 consists of nuclear and industrial HVAC subsystems designed to serve the confinement and non-confinement zones of Dry Transfer Facility 1, respectively. No portion of either subsystem is classified as important to safety (Section 1.3). However, the nuclear HVAC subsystem incorporates appropriate measures to ensure that potential radioactive contamination remains as low as is reasonably achievable (ALARA). The Dry Transfer Facility 1 is designed for receipt of transportation casks; transfer of high-level radioactive waste, spent nuclear fuel, and naval canisters into waste packages; opening dual purpose canisters and transferring spent nuclear fuel; loading of site-specific casks for aging; and welding of the packages before they are transported underground for emplacement. Located within the structure of Dry Transfer Facility 1, the HVAC system is designed to:

- Maintain environmental conditions (temperature, pressure, and relative humidity) for habitability in the Dry Transfer Facility 1. The system provides conditioned air for cooling, heating, and ventilation to ensure air quality meets standards required for the safety, health, and comfort of the occupational workers.

- Maintain environmental conditions for reliable equipment operation and for removal of decay heat dissipated from the nuclear waste during the handling and staging operations performed inside Dry Transfer Facility 1.

- Minimize personnel exposure to radiological hazards associated with the release of radioactive materials so that radiation doses do not exceed acceptable levels and remain ALARA. The HVAC system minimizes the spread of contamination by filtration, maintaining differential pressures between contamination control zones, and ensuring that the ventilation air flows from areas of low potential for contamination toward areas of higher potential for contamination.

- Provide a functionally integrated system that supports safe operation of Dry Transfer Facility 1.

Confinement Zoning–The Dry Transfer Facility 1 is divided into four ventilation zones based on varying degrees of potential contamination to ensure that the radioactive contamination is controlled and minimized. The ventilation zones consist of a primary confinement zone, a secondary confinement zone, a tertiary confinement zone, and a non-confinement zone. The potentially contaminated areas of the facility (primary, secondary, and tertiary confinement zones) are served by the nuclear HVAC subsystem, whereas the clean areas of the facility (non-confinement zone) are served by the industrial HVAC subsystem. Controlling pressures between confinement zones maintains the airflow from areas with low potential for radioactive contamination to areas with higher potential for radioactive contamination. The differential

pressures between confinement zones are shown in Table 1. The confinement zoning conforms to the intent of regulatory position C.4 of Regulatory Guide 3.18.

The ventilation confinement zones of Dry Transfer Facility 1, briefly described here, are shown in Figures 1 through 3.

- **Primary Confinement Zone**–This zone includes areas where radioactive materials are processed and are normally contaminated due to airborne particulates from exposed spent nuclear fuel. The transfer cell, staging area, dual-purpose canister-cutting cell, and remote high-efficiency particulate air (HEPA) filter room are considered part of the primary confinement zone.

- **Secondary Confinement Zone**–This zone includes areas where potential for contamination is high or areas that could become contaminated during an abnormal event. Areas considered to be part of the secondary confinement zone are the operating galleries adjacent to the primary confinement zone, cask preparation and decontamination cells, closure cells and closure maintenance areas, loading and unloading cells, waste package loadout room and buffer area, empty dual-purpose canister load cell, equipment and maintenance access areas, and the HVAC equipment room for the primary confinement exhaust system.

- **Tertiary Confinement Zone**–This zone includes areas where potential for contamination is low, such as the operating galleries adjacent to the closure cells and maintenance areas, shipping cask and waste package receipt areas, HVAC equipment room for the secondary and tertiary confinement exhaust system, and transporter room.

- **Non-confinement Zone**–This zone includes areas where there is no potential for contamination since it is isolated from the confinement zones. Office facilities, electrical rooms, control room, and the non-radioactive support areas are examples of non-confinement zones.

Nuclear HVAC Subsystem–The nuclear HVAC subsystem serves the potentially contaminated zones of Dry Transfer Facility 1 (i.e., the primary, secondary, and tertiary confinement zones) during normal operation and during Category 1 and Category 2 event sequences that may include release of radioactive materials. The design incorporates measures from ALARA consideration although no portion of the subsystem is classified as important to safety (Section 1.3). The electrically operated components of the nuclear HVAC subsystem required for normal operations are powered from the normal electrical power system. The nuclear HVAC subsystem flow diagrams are shown in Figures 4 through 6.

Each of the primary and secondary confinement zones of Dry Transfer Facility 1 is provided with a once-through HVAC supply subsystem and HVAC exhaust subsystem. The HVAC supply subsystem operates under normal operating conditions by drawing 100-percent outdoor air that is filtered and conditioned for distribution to the potentially contaminated areas of the facility. The tertiary confinement zone is provided with a recirculation system that has the capability to exhaust 100 percent of the supplied air upon detection of radioactive contamination.

The exhaust air from the contaminated areas is filtered through the exhaust air-cleaning units prior to release to the atmosphere through the ventilation stack.

The nuclear HVAC subsystem for the primary confinement areas consists of three supply air handling units with three supply air fans, four normal exhaust air-cleaning units with three normal exhaust air fans, and two backup exhaust air-cleaning units with two backup exhaust air fans. Three supply air-handling units with three supply air fans and three normal exhaust air-cleaning units with two exhaust air fans are aligned during normal operating conditions. Each exhaust air-cleaning unit consists of a demister and two stages of HEPA filters.

The exhaust duct leaving the primary confinement areas is provided with a remote HEPA filter system consisting of high-efficiency prefilters and HEPA filters to reduce the amount of radioactive particulate from the exhaust air. The remote HEPA filters are designed for remote maintenance (filter replacement) because of expected high dose rates in the area. Surveillance testing (i.e., in-place leak testing) of remote HEPA filters is not required since the HEPA filters are used only as prefilters.

The nuclear HVAC subsystem for the secondary confinement areas consists of six supply air-handling units with six supply air fans and ten exhaust air-cleaning units with six exhaust air fans. Each exhaust air-cleaning unit consists of a demister, a high-efficiency filter, and two stages of HEPA filters.

The nuclear HVAC subsystem for the tertiary confinement areas consists of two supply air-handling units with two supply air fans to provide the minimum supply of outdoor air, seven recirculating air-cleaning units with four exhaust air fans, and two exhaust air-cleaning units with two exhaust air fans. Each recirculating air-cleaning unit consists of a demister, a high-efficiency filter, a single stage HEPA filter, and a cooling coil. Each exhaust air-cleaning unit consists of a demister, a high-efficiency prefilter, and two stages of HEPA filters.

The backup exhaust air-cleaning units of the nuclear HVAC subsystem maintain the designed negative pressure in Dry Transfer Facility 1 during an event sequence to prevent exfiltration of contaminated air to the surrounding areas and the atmosphere. This portion of the nuclear HVAC subsystem serves the primary confinement areas. The backup exhaust air-cleaning units are redundant, and the associated exhaust fans are powered from a reliable backup power source. The backup exhaust air-cleaning units are provided as defense in depth but are not important to safety because both the onsite and offsite calculated radiological doses meet regulatory requirements without any filtration.

The design of the nuclear HVAC system includes a standby exhaust air-cleaning unit. If the normally operating unit fails to start during normal operation, the standby unit automatically starts to maintain the design room differential pressure and continue its filtration function. The standby unit also permits isolation of an exhaust air-cleaning unit for filter replacement or maintenance. The standby unit is brought online without diminishing either the capacity or the function of the entire system.

The HVAC supply and exhaust equipment rooms are located such that potentially contaminated air will not be recirculated back through the outdoor air intakes. The HVAC supply and exhaust

equipment room layout, location of the outdoor air intakes, and location of the ventilation stack are shown in Figures 7 and 8. The filters, coils, demisters, supply fans, and exhaust fans are located in these rooms.

Industrial HVAC Subsystem–The Dry Transfer Facility 1 industrial HVAC subsystem serves the Dry Transfer Facility 1 non-confinement zones (i.e., clean areas) not served by the nuclear HVAC subsystem during normal operation, such as the control room, non-radioactive support rooms, and electrical rooms. The subsystem is provided with a recirculation HVAC system and is designed to maintain a slight positive pressure in the non-confinement areas relative to atmosphere or adjacent confinement areas. The industrial HVAC subsystem is not required to operate during an event sequence and is classified as not important to safety (Section 1.3). The industrial HVAC system has no interface with the nuclear HVAC system. The flow diagram for this subsystem is shown in Figure 9.

The subsystem consists of recirculating air-conditioning units and associated ductwork, dampers, registers, and controls. The electrically operated components of the subsystem are powered from the normal alternating current electrical power system.

HVAC System Interfaces–In order to ensure system readiness and continued operation, the HVAC system components located outdoors are designed to operate in extreme environmental conditions. The supply air intakes are protected from the environmental elements such as snowfall, precipitation, sand, and smoke. As appropriate, the intakes and exhausts are provided with tornado missile barriers to preclude the entry of missiles into the building.

The HVAC central plant heating and cooling system provides chilled water and hot water to the HVAC air-handling unit heat exchanger to condition the air supply in the different areas of Dry Transfer Facility 1. Temperature and humidity are not controlled during event sequence conditions. The HVAC central plant heating and cooling system is not required to function during Category 1 or Category 2 event sequences and is therefore not important to safety.

The HVAC system has smoke detectors to shut off the supply fans and exhaust fans (except for the primary confinement zone) and to prevent recirculation of smoke into the occupied areas of the facility in the event of a fire. Also, in the event of a fire, the primary confinement zone exhaust fan would continue to operate to maintain the required pressure differential in that zone. Ductwork penetrations in fire barriers are provided with heat-activated fire dampers that close to confine the fire and prevent the spread of contamination through the ductwork. The exhaust air-cleaning units are provided with fire detectors and a fire suppression system. The fire suppression system supports the safety strategy of moderator exclusion in the transfer cells. Where moderator exclusion is not required, automatic and manual water deluge systems are provided in accordance with NFPA 13 2002, *Standard for the Installation of Sprinkler Systems*, and NFPA 15 2001, *Standard for Water Spray Fixed Systems for Fire Protection.*

The Dry Transfer Facility 1 HVAC system ventilation stack is provided with an isokinetic sampling system and with sample ports circumferentially located 90 degrees apart. This system provides continuous monitoring of radioactive contaminants in the exhaust air. The isokinetic sampling system interfaces with the Digital Control and Management Information System for data collection, trending, and remote monitoring of the radiation level in the exhaust stack. An

alarm is provided to indicate an abnormality, or if an off-normal event has occurred, or if the setpoint for the exhaust air radiation level has been exceeded.

HVAC System Component Description–The Dry Transfer Facility 1 HVAC system consists of components dedicated to supply air to or exhaust air from the facility. The supply system components consist of air-handling units or air-conditioning units, supply fans, outdoor air intake louvers, and supply air distribution. The supply air distribution consists of ductwork, reheat coils, pressure control dampers, air-balancing devices, and isolation dampers. The exhaust system components consist of exhaust air-cleaning units, exhaust air fans, pressure control dampers, isolation dampers, air-balancing devices, ductwork, and a ventilation stack with stack monitoring capability.

Major components of the Dry Transfer Facility 1 nuclear HVAC subsystem and the related design data are shown in Table 2. Table 3 shows the major components of the Dry Transfer Facility 1 industrial HVAC subsystem and the related design data.

- **Supply Air-Handling Units**–Each supply air-handling unit consists of outdoor air intake filters, heating coils, and cooling coils. The water coils and piping are located outside of the moderator exclusion area.

  - ***Filters***–The filter elements for the supply air-handling units are replaceable, extended (i.e., bag-type) media, dry-type medium efficiency filters made of glass fiber and have an efficiency rating of 80 to 90 percent 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 nominal size of each bag-type filter element is 24 x 24 x 36".

  - ***Cooling Coils***–The cooling coils are constructed of copper tubes and fins mechanically bonded to the tubes. The tube bundles are enclosed in a steel frame. Coils are arranged for horizontal airflow and include vent and drain connections. The coils are arranged for counterflow design using chilled water. The cooling coils are in accordance with ARI 410-2001, *Forced Recirculation Air Cooling and Air Heating Coils*.

  - ***Heating Coils and Reheat Coils***–The heating coils and reheat coils are constructed of copper tubes with helically wound, permanently bonded, smooth soldered-coated copper fins. The reheat coils are duct mounted to provide supplemental heat to areas where additional heating is required. The coils are designed for heating air with hot water. The heating coils are in accordance with ARI 410-2001.

- **Exhaust Air-Cleaning Units**–Each exhaust air-cleaning unit consists of demisters, prefilters, and HEPA filters. The materials of construction are in accordance with ASME AG-1-1997, *Code on Nuclear Air and Gas Treatment*.

  - ***Demisters***–The demisters in the air-cleaning units are used to protect the HEPA filters from damage or loss because of entrained moisture in the air stream. The demister

pads are constructed of glass fiber or corrosion resistant (i.e., stainless steel) wire and conform to the requirements of Section FA of ASME AG-1-1997.

- *Prefilters*–The prefilters are installed upstream of the first stage HEPA filter to remove large airborne particulates, thereby reducing the particulate loading on the HEPA filters and extend their service life. The prefilters have an average atmospheric dust-spot efficiency of 80 percent in accordance with ANSI/ASHRAE 52.1-1992, and are certified to UL 900-1994, *Test Performance of Air Filter Units*, as Class 1 filters. The prefilter elements are replaceable, glass fiber media and conform to the requirements of Section FB of ASME AG-1-1997.

- *HEPA Filters*–The HEPA filters function to remove particulate contaminants from the airstream. HEPA filters have a minimum removal efficiency of 99.97 percent on particles measuring 0.3 μm or larger. The framing system is designed to accommodate a 24 x 24 x 12" filter element. The HEPA filter element is composed of glass fiber media and conforms to the requirements of Section FC of ASME AG-1-1997.

- **Supply Fans and Exhaust Fans**–The supply fans for the air-handling units and the exhaust fans for the exhaust air-cleaning units are either directly driven or belt driven, heavy-duty centrifugal-type fans with backward inclined or airfoil blades. The fan housing is 10-gauge carbon steel or stainless steel, at a minimum, with continuously welded side sheets and scroll sheets. The fans are provided with variable speed drives to provide adjustment in the system airflow to maintain the required pressures in the confinement areas and to compensate for filter loading. The supply and exhaust fans are designed in accordance with Section BA of ASME AG-1-1997. The fan performance testing is in accordance with ANSI/AMCA 210-99, *Laboratory Methods of Testing Fans for Aerodynamic Performance Rating*.

- **Dampers**–The design and construction of the dampers are in accordance with Section DA of ASME AG-1-1997.

  - *Isolation Dampers*–Where a means of system isolation is required, butterfly dampers or parallel-blade-type dampers are utilized. These dampers are pneumatically operated and are designed to automatically fail in the safe position.

  - *Flow Control (Balancing) Dampers*–Opposed-blade-type dampers are utilized, as necessary, to provide a means of system balancing. In general, these dampers are manually operated.

  - *Backdraft Dampers*–Backdraft dampers are employed, where required, to maintain the proper direction of airflow. Backdraft dampers are equipped with adjustable counterweight.

  - *Fire Dampers*–Fire dampers are the curtain-type dampers located in fire barriers, as necessary, to maintain the fire ratings of the barriers, and they are listed by

Underwriters Laboratories Inc. Fire dampers are equipped with either a fusible link or an electro-thermal link.

- **Ductwork**–The supply and exhaust ductwork is fabricated and installed in accordance with SMACNA 1995, *HVAC Duct Construction Standards Metal and Flexible*. The supply ductwork is generally constructed of galvanized steel with outside thermal insulation. The exhaust ducts are sized to maintain sufficient transport velocities to prevent particulate contaminants from settling out of the air stream. The exhaust ducts from the potentially contaminated areas (primary, secondary, and tertiary zones) are made of stainless steel with welded construction to minimize duct leakage.

- **Ventilation Stack**–Dry Transfer Facility 1 is provided with a single ventilation stack, which is nominally 10 ft in diameter and extends to approximately 12 ft above the roofline. The stack diameter is selected on an average discharge velocity of 2500 ft/min to provide adequate plume rise and jet dilution.

HVAC System Maintenance Considerations–The Dry Transfer Facility 1 HVAC system is designed to be operational for 50 years. Components with a shorter life span are designed and installed to permit replacement with minimal effect on operations while maintaining personnel exposure ALARA. Provisions are made for the routine maintenance of the HVAC components in order to maximize their operational life. The HVAC system standby unit is used to isolate an exhaust air-cleaning unit for filter replacement or maintenance. The HEPA filters are replaced when the differential pressure reaches 1.8 to 2-in. water gauge, a condition that may occur due to dust or particulate loading.

Instrumentation is provided to facilitate maintenance, troubleshooting, and surveillance testing. Filter efficiency test ports are provided to allow for regularly scheduled testing of filters. Procedures are provided to permit testing, maintenance, and repair of components.

HVAC System Tests and Inspections–The Dry Transfer Facility 1 HVAC system is designed to permit periodic inspection of system components. Components are inspected prior to installation. A system air balance, system test, and system adjustments to design conditions are conducted in the course of the repository pre-operational test program. Instruments are calibrated in accordance with the repository maintenance program. Components requiring preventive maintenance are located in accessible areas to permit periodic inspection during normal repository operation. Automatic controls are tested for actuation at the proper setpoints. Alarm functions are checked for operability.

- The method of leak testing of ductwork is done in accordance with Section 6 of ASME N510-1989, *Testing of Nuclear Air Treatment Systems*, and in accordance with Sections SA and TA of ASME AG-1-1997.

- Testing methods for the fans is in accordance with ANSI/AMCA 210-99 and with Section BA, Article BA-5000 of ASME AG-1-1997.

- The HEPA filters are factory-tested in accordance with the guidance provided in Regulatory Guide 1.140. The HEPA filters are tested with monodispersed dioctyl

phthalate aerosol to demonstrate a minimum particulate removal efficiency of no less than 99.97 percent for 0.3-μm particulates. The prefilters or moisture eliminators do not undergo factory or in-place testing because no credit is taken for removal of particulates by the prefilters.

- In-place leak testing of the air-cleaning units is performed in accordance with Regulatory Guide 1.140 and ASME N510-1989. A functional test of the HEPA filter is performed whenever a filter element is replaced. A pre-operational test is conducted to verify that negative pressure exists in the waste handling areas when the ventilation system is in operation. Regularly scheduled surveillance testing of the air-cleaning units is performed as part of the maintenance program to ensure that the system is functioning properly.

1.2 Operational Processes and Procedures

Nuclear HVAC Subsystem–The Dry Transfer Facility 1 nuclear HVAC system operates under normal operating conditions by drawing 100-percent outdoor air from the intake plenums, which is filtered and conditioned for distribution to the three potentially contaminated areas of the facility (primary, secondary, and tertiary confinement zones). The confinement zones are provided with an air change frequency of four to eight air changes per hour. The hot water preheating coil is capable of heating 100-percent of the outdoor supply air from 24° to 55°F during winter. Each zone is provided with hot water reheat coils actuated by thermostats to meet the design temperature requirement for comfort and process needs. During summer, the chilled water coil is capable of cooling 100% of the outdoor supply air from 102° to 55°F. Ambient air temperature for the unoccupied confinement areas of Dry Transfer Facility 1 is maintained at a minimum of 40°F and a maximum of 104°F during normal operation.

Exhaust air from the Dry Transfer Facility 1 confinement zones is collected through the ductwork system and is filtered through the exhaust air-cleaning units prior to being released to the atmosphere through the ventilation stack. The exhaust air-cleaning units and the exhaust fans are sized to compensate for air leaking into the building because of the designed negative pressurization for confinement of potentially radioactive contaminants. Factoring in leakage into the building and the increases in filter resistance, the exhaust fans are fitted with flow control mechanisms or adjustable speed drives. Each exhaust air-cleaning unit is provided with the necessary system and monitoring instrumentation.

Industrial HVAC Subsystem–The Dry Transfer Facility 1 industrial HVAC subsystem provides conditioned air for cooling, heating, and ventilation to ensure meeting the air quality standard required for the safety, health, and comfort of the occupational workers. Under normal operating conditions, the system operates by drawing outdoor air from the intake plenums, which is filtered and conditioned for distribution to the non-confinement zones. The system provides outdoor air of no less than 10 percent of the total system airflow rate or as is required to maintain proper indoor air quality and slight pressurization of the non-confinement zones relative to the atmosphere or to adjacent confinement zones. During winter, the hot water preheating coil is capable of heating the supply air to approximately 55°F. The non-confinement zone is provided with hot water reheat coils actuated by thermostats to meet the design temperature requirement

for comfort and process needs. During summer, the chilled water coil is capable of cooling the supply air to approximately 55°F.

The Dry Transfer Facility 1 industrial HVAC subsystem maintains a slight positive pressure in the areas served by the system to minimize infiltration of unconditioned air or dust during normal operation. Operation or failure of the industrial HVAC subsystem has no impact on the operation of the nuclear HVAC subsystem.

Normal Operation–The Dry Transfer Facility 1 HVAC system is designed to operate continuously throughout the year. The system capacities meet or exceed the requirements for filtration, ventilation, heating, and cooling under normal operating conditions. Design margins are included to account for unforeseen conditions. The occupied areas of the facility are designed for a minimum of four air changes per hour. The amount of air circulation is provided to meet room temperature requirements and for effective contamination control. The nominal indoor design temperatures and relative humidity are shown in Table 4.

Category 1 and Category 2 Event Sequence Conditions–Control of temperature and humidity is not required during event sequence conditions, including loss of power, release of radioactive materials, and equipment failure. HVAC system components are not required to function during Category 1 and Category 2 event sequences or to mitigate the effects of event sequence conditions.

A preclosure safety analysis has been performed for the repository in accordance with the requirements of 10 CFR Part 63. This analysis includes evaluation of internal and external hazards, event sequence analyses (including the role of Dry Transfer Facility 1 HVAC structures, systems, and components [SSCs] during an event sequence), consequence analysis, and the safety classification of SSCs. Based on this analysis, the Dry Transfer Facility 1 HVAC system has no functions that are required to maintain acceptable onsite and offsite radiological doses.

During a Category 1 or Category 2 event sequence within Dry Transfer Facility 1 (e.g., high radiation, loss of power), a Dry Transfer Facility 1 isolation signal (DTF1 I-A and DTF1 I-B) is initiated, and the following actuations occur:

- The Dry Transfer Facility 1 supply air fans and the normal exhaust air fans are de-energized, and the isolation dampers at the supply distribution ductwork and at the inlet of the normal exhaust air-cleaning units close.
- The Dry Transfer Facility 1 isolation signal starts the primary confinement area backup exhaust air fans at a reduced flow to provide continuity of negative pressurization during accident and post-accident conditions.
- The static pressure differential between the exhaust air plenum and the atmospheric reference header is maintained at a constant level by a differential static pressure controller modulating the capacity of the backup exhaust air fans.

These actions minimize contamination of the HVAC system and the building in the event of a radiological release. Although not required to maintain acceptable onsite and offsite doses, the

backup exhaust air-cleaning units are provided as defense in depth in the event that a particulate release occurs during waste handling operations.

Startup and Shutdown Sequence–When starting up the nuclear HVAC subsystem as part of the automatic startup sequence in the control system, the fans are started in the following sequence to ensure that the required pressurization in the confinement areas is maintained:

- Primary confinement zone normal exhaust fans, followed by the primary confinement zone supply fans
- Secondary confinement zone exhaust fans, followed by the secondary confinement zones supply fans
- Tertiary confinement zone exhaust fans and supply fans
- Non-confinement zone supply fans and exhaust fans.

For planned maintenance and shutdown, the building ventilation systems are taken out of service in the reverse of the starting order. If any system fails during normal operation, the shutdown sequence is the same as that for removal from service, and any systems having a higher contamination potential than the failed system will remain in operation.

Controls and Instrumentation–The Dry Transfer Facility 1 HVAC system parameters are monitored and controlled by temperature, pressure, and flow instrumentation. Operation of heating and cooling coils is automatically regulated by temperature-indicating controllers. Fans are controlled from the control room. The system monitoring, status indication, and alarm functions are shown in Table 5. The control logic for the automatic operation of the Dry Transfer Facility 1 nuclear HVAC subsystem is depicted in Figure 10.

The following aspects of instrumentation for the Dry Transfer Facility 1 HVAC system are provided either locally or in the control room, in accordance with Table 4-2 of ASME N509-1989, *Nuclear Power Plant Air-Cleaning Units and Components*, and with Section IA of ASME AG-1-1997:

- Indication of airflow
- Indication and control of supply air temperature
- Position indication of isolation dampers
- Indication of the operational status of the fans
- Indication and alarm on low-pressure differential across the fan
- Indication and alarm on high-pressure differential across the exhaust air-cleaning units
- Indication of temperature at the inlet of the exhaust air-cleaning units
- Indication and alarm on high-moisture content downstream of the moisture eliminator
- Indication and alarm of pressure differential across the first-stage HEPA filters
- Alarm on high temperature in the exhaust air-cleaning units
- Indication of pressure differential across the second-stage HEPA filters
- Indication of radioactive concentrations in the exhaust ducting
- Indication of differential pressure between primary confinement zone and adjacent areas.

1.3 SSCs Important to Safety

Nuclear HVAC Subsystem–There are no SSCs important to safety for the functioning of the nuclear HVAC subsystem serving Dry Transfer Facility 1.

Industrial HVAC Subsystem–There are no SSCs important to safety for the functioning of the industrial HVAC subsystem serving Dry Transfer Facility 1.

1.4 Administrative or Procedural Safety Controls to Prevent Event Sequences or Mitigate Their Effects

No administrative or procedural safety controls are required to prevent or mitigate the effects of Category 1 or Category 2 event sequences. Actuation of the isolation dampers and operation of the backup exhaust air-cleaning system are automatic. Manual initiation is available as a defense-in-depth feature. The backup exhaust air-cleaning system may be used to control exfiltration of contaminated air by imposing a negative pressure in the Dry Transfer Facility 1. Continuous monitoring and recording of the exhaust air through the ventilation stack are performed.

1.5 HVAC System Design Criteria and Design Bases

There are no SSCs important to safety for the functioning of the nuclear or the industrial HVAC subsystems. Therefore, there are no design bases requirements needed to prevent Category 1 or Category 2 event sequences or to mitigate their effects. The Dry Transfer Facility 1 HVAC system design criteria are provided below. The design criteria provided below ensure system functionality and are derived from applicable standards, codes, laws, regulations, and general discipline design criteria.

- The HVAC supply system shall be provided with prefilters and high-efficiency filters at the outdoor air intake to prevent accumulation of dust in the facility.

- The nuclear HVAC subsystem shall maintain a controlled airflow path directed from areas of low potential for radioactive contamination to areas of higher potential for radioactive contamination.

- The nuclear HVAC subsystem shall be capable of isolating areas or zones subject to contamination by airborne radioactive materials from those that have no potential for contamination.

- The nuclear HVAC exhaust subsystem shall be provided with stages or banks of 99.97 percent HEPA filters or other air-cleaning devices at the exhaust or in the recirculation system serving confinement areas to assist in the removal of airborne radioactive contaminants.

- The nuclear HVAC subsystem shall, in conjunction with physical barriers, divide and arrange the Dry Transfer Facility 1 into prescribed contamination confinement compartments based on their level of, or potential for, airborne radioactive or hazardous contamination.

- The Nuclear HVAC subsystem shall maintain the differential pressures between the prescribed contamination confinement areas of the Dry Transfer Facility 1 during normal operating mode and during an event sequence in accordance with Table 1.

- The systems shall be provided with the necessary instrumentation and control hardware that directly operate, control, monitor, alarm, and provide equipment status required to identify the meaning and significance of the conditions for the functions identified in Table 5.

- Ductwork conveying air that is contaminated with airborne radioactive contaminants or ductwork with potential for being contaminated by airborne radioactive contaminants shall be designed to minimize accumulation or trapping of such contaminants, and shall be provided with access doors or hatches at strategic and accessible locations.

- The systems shall be provided with fire protection features to operate in conjunction with the fire-rated barriers, fire suppression, fire detection, and the fire alarm system. The exhaust air-cleaning units shall be provided with deluge water drain capabilities.

- The repository ventilation stack shall be provided with a continuous air monitoring system to measure and record the releases of effluents into the environment (e.g., airborne radioactive particulate matter, radioactive iodine, noble gases) through sampling near the point of release.

- System components shall be designed to operate within environmental limits as defined in Table 4, established for their location within the installation including but not limited to, temperature, humidity, and radiation levels for the applicable performance requirements.

- The Nuclear HVAC subsystem ductwork and components shall be designed, constructed and supported to remain in-place so that its failure will not lead to failure of SSCs important to safety.

1.6 Design Methodologies

The Dry Transfer Facility 1 nuclear and industrial HVAC subsystems are designed in accordance with the codes and standards listed in Section 1.8. The design methodologies utilized are consistent with nuclear industry practices. No special, unique, or first-of-a-kind design methodologies are used in the design and analysis of the Dry Transfer Facility 1 HVAC system.

1.7 Consistency of Materials with Design Methodologies

The materials for construction for the major SSCs of the Dry Transfer Facility 1 HVAC system are provided in Section 1.1, under the heading of HVAC System Component Description. Selection of these materials is consistent with the recommendation of the industry codes and standards identified in Section 1.8. There are no unique or first-of-a-kind material applications in the Dry Transfer Facility 1 HVAC system.

1.8 Design Codes and Standards

The Dry Transfer Facility 1 HVAC system is designed in accordance with the applicable guidance provided in the following documents. These codes and standards provide implementation guidance for the design of the Dry Transfer Facility 1 HVAC SSCs.

- *Nuclear Air Cleaning Handbook, Design, Construction, and Testing of High-Efficiency Air Cleaning Systems for Nuclear Application* (Burchsted et al. 1979)
- ANSI/AMCA 210-99, *Laboratory Methods of Testing Fans for Aerodynamic Performance Rating*
- ANSI/ANS-57.7-1988, *Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)*
- ANS/ANSI 57.9-1992, *Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)*
- ANSI/ASHRAE 55(55a)-1995, *Thermal Environmental Conditions for Human Occupancy, with Addendum*
- ANSI/ASHRAE 52.1-1992, *Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter*
- ARI 410-2001, *Forced Recirculation Air Cooling and Air Heating Coils*
- ASHRAE 2001, *2001 ASHRAE Handbook, Fundamentals*
- ASHRAE DG-1-1993, *Heating, Ventilating, and Air Conditioning Design Guide for Department of Energy Nuclear Facilities*
- ASME AG-1-1997, *Code on Nuclear Air and Gas Treatment*, including Addenda
- ASME N509-1989, *Nuclear Power Plant Air-Cleaning Units and Components*
- ASME N510-1989, *Testing of Nuclear Air Treatment Systems*
- NFPA 13-2002, *Standard for the Installation of Sprinkler Systems*
- NFPA 15-2001, *Standard for Water Spray Fixed Systems for Fire Protection*
- NFPA 90A-2002, *Standard for the Installation of Air-Conditioning and Ventilating Systems*
- NFPA 801-1988, *Standard for Fire Protection for Facilities Handling Radioactive Materials*
- SMACNA 1995, *HVAC Duct Construction Standards Metal and Flexible*

- UL 900-1994, *Test Performance of Air Filter Units*
- 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*
- Regulatory Guide 3.12, *General Design Guide for Ventilation Systems of Plutonium Processing and Fuel Reprocessing Plants*
- Regulatory Guide 3.18, *Confinement Barriers and Systems for Fuel Reprocessing Plants*
- Regulatory Guide 3.32, *General Design Guide for Ventilation Systems for Fuel Reprocessing Plants*

1.9 Load Combinations Used for Normal Operations and Category 1 and Category 2 Event Sequence Conditions

The load combinations used in the Dry Transfer Facility 1 HVAC system design analyses are consistent with those used and accepted by the U.S. Nuclear Regulatory Commission in the design of similar types of systems in nuclear facilities. Loads due to temperatures, humidity, and differential pressures used in the design analyses are based on nuclear industry codes and standards, which are within the range of industry practices. No special, unique, or first-of-a-kind loads are imposed on the Dry Transfer Facility 1 HVAC system.

Table 1. Differential Pressures in Confinement and Non-confinement Zones

Confinement Zone	Definition	Pressure Requirement
Primary	Areas where radioactive materials or contamination are present during normal operations	–0.7 to –1.0 in. wg relative to secondary –0.8 to –1.15 in. wg relative to tertiary –0.95 to –1.25 in. wg relative to atmosphere
Secondary	Areas where potential for contamination is high or that could become contaminated from an abnormal event	–0.1 to –0.15 in. wg relative to tertiary, and at least –0.25 in. wg relative to the atmosphere
Tertiary	Areas where potential for contamination is low	–0.1 to –0.15 in. wg relative to atmosphere
Non-confinement Area	Areas with no potential for contamination	Atmospheric to +0.15 in. wg

NOTE: The values above are obtained from Sections 1 and 2 of ASHRAE DG-1-93. The confinement zoning conforms to the intent of regulatory position C.4 of Regulatory Guide 3.18; wg = water gauge.

Table 2. Dry Transfer Facility 1 Nuclear HVAC Subsystem Component Design Data

PRIMARY CONFINEMENT ZONE
Supply Air-Handling Unit
Quantity Airflow (ft^3/min) Number of filter elements Cooling capacity (Btu/h) Chilled water flowrate (gal/min) Heating capacity (Btu/h) Hot water flowrate (gal/min)
Supply Air Fan
Quantity Airflow (ft^3/min) Static pressure (in. wg) Motor (hp)
Exhaust Air-Cleaning Unit (Normal)
Quantity Airflow (ft^3/min) Number of moisture eliminator elements Number of first-stage HEPA filter elements Number of second-stage HEPA filter elements
Exhaust Air Fan (Normal)
Quantity Airflow (ft^3/min) Static pressure (in. wg) Motor (hp)
Backup Exhaust Air-Cleaning Unit
Quantity Airflow (ft^3/min) Number of moisture eliminator elements Number of first-stage HEPA filter elements Number of second-stage HEPA filter elements
Backup Exhaust Air Fan
Quantity Airflow (ft^3/min) Static pressure (in. wg) Motor (hp)
SECONDARY CONFINEMENT ZONE
Supply Air-Handling Unit
Quantity Airflow (ft^3/min) Number of filter elements Cooling capacity (Btu/h) Chilled water flowrate (gal/min) Heating capacity (Btu/h) Hot water flowrate (gal/min)
Supply Air Fan
Quantity Airflow (ft^3/min) Static pressure (in. wg) Motor (hp)

Table 2. Dry Transfer Facility 1 Nuclear HVAC Subsystem Component Design Data (continued)

Exhaust Air-cleaning Unit
Quantity
Airflow (ft^3/min)
Number of moisture eliminator elements
Number of prefilter elements
Number of first-stage HEPA filter elements
Number of second-stage HEPA filter elements
Exhaust Air Fan
Quantity
Airflow (ft^3/min)
Static pressure (in. wg)
Motor (hp)
TERTIARY CONFINEMENT ZONE
Supply Air-Handling Unit
Quantity
Airflow (ft^3/min)
Number of filter elements
Cooling capacity (Btu/h)
Chilled water flowrate (gal/min)
Heating capacity (Btu/h)
Hot water flowrate (gal/min)
Supply Air Fan
Quantity
Airflow (ft^3/min)
Static pressure (in. wg)
Motor (hp)
Exhaust Air-Cleaning Unit
Quantity
Airflow (ft^3/min)
Number of moisture eliminator elements
Number of prefilter elements
Number of HEPA filter elements
Exhaust Air Fan
Quantity
Airflow (ft^3/min)
Static pressure (in. wg)
Motor (hp)
Recirculating Air-Cleaning Unit
Quantity
Airflow (ft^3/min)
Static pressure (in. wg)
Motor (hp)
Cooling capacity (Btu/h)
Chilled water flowrate (gal/min)
Number of moisture eliminator elements
Number of HEPA filter elements
Recirculation Air Fan

NOTE: BTU = British Thermal Unit; hp = horsepower; wg = water gauge.

Table 3. Dry Transfer Facility 1 Industrial HVAC Subsystem Component Design Data

Control Room and Computer Room Air-Conditioning Units
Quantity
Airflow (ft^3/min)
Static pressure (in. wg)
Motor (hp)
Cooling capacity (Btu/h)
Chilled waterflow (gal/min)
Heating capacity (Btu/h)
Hot water flowrate (gal/min)
Electrical Equipment Room Air-Conditioning Units
Quantity
Airflow (ft^3/min)
Static pressure (in. wg)
Motor (hp)
Cooling capacity (Btu/h)
Chilled waterflow (gal/min)
Heating capacity (Btu/h)
Hot water flowrate (gal/min)
Cold Support Areas and Offices Air-Conditioning Units
Quantity
Airflow (ft^3/min)
Static pressure (in. wg)
Motor (hp)
Cooling capacity (Btu/h)
Chilled waterflow (gal/min)
Hot water flowrate (gal/min)

NOTE: BTU = British Thermal Unit; hp = horsepower; wg = water gauge.

Table 4. Nominal Indoor Design Temperatures and Relative Humidity

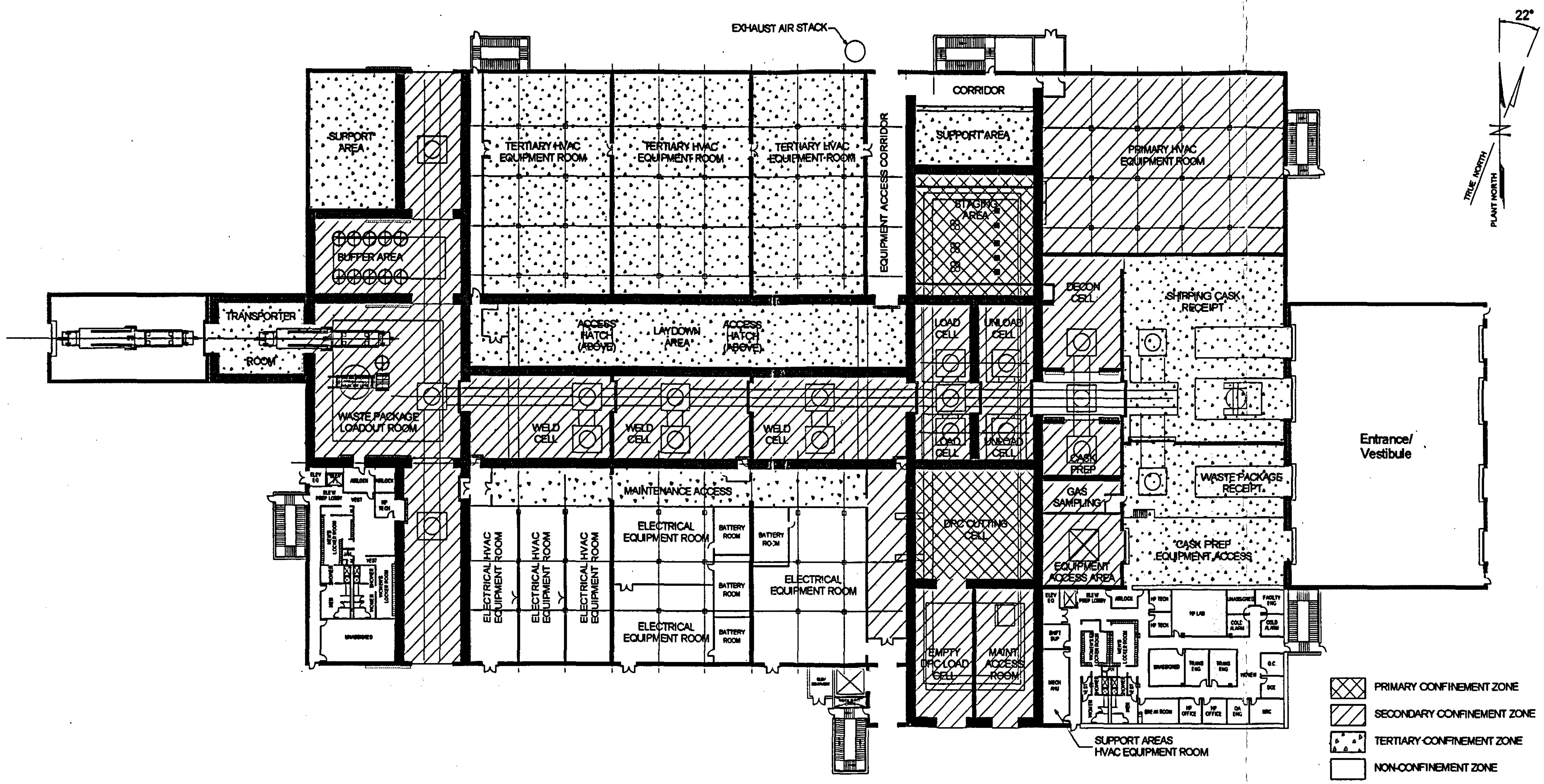
Area	Summer / Winter (°F Dry Bulb)	Summer/ Winter (% RH)
Normally occupied areas (e.g., offices, maintenance areas, access control)	76°F / 72°F	30 to 60% / 30 to 60%
Usually unoccupied areas (e.g., mechanical and electrical equipment rooms, cask and waste package receiving, preparation and handling areas, fuel handling areas, disposal canister weld areas)	90°F / 65°F	Humidity control not required
Unoccupied areas (e.g., transfer cells, dual-purpose canister cutting cell, disposal container handling cells, assembly staging areas, remote HEPA filter room)	104°F(max) / 40°F(min)	Humidity control not required
Sensitive electronics equipment areas (e.g., control rooms, computer rooms, monitoring rooms)	72° / 72°F	45 to 55% / 45 to 55%

NOTE: The above values are derived from ANSI/ASHRAE 55(55a)-1995, ANSI/ANS 57.7-1988, *American National Standard Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)*, and ASHRAE 2001. Control of temperature and humidity is not required during or after event sequence conditions such as loss of power or equipment failure. Further study is required to evaluate the impact of extreme low and high temperatures in all the listed areas and the impact of humidity on sensitive electronic equipment. Special provisions may be provided for components with special humidity requirements. HEPA = high-efficiency particulate air; RH = relative humidity.

Table 5. System Monitoring, Status, and Alarm Functions

Requirements	Functions
Space temperature	Facility ventilation zone temperature indication and control
Airflow rate	Filter trains, ventilation stack
Differential pressure	Filters, moisture eliminators, and areas of the waste handling facilities that require specific pressure differential control with respect to other areas or to the outside atmosphere
Radiation level indication and monitoring	Indication of radiation level at the HEPA filtration units and at the ventilation stack discharge
Smoke and high heat detection	Detection interface with the fire protection system for fire suppression, as required
On–off status	Status for electrically powered or controlled equipment
Open–closed status	Status for motor control breakers, valves, and dampers
Failure alarms	Alarm the failure of specific equipment and components

NOTE: HEPA = high-efficiency particulate air.



SINGLE TRAIN DRY TRANSFER FACILITY WITH 3 WELD CELLS 1st FLOOR PLAN

SCALE: NOT TO SCALE

FIGURE 1

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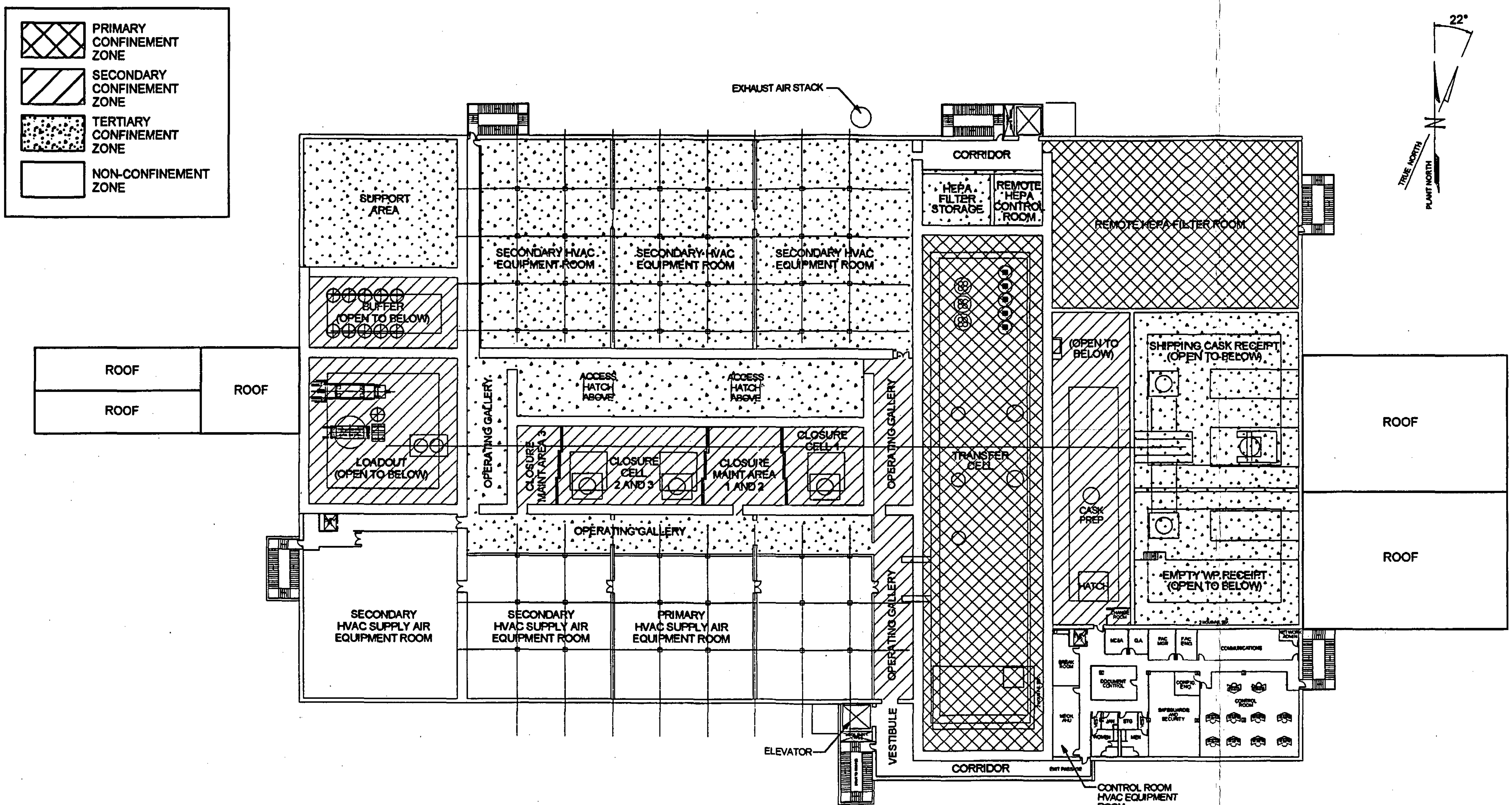
DRY TRANSFER FACILITY #1
VENTILATION CONFINEMENT ZONES
FIRST FLOOR



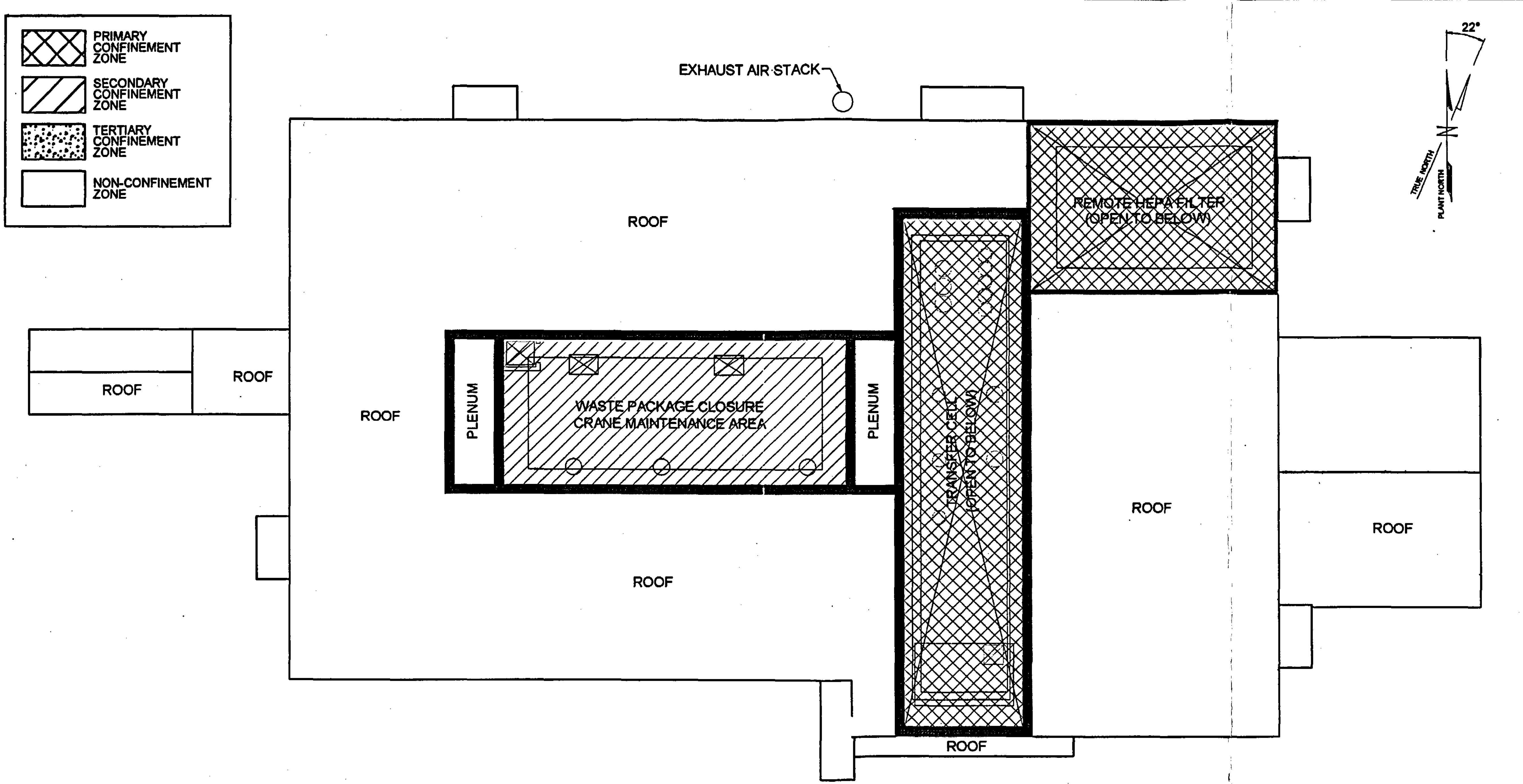
SINGLE TRAIN DRY TRANSFER FACILITY WITH 3 WELD CELLS 2nd FLOOR PLAN

SCALE: NOT TO SCALE

FIGURE 2

00336DC_002.ai

DRY TRANSFER FACILITY #1
VENTILATION CONFINEMENT ZONES
SECOND FLOOR PLAN



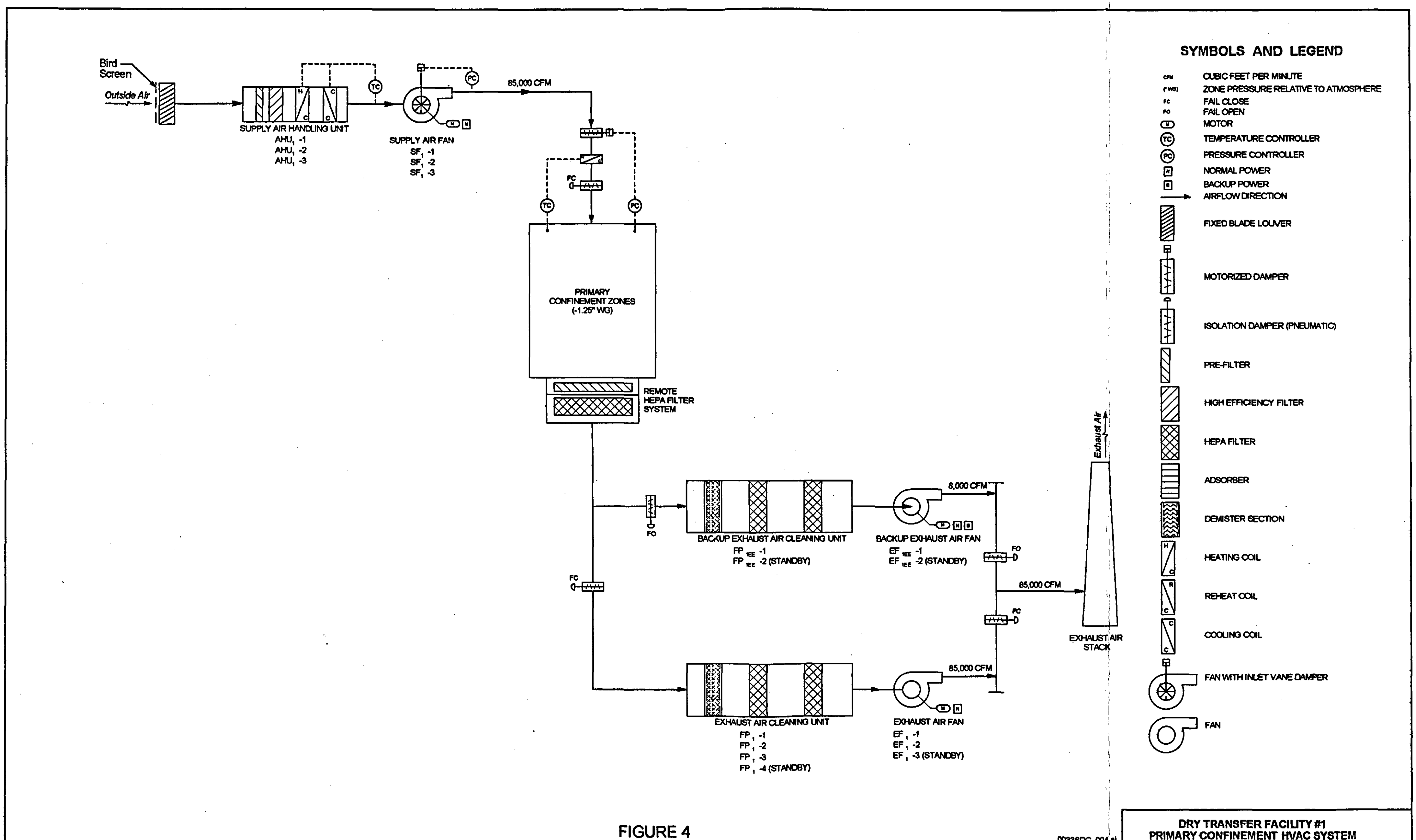
SINGLE TRAIN DRY TRANSFER FACILITY WITH 3 WELD CELLS 3rd FLOOR PLAN

SCALE: NOT TO SCALE

FIGURE 3

00336DC_003.ai

DRY TRANSFER FACILITY #1
VENTILATION CONFINEMENT ZONES
THIRD FLOOR PLAN



Bird Screen
Outside Air
SUPPLY AIR HANDLING UNIT
AHU, -1
AHU, -2
AHU, -3
SUPPLY AIR FAN
SF, -1
SF, -2
SF, -3
85,000 CFM
PRIMARY CONFINEMENT ZONES (-1.25" WG)
REMOTE HEPA FILTER SYSTEM
BACKUP EXHAUST AIR CLEANING UNIT
FP -1
FP -2 (STANDBY)
BACKUP EXHAUST AIR FAN
EF -1
EF -2 (STANDBY)
8,000 CFM
85,000 CFM
EXHAUST AIR CLEANING UNIT
FP, -1
FP, -2
FP, -3
FP, -4 (STANDBY)
EXHAUST AIR FAN
EF, -1
EF, -2
EF, -3 (STANDBY)
85,000 CFM
Exhaust Air
EXHAUST AIR STACK
SYMBOLS AND LEGEND
CUBIC FEET PER MINUTE
ZONE PRESSURE RELATIVE TO ATMOSPHERE
FAIL CLOSE
FAIL OPEN
MOTOR
TEMPERATURE CONTROLLER
PRESSURE CONTROLLER
NORMAL POWER
BACKUP POWER
AIRFLOW DIRECTION
FIXED BLADE LOUVER
MOTORIZED DAMPER
ISOLATION DAMPER (PNEUMATIC)
PRE-FILTER
HIGH EFFICIENCY FILTER
HEPA FILTER
ADSORBER
DEMISTER SECTION
HEATING COIL
REHEAT COIL
COOLING COIL
FAN WITH INLET VANE DAMPER
FAN
DRY TRANSFER FACILITY #1
PRIMARY CONFINEMENT HVAC SYSTEM
00336DC_004.ai

FIGURE 4

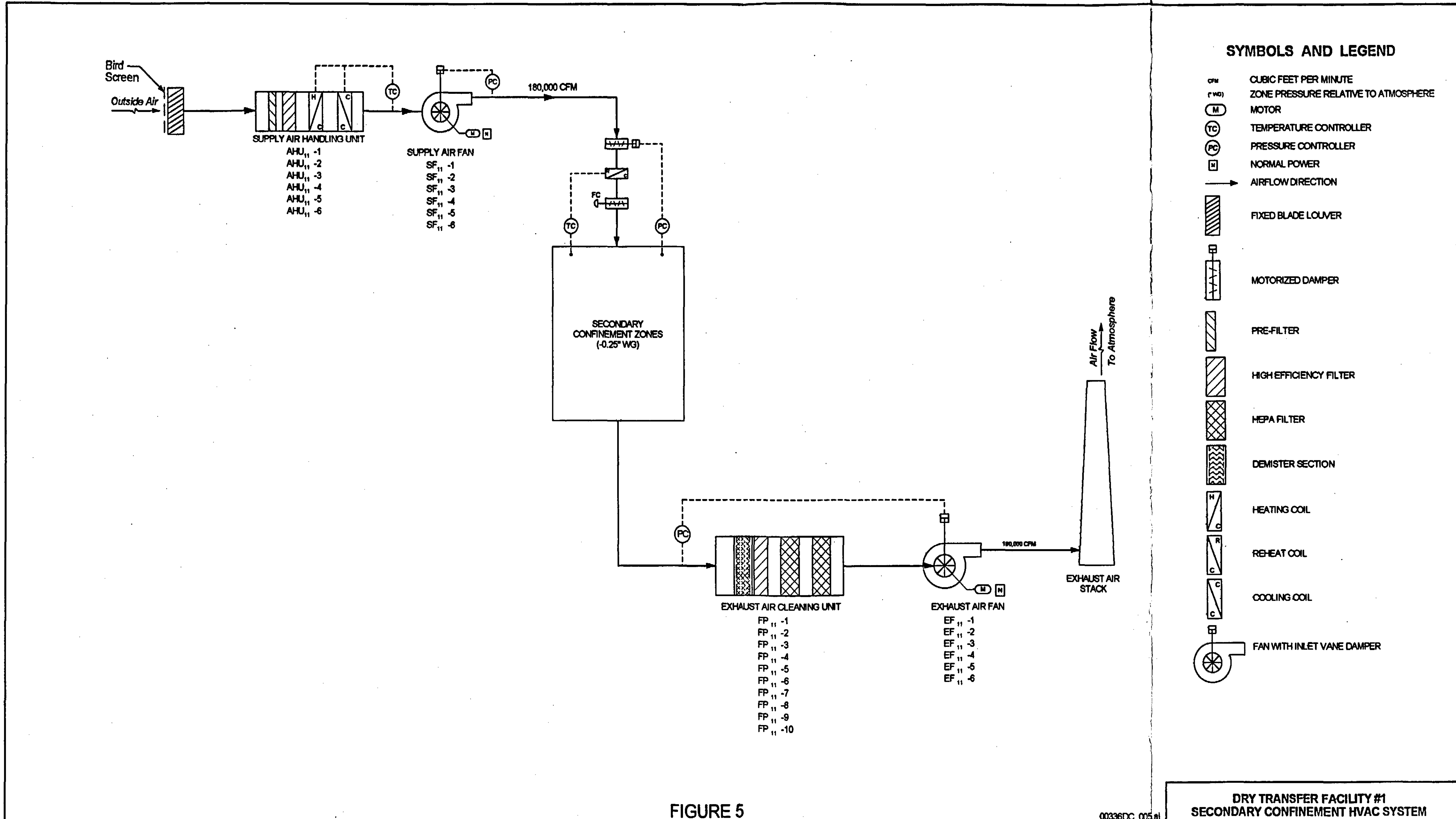


FIGURE 5

DRY TRANSFER FACILITY #1
SECONDARY CONFINEMENT HVAC SYSTEM

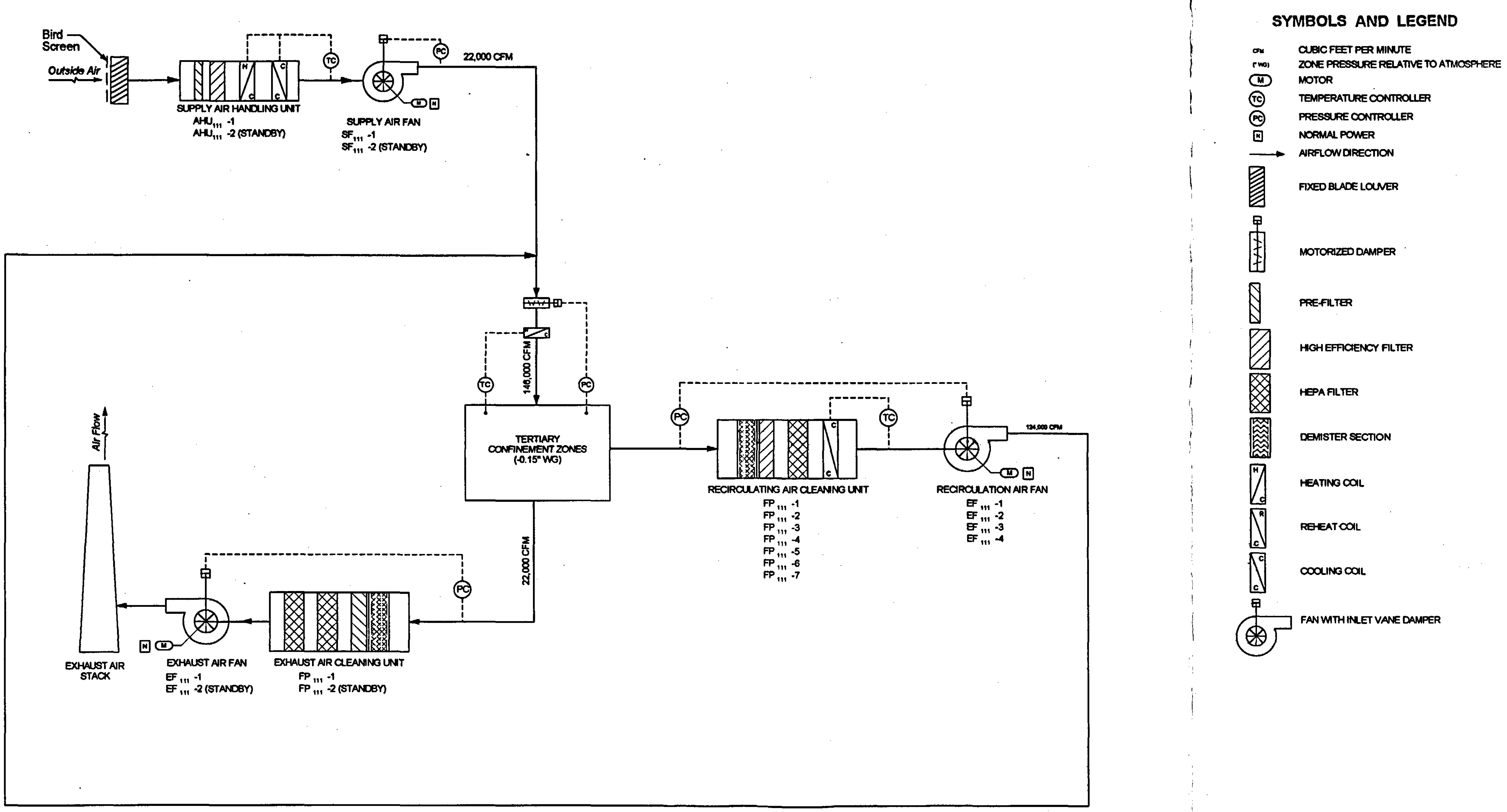


FIGURE 6

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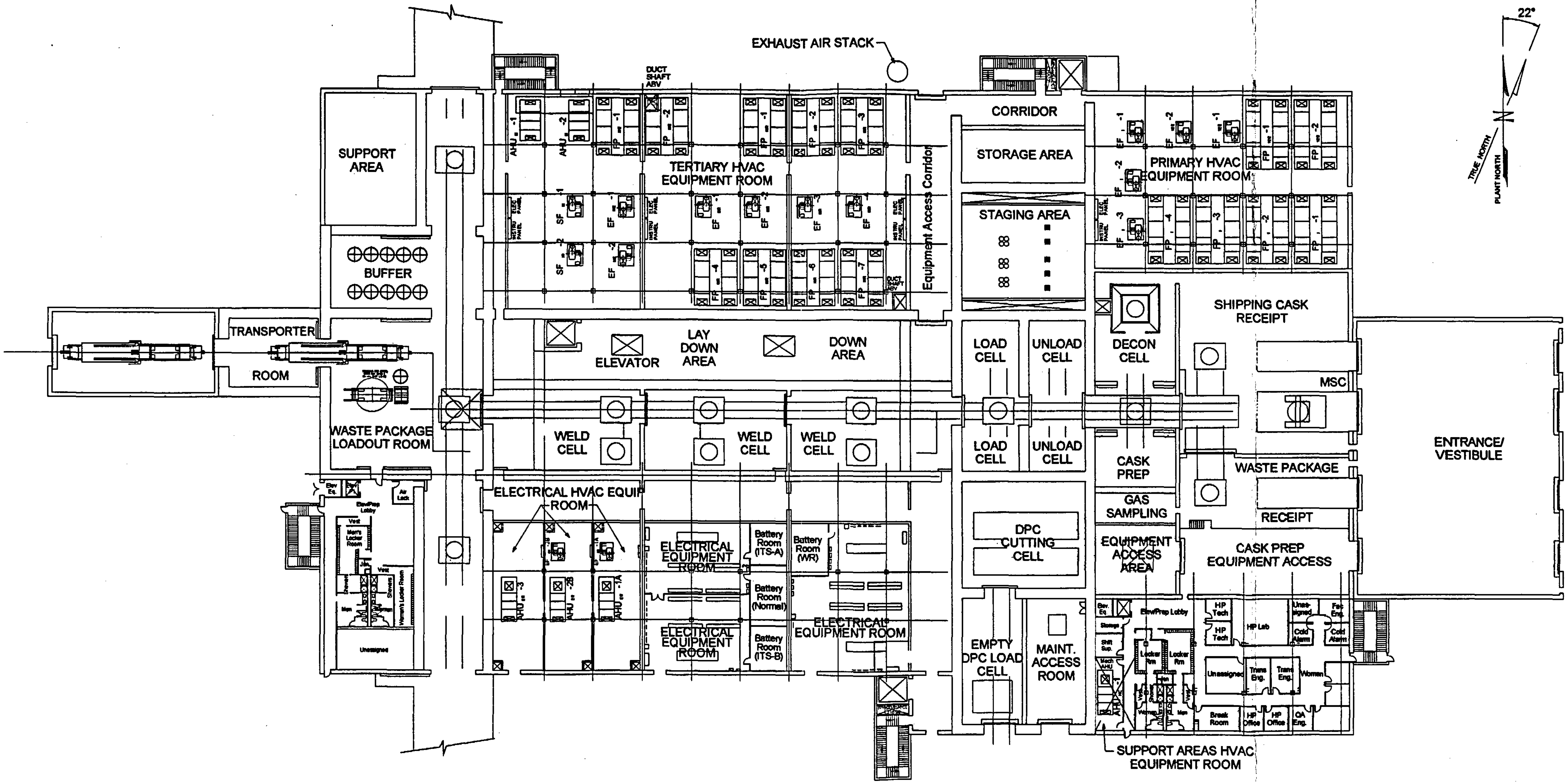
DRY TRANSFER FACILITY #1
TERTIARY CONFINEMENT HVAC SYSTEM



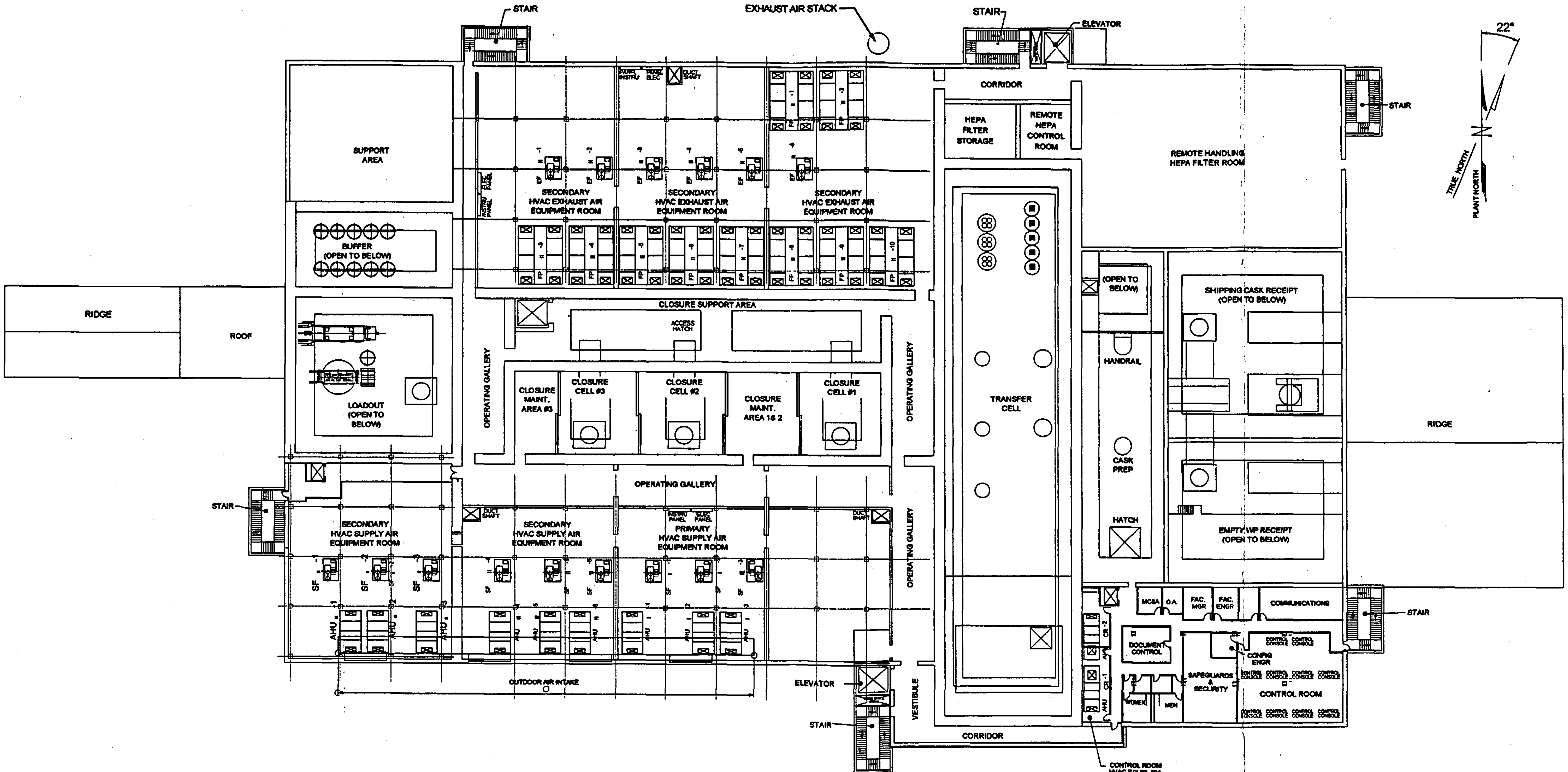
SINGLE TRAIN DRY TRANSFER FACILITY WITH 3 WELD CELLS 1st FLOOR PLAN

SCALE: NOT TO SCALE

FIGURE 7

00336DC_007.ai

DRY TRANSFER FACILITY #1
HVAC EQUIPMENT ARRANGEMENT
FIRST FLOOR



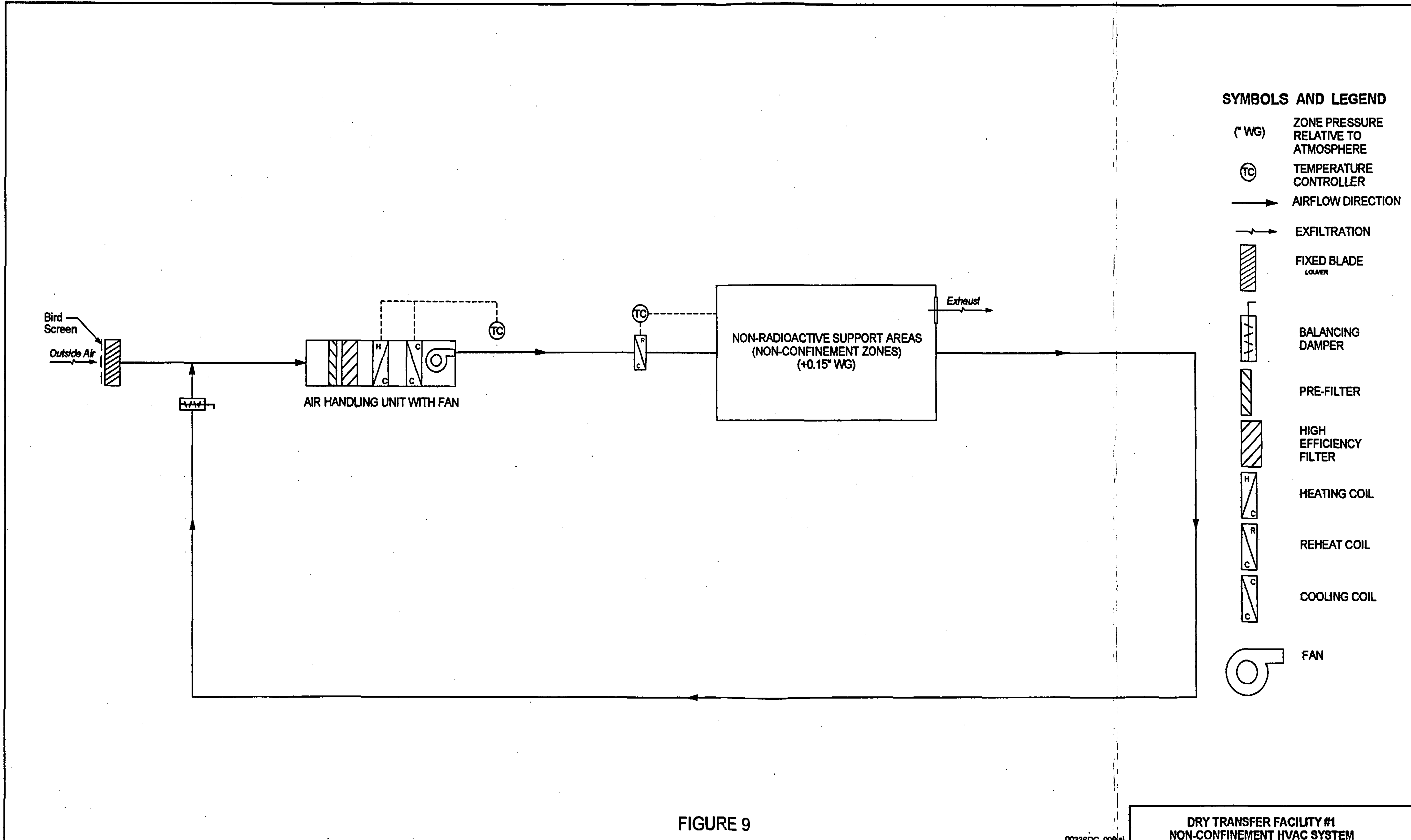
SINGLE TRAIN DRY TRANSFER FACILITY WITH 3 WELD CELLS 2nd FLOOR PLAN

SCALE: NOT TO SCALE

FIGURE 8

00336DC_008.ai

DRY TRANSFER FACILITY #1
HVAC EQUIPMENT ARRANGEMENT
SECOND FLOOR



Bird Screen
Outside Air
AIR HANDLING UNIT WITH FAN
NON-RADIOACTIVE SUPPORT AREAS
(NON-CONFINEMENT ZONES)
(+0.15" WG)
Exhaust
SYMBOLS AND LEGEND
(" WG) ZONE PRESSURE RELATIVE TO ATMOSPHERE
TEMPERATURE CONTROLLER
AIRFLOW DIRECTION
EXFILTRATION
FIXED BLADE LOUVER
BALANCING DAMPER
PRE-FILTER
HIGH EFFICIENCY FILTER
HEATING COIL
REHEAT COIL
COOLING COIL
FAN
00336DC_009.ai
DRY TRANSFER FACILITY #1
NON-CONFINEMENT HVAC SYSTEM

FIGURE 9

(NO FILE DESIGNED YET FOR THIS FIGURE)

FIGURE 10

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DRY TRANSFER FACILITY #1
NUCLEAR HVAC SUB-SYSTEM
CONTROL LOGIC DIAGRAM