PLANNING REPORT

for

NMSU COMPUTER DATA CENTER

at

NEW MEXICO STATE UNIVERSITY

LAS CRUCES, NEW MEXICO

HZ PROJECT NUMBER 14.0294.05

FINAL REPORT

APRIL 2014

HUITT-ZOLLARS

6501 Americas Parkway NE, Suite 550
Albuquerque, New Mexico 87110-8154
(505) 883-8114 ph ~ (505) 883-5022 fax

TABLE OF CONTENTS

SECTION ONE

SECTION ONE- EXECUTIVE SUMMARY

This Programming Report on New Mexico State University (NMSU) Data Center facility is based upon HVAC and Electrical systems condition assessment for this facility conducted by Huitt-Zollars, Inc. in December of 2012 (Refer to Appendix B) and a and information obtained during coordination meeting with NMSU representatives on September 20th 2013 (Refer to Attachment A).

Data Center is occupying Information and Communication Technologies Building located at the corner of Stewart Street and Sweet Street. The building was originally built in 1978. In the spring of 1987 its primary computer room was doubled in size. The existing building is approximately a 100,000 sq. ft. two-story structure with 2-story office area on the north side of the building and a single story structure one to the East and one to the West, including 7,200 sq. ft. of Data Center area. The building envelope consists of CMU exterior walls on the east side and framed walls at the west side of the building, some exterior glazing and metal insulated roof. The layout of the Data Center needs to be reconfigured to provide a larger machine room for the computer racks, as well as provide offices for the employees of the center that are isolated from the noise and conditioned air of the machine rooms. The design illustrated in the report provides for new office space constructed on the north side of the existing building. This will allow a maximum amount of space for the machine rooms to accommodate the added computer racks anticipated over the next 10 to 15 years. The build out of the center will require construction phasing to ensure operations are maintained. The timing and scope of each phase will be determined by the funding available and the operational requirements. The total estimated cost for the entire project as illustrated in this report is approximately $3.7M for all phases. This cost does not include the racks, computer components or computer cabling.

The air conditioning in the building is provided from the Central Plant through underground chilled water and a high-pressure steam distribution system. Existing secondary chilled water pumps and a heating hot water pumps along with steam to hot water heat exchangers provide chilled water and hot water distribution throughout the building.
Existing air conditioning equipment serving Data Center shall be removed and replaced with new floor-mounted inside IT equipment space computer room air conditioning (CRAC) units.

The Data Center is fed from the Central Plant Switchboard at 4.16 kV and is currently supported by the Cogeneration turbine powered generator. An alternate feeder is also provided from the 23.9kV system through Transformer T25-410. This provides some additional reliability on the primary side; however; both the 4.16 kV and the output of T25-410 are connected through a single SF6 switch presenting a single point of failure in the system. All connections into the data center past the SF6 switch are radial feeds and also are single points of failure to the data center.

Based on the number of single points of failure, the data center power system must be classified as a Tier 1 facility only.

Recommendations include a broad scope of upgrades to the existing power system to raise the Tier rating of the data center to a Tier II facility. These include alternate 4.16 kV feeder paths, transformers, switchboards, UPS systems, and Computer Room Power Distribution Units to provide a true N+1 power system. Consideration was given to an additional 25 kV feeder to the data center; however, unless this feeder comes from a source separate from the Totugas Substation, there would be little if any increase in system reliability.

SECTION TWO

SECTION TWO - EXISTING CONDITIONS

For the description of existing conditions at the Data Center refer to Huitt-Zollars, Inc. “HVAC and Electrical Systems Assessment Report” in Appendix B.

SECTION THREE

SECTION THREE - CODE ANALYSIS

Applicable Codes

Design shall comply with latest editions of all applicable codes and criteria of state of New Mexico and City of Las Cruces, as they may apply to the project, including but not limited to the following:

ASHRAE Fundamentals Handbook
ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy
ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality
ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE Technical Committee 9.9-2011, Environmental Guidelines for Datacom Equipment, supplement to Thermal Guidelines for Data Processing Equipment

International Building Code
International Mechanical Code
International Plumbing Code

NFPA 70 – National Electrical Code
NFPA 72 – National Fire Alarm and Signaling Code
NFPA 90A - Installation on Air-Conditioning and Ventilation Systems
NFPA 101, Life Safety Code

Meeting Notes for NMSU Data Center Upgrades dated September 20, 2013
E-mail with loads for Data Center IT Equipment Room

Occupancy Type B

Square Footage 7,200 SF (Data Center)
1620 SF (New Office Area)

Occupant Load

B – Business Occupancy		
Occupant Load	16	
Required exits	2	
Existing Exits	2	

Type of Existing Construction II B

allowable area

Occupancy	Type of Construction	Allowable Square Footage
B	II B	23,000 GSF

Building Height
Allowable: Two-story Actual – One-story

Separation Requirements
Per IBC 2009 - None Required

Exit Requirements

IT ROOM		
Total Exit width required:	32 inches	Actual:
OFFICE AREA		
Total Exit width required:	32 inches	Actual:
Exit Distance required:	200 feet (max.)	Actual:

Fire Sprinkler System

A wet-pipe pre-action fire sprinkler system shall be provided in the new office area and in the existing mechanical room. The existing clean agent fire suppression system will be modified to meet the requirements of the new layout of the computer rooms in the Data Center.

SECTION FOUR

SECTION FOUR - LONG RANGE DESIGN CONCEPT

INFORMATION TECHNOLOGY EQUIPMENT

IT equipment at the Data Center will include various servers and telecommunication equipment on chassis installed in numerous equipment racks and providing support for the entire university campus mission, including administrative computing, research systems support and the university networking department.

Administrative Computing (Main Machine room)
This room will house IT equipment providing general support to NMSU website and to various systems throughout the campus. The IT equipment and racks will be a combination of existing racks and the new racks supplied from various manufacturers, including IBM, Compaq, Cisco Microsystems, etc. Six PDH units will support IT equipment in this room.

Research Systems (Secured Data Room)
This room will house IT equipment racks providing support to NMSU research systems. The IT equipment and racks are supplied from various manufacturers. Four PDH units will provide support for IT equipment in this room. These racks will be relocated and consolidated with racks within main machine room area.

Networking Department (NOC)
This room will house equipment racks, UPS and PDH supporting NMSU Networking Department.

UPS Room
Two Uninterrupted Power Supply units (UPS) will be installed in that room to support IT equipment throughout.

Office Area
New building addition will house multiple enclosed offices with personal computers and with various office appliances, including printers, copiers, etc. Break room/conference room will be provided for the space occupants.

The new design shall reconfigure the existing computer racks and provide new racks as applicable to accommodate facility needs. Refer to Appendix E for proposed rack layout options.

The following is anticipated heat rejection rate for the IT equipment:

- Administrative Computing (Main machine room)
  - Thirty nine Equipment Racks – 826,500 Btu/h or 241.8 kWh
  - Six PDU units – 24,000 Btu/h or 7.0 kWh
- Research Systems (Secured Data Room)
  - Equipment Racks – 338,300 Btu/h or 99.2 kWh
  - Four PDH units – 16,000 Btu/h or 4.7 kWh
- Networking (NOC)
  - Equipment Racks – 153,500 Btu/h or 45.0 kW

  - Four PDH units – 16,000 Btu/h or 4.7 kWh
- UPS unit in the main room
  - Two UPS assemblies – 87,600 Btu/h or 25.6 kWh

Note: The values indicated above are estimated based on average heat rejection from each IT equipment rack (6.2 kWh per rack in main machine room and 3.0 kWh for networking racks) per information provided by the NMSU ICT Department during initial programming phase. These values are multiplied by the number of racks as shown on current floor plan.
The future design shall confirm with NMSU the heat rejection values and the operation diversity of power supply to the server racks and/or diversity on the heat rejection for sizing of electrical equipment and the HVAC cooling equipment.

ARCHITECTURE

The proposed new floor plan layout is included in Appendix A of this report. This layout is based on the requirements as discussed in previous meetings and illustrates one possible design scenario for the long range development of the space. This layout provides for the construction of new office spaces on the north end of the building to allow maximum area for the computer rooms. It is anticipated that the new office area will be constructed as the first phase of the project. The build out of the machine rooms and associated support spaces will be constructed in subsequent phases based on operational and equipment needs and funding allocations. The cost estimate as shown in Section Five indicates the costs for the Phase One and with subsequent phases as a separate cost. The costs of each subsequent phase will be determined by available funding as well as operational requirements.

The following is a brief description of the proposed interior finishes and systems. Cut sheets of some of these items are included in Appendix B of this report.

Interior Partitions

One-hour rated and non-rated interior partitions (UL Des U419) shall be constructed of 4” steel stud framing with type ‘X’ gypsum board wall facing on both sides. Rated walls where required shall extend from floor slab to structural roof deck. Non Rated walls can terminate above the ceiling.

Gypsum wallboard shall be 5/8” thick, type ‘X’, tapered edge, conforming to requirements of ASTM C1396/C36. Joint treatment materials shall conform to the requirements of ASTM C 475. Screws shall conform to the requirements of U419, ASTM C 1002 and C 954 where applicable. Corner beads, edge trim, and control (expansion) joints shall conform to the requirements of ASTM C 1047, and shall be corrosion protective-coated steel designed for its intended use. Flanges shall be free of dirt, grease, and other materials that may adversely affect the bond of joint treatment. Provide STC 40 (minimum) per USG-860808.

Ceilings

Provide a ceiling system consisting of sound controlling acoustical panels mounted in a ceiling suspension grid system.

Provide 24-inch by 24-inch by ¾-inch thick acoustical panels with regular edge having an LR-1 Light Reflectance Coefficient of 0.75 (minimum) and a Noise Reduction Coefficient of 0.75 (minimum). Units to be Class A, non-combustible, with a maximum flame spread rating of 25 and a maximum smoke development rating of 450 per ASTM E 84.

Provide an exposed grid, standard width flange suspension system complying with ASTM C 635 for heavy-duty systems. Grid shall be steel or aluminum, with factory-applied enamel finish. Suspension system shall be capable of supporting the finished ceiling, light fixtures, mechanical diffusers, and other loads as applicable. Conform to seismic design guidance in UFC 3-310-04 and ASTM E 580.

Elevations of ceiling system installations are indicated on the Drawings. Installation of acoustical ceilings shall comply with ASTM C 636.

Floors

Rubber tile shall be a static conductive per ANSI/ESD S7.1-2005, smooth surface, vulcanized two layer construction and conform to ASTM F 1344. Rubber content shall be approximately 31%. Back of tile to be flat back, double sanded. Electrical resistance from floor to ground shall be 1,000,000 ohms (1.0 x 10 to the 6th) to 100,000,000 ohms (1.0 x 10 to the 8th) when tested in accordance with ASTM F150 and ESD S7.1. Tile shall be 24 inches square and 2 mm thick. Taber abrasion test, ASTM D 3389, H-18 wheel, 500 gram load, 1000 cycles, gram weight loss not greater than 0.50. Hardness per ASTM D 2407, Shore A, greater than 81. Slip resistance ASTM D2047, equal or greater than 0.6, ADA guidance compliance. Decay time to be <0.025 seconds when tested to FTM 4046 101. Static generation to be <20 volts when tested according to ESD STM 97.2

Access Floor: Provide Rigid Grid Access Flooring System with adjustable pedestals and readily removable floor panels. System shall comply with ICC-ES AC300. Floor panels shall have tiles installed at jobsite. Floor panels shall be tested in accordance with CISNA Access Floors. System shall have concentrated load of 1,250 pounds per square inch without top-surface deflection more than 0.10 inch. System shall have a 1,200-pound rolling load with casters. Stringers shall support 250 concentrated load at mid-span. Pedestals shall be capable of supporting a 5,000-pound axial load without permanent deformation. System to be furnished with factory installed vinyl composition tile.

Windows

Glazing. Interior ¾ hour rated fire glazing shall be 1” thick double glazed tempered. Sizes as indicated on Drawings. Exterior windows at the office area will be steel framed units with 1” insulated glass with operable sections.

Hollow Metal Frames. Comply with SDI/DOOR A250.8, Level 1, with welded corners or knock-down field-assembled corners. Fire rated frames shall comply with NFPA 80. Finish color of frames shall be coordinated with the interior color palette.

Doors

Wood Doors. Interior 20 min rated doors shall be solid core wood, custom grade, balance matched, quarter sawn or plain sliced veneer. Wood doors shall be factory finished with tinted polyurethane with low gloss sheen.

Hollow Metal Frames. Comply with SDI/DOOR A250.8, Level 1, with welded corners or knock-down field-assembled corners. Fire rated frames shall comply with NFPA 80. Finish color of frames shall be coordinated with the interior color palette.

Hardware. Provide hardware manufactured to template and complying with NMSU requirements. Hardware for fire-rated door assemblies shall be listed and comply with requirements of NFPA 80. Exit hardware shall comply with NFPA 101 criteria. Hardware at security doors shall be coordinated with access control and alarm system requirements. Hinges shall be ball-bearing, stainless steel with BHMA 689 finish.
All locksets shall be ANSI 156.2 Series 4000, Grade 1 Certified. Furnish with standard 2 3/4" backset. Lock chassis shall be fabricated of brass or corrosion-treated steel. Latchbolt shall be solid brass or stainless steel with a minimum 9/16" throw. Locks shall be non-handed and fully field reversible.

Insulation and Sealants

Interior Sound Insulation. ASTM C 665, Type I, UL-labeled mineral wool sound attenuation fire blankets (SAFB), mildew-proof and moisture-resistant. Nominal density shall be 2.5 pcf, with an R-Value of 3.7 per inch of thickness. Blankets shall be rated non-combustible when tested according to ASTM E 136, and have 0 flame spread and 0 smoke developed ratings in accordance with ASTM E 84.

Finishes

Paint. Painted gypsum board walls, exposed to view, shall have a spray-on texture, medium orange peel and shall be painted a minimum of one prime coat and two coat finish. All spaces shall have satin finish on walls, eggshell finish on hollow metal frames and eggshell finish on ceilings.

Wall Base. Allowable materials shall be rubber. Rubber base shall be continuous roll rather than 4-foot lengths in order to give a smooth finished appearance with a minimum of joints between corners. The base shall be a minimum of 4 inches high.

Corner Guards. Provide 3-inch wide, surface mounted, rigid vinyl corner guards at all exterior wall corners of gypsum board walls. Top of edge guards shall be a minimum of 6 feet above finished floor. Bottom of guard shall be to floor in areas of no base and to top of base at all other areas.

Firestopping

Material shall have a flame spread of 25 or less, a smoke developed rating of 50 or less, and a fuel contribution of 50 or less when tested in accordance with ASTM E 84 or UL 723. The materials shall be nontoxic to human beings at all stages of applications and during fire conditions. Firestopping materials for through-penetrations of fire resistance rated construction shall provide fire resistance rating in accordance to ASTM E 814 or UL 1479. Firestopping materials for construction joints in fire resistance rated construction shall provide a fire resistance rating in accordance to ASTM E 119 or UL 263. Construction joints include those joints used to accommodate expansion, contraction, wind or seismic movement of the building. Firestopping materials shall be non-combustible when tested in accordance with ASTM E 136.

HEATING VENTILATION AND AIR CONDITIONING (HVAC)

Design Criteria

Outdoor Temperature Design Data – Las Cruces, NM:

- 0.4% Cooling Design Dry-Bulb temperature – 100.0ºF
- 0.4% Cooling Design Wet-Bulb temperature – 64.0ºF
- 99.6% Heating Design Dry-Bulb temperature – 21.0ºF
- Climate zone per ASHRAE 90.1 – 3B

Indoor Design Conditions
Office areas: Based on ASHRAE 55-2010 criteria the indoor design conditions for office areas shall be as follows:

- Occupied indoor cooling setpoint temperature – 75ºF
- Occupied indoor heating setpoint temperature – 70ºF
- Unoccupied indoor cooling setpoint temperature – 85ºF
- Unoccupied indoor heating setpoint temperature – 63ºF
- Maximum indoor relative humidity – 60%

IT Equipment Rooms: Based on evaluation of IT equipment and UPS equipment requirements and on the User's past operational experience the indoor design conditions for the server rooms will be as follows:

- Indoor cooling cycle temperature – 70ºF
- Indoor heating cycle temperature – 70ºF
- Indoor relative humidity – 30%-55%

HVAC Zones

- Main machine room, including secure data area
- Networking
- Enclosed office area (two or three zones)

Occupancy Load

- Total space occupancy is 16 people.

Building Envelope and HVAC Load Criteria

U-values (Btu/h-ft2-oF) of the existing building construction elements have been used for the HVAC load estimates. The building construction of the new addition shall meet the most current requirements of ASHRAE 90.1.

Internal Loads, Including Equipment Heat Release Data:
People - Cooling loads for people is based upon activity and occupancy as prescribed in ASHRAE Fundamentals Handbook.

Lighting - The values indicated below are the maximum performance values per ASHRAE 90.1.

- Offices – 1.0 W/ft^2

- IT rooms – 1.5 W/ft^2

Miscellaneous Equipment:
- Offices – 2.0 W/ft^2
- Break room – approximately 2.0 kW

IT Equipment**:**
- Refer to “Information Technology Equipment” section Four above for IT equipment heat release information

Ventilation: Minimum outside air rates to the occupied spaces and to server rooms shall be provided according to ASHRAE 62.1 as follows:
- Office areas: 5 cfm per person and 0.06 cfm per sq. ft.
- IT equipment room: 5 cfm per person and 0.12 cfm per sq. ft.

HVAC Design Load

Refer to Table 1 below for estimated HVAC design loads:

Table 1

Area	Capacities	
	Heating (kBtu/h)	Cooling (kBtu/h)
Main Machine room including secured data area (3,470 sq. ft.)	-	1,204.8 (780.0)
IT Equipment room	-	0.0 (252.0)
Networking Equipment (1,120 sq. ft.)	-	169.5 (240.0)
UPS room (760 sq. ft.)	15.0	87.6 (36.0)
Enclosed Offices (1,940 sq. ft.)	65.0	90.0 (60.0)
Break room/Conference room (180 sq.ft.)	20.0	22.0 (48.0)
Mechanical room (430 sq.ft.)	20.0	-
Total (7,200 sq. ft.)	120.0	1573.9 (1416.0)

Note: Figures in parenthesis are the estimated cooling loads at the current conditions for references.

Data Center Cooling System

Chilled water supply to the facility is provided from the Central Plant. The Central Plant is operating at chilled water supply temperature of 44°F with 12°F of temperature differential (temperature differential may vary).

Two independent chilled water services provided to the building:

- One 4" chilled water supply and return line is provided from the onsite distribution pipes at the south-west corner of the building. Two base-mounted constant volume chilled water pumps located in the ICT building mechanical room (CHP-21, CHP-22) with approximate capacity of 100 GPM, 53 feet head, one operating and one in standby, provide chilled water supply to the air-handling units AHU-1 and AHU-2. One base-mounted constant volume chilled water pump (CHP-20) with approximate capacity of 157 GPM, 63 feet head in the 1st floor mechanical room provides chilled water supply to the penthouse air-handling unit serving the main building area.
- The second 4" chilled water supply line is provided from the Science Hall at the north-east corner of the building. Two existing base-mounted constant volume chilled water pumps with approximate capacity of 240 GPM, 80 feet head, 10 HP each, one operating and one in standby provide chilled water supply to the Data Center air-handling units AHU-3 and AHU-4 at the second floor mechanical room.

These two branches are connected together at the second floor. This arrangement creates building chilled water loop that essentially provides a backup for chilled water supply to air-handling units serving Data Center from either source. One set of isolation valves is located at the north-east corner of existing room 129 below raised floor and a second set of valves is located inside the second floor ceiling plenum.

The primary chilled water pumps at Central Plant provided with electric power supply from El Paso Electric with emergency power provided from the gas turbines at the Central Plant that allows for continuing chilled water distribution during El Paso Electric shutdowns. The chillers however would not be operational. There are only a few buildings with separate pumps tied directly to the loop and therefore the temperature of the chilled water may remain sufficient for an extended time during power outage to cool Data Center. No additional source of cooling, such as DX-type equipment, is required.
New design shall provide emergency power supply to the secondary chilled water pumps CHP-20, CHP-21 and CHP-22 in the ICT building and to the secondary pumps in the Science Hall to allow for chilled water supply to the Data Center air conditioning equipment during emergency power shutdowns. The design for new Data Center shall verify if the capacity of existing pumps meet the new cooling demand. If required these pumps shall be replaced to meet cooling loads of new Data Center.

Existing 4" chilled water piping under raised floor in room 129 shall be re-routed if required to clear space for the under-floor air distribution and for cabling routing. The damaged sections of the piping insulation shall be repaired. New and existing materials shall meet plenum requirements and be replaced if required.

The location of existing isolation valves shall be properly labeled and instructions to maintenance personnel shall be placed nearby. ***These manual valves should be replaced with new motor-operated valves for ease of operation during emergency conditions.***

Existing under-floor water leak detection system shall be replaced, as required, to meet new Data Center layout and underfloor piping configuration.

Data Center Heating System

For details on ICT Building heating system refer to “HVAC and Electrical Systems Assessment Report” in Appendix B.
Existing steam supply and condensate return piping to HVAC equipment serving Data Center shall be removed entirely inside scope of the project and piping appropriately capped water tight.

Heating hot water supply shall be provided to the heating coils of the new air handling unit and to the reheat coils of VAV boxes serving Data Center office area.
The heating hot water supply shall be available from either:

- The ICT building hot water piping on the second floor mechanical room;
- 1” heating hot water line provided from the Science Hall at the north-east corner of the building.

The system is operating at heating hot water supply temperature of 180°F with 20°F of temperature differential and is dedicated only to the HVAC equipment serving computer center.

Existing 1” hot water piping under raised floor in existing room 129 may be re-routed if required to clear space for the under-floor air distribution and for cabling if required. The damaged sections of the piping insulation shall be repaired. New and existing materials shall meet plenum requirements and shall be replaced if required.

Apparent Competitive Mechanical Systems

Four existing air-handling units provide air-conditioning to the project area. Units are outdated and shall be removed entirely along with associated ductwork, air distribution devices, piping, controls and all other accessories. Abandoned old equipment above ceiling shall also be removed. **All materials above ceiling and inside the access floor, including but not limited to the piping, cables, etc. not rated for plenum installation shall be removed or replaced with adequate material.** Refer to Appendix B for details.

Next to the technology systems themselves, the cooling system consumes the most energy in the data center, accounting up to 37% of data center electricity use. This report has considered various types of HVAC systems for increasing data center cooling efficiency, including:

Alternative 1: Baseline HVAC System: For the purpose of this study the baseline or “typical” HVAC system for IT equipment process cooling will include only perimeter type DX computer room air-conditioning unit (CRAC) with electric humidification, and electric reheat. The baseline HVAC system for office area will be a packaged rooftop DX-type with gas heat in compliance with ASHRAE 90.1.

Alternative 2: HVAC system for this alternative will be a 4-pipe hydronic system with perimeter constant volume computer room air-conditioning units with chilled water cooling coils and hot water heating. HVAC system for office area will be a constant volume air-handling unit with chilled water cooling coils and hot water heating.

Alternative 3: HVAC system for this alternative will be the same as Alternative 2, except CRAC units will be variable air volume units with high-efficiency plenum type fans in lieu of standard centrifugal fans. HVAC system for office area shall be a variable air volume air-handling unit with chilled water cooling coils and hot water heating with multiple VAV air terminal units with reheat coils and with 100% economizer option.

Based on anticipated energy consumption and on probable life-cycle cost effectiveness of subject cooling systems and on the past project experience the Alternative 3 is proposed for this study. The next phase design shall provide detailed life-cycle calculations and implementation of up-to-date HVAC systems.

Recommended HVAC System

Six variable volume computer room air-handling units with hydronic cooling coils and with electric humidification and with hot water reheat shall serve Data Center main equipment room. New units shall be equal to Liebert model CW-114 with approximate cooling capacity of 280 kBtu/h at 14,000 CFM each. Four larger size CRAC units can be employed, if desirable. One of the units shall be designated for the stand-by operation to provide N+1 redundancy. Air side economizers are not included for the CRAC units in this alternative, because they are not required for special process loads.

Two variable volume computer room air-handling units Liebert model CW-084 with approximate cooling capacity of 102 kBtu/h at 4,000 CFM shall provide air conditioning in Networking room. No cooling equipment redundancy is required for this room per NMSU.

One variable volume air-handling unit mounted in mechanical room with approximate cooling capacity of 88 kBtu/h at 2,800 CFM shall provide air-conditioning to the UPS room.

One variable volume roof-mounted air-handling unit with approximate cooling capacity of 112 kBtu/h at 3,600 CFM shall provide air-conditioning to the office area and the to the break room. Unit shall be provided with air-side economizer. Three to four VAV air terminal units shall provide temperature control in dedicated office space zones.

Exiting secondary chilled water pumps CHP-20, CHP-21 and CHP-22 in the ICT building shall be replaced with new pumps with appropriate capacity.

Two new roof-mounted exhaust fans, one – operating and one – stand-by, shall provide exhaust ventilation for smoke evacuation in each of the IT equipment rooms (Main Machine room, Networking room and UPS room) at the minimum rate of 1 cfm per 1 sq.ft. Fans shall be interlocked with ultra-sensitive smoke detection system. Activation shall occur at the least sensitive alarm detection signal.

One in-line supply fan suspended from structure above ceiling or roof-mounted fans) with approximate capacity of 1,500 CFM shall be provided for ventilation air supply to CRAC units through the ceiling plenum. The fans shall be provided with a filter box with MERV-13 filters to filter out most contaminants and protect server equipment in accordance with ASHRAE TC 9.9 recommendations. The filter box shall include a pressure sensor to alert the BAS that filters require maintenance. Duct-mounted hydronic heater shall be provided for outside air pretreatment. Design shall consider supply fan installation inside mechanical room.

Design Objectives and Provisions

Proper sealing of data center environment
Cooling losses through floors, walls and ceiling, or introduction of dry air from outside of the critical facility, increases cooling system loads and increases cooling energy costs. Therefore the Data Center shall be isolated from general building and from outside environment as much as practical.

The detailed investigation of the area shall be conducted and all openings in doors, windows and walls, and cable and piping entrances through the walls including access floor plenum shall be sealed airtight as applicable.

Optimizing Air Flow
Most equipment racks manufactured today are designed to draw in air through the front and exhaust out of the rear. This allows equipment racks to be arranged to create hot aisles and cold aisles. This approach positions racks so that rows of racks face each other, with the front of each opposing row of racks drawing cold air from the same aisle (the “cold” aisle). Hot air from two rows is exhausted into a “hot” aisle, raising the temperature of the air returning to the CRAC unit and allowing the CRAC to operate more efficiently. This approach is most effective when cold air and hot air do not mix. Therefore, perforated floor tiles shall be installed only in cold aisles. Blanking panels may be used to fill open space in racks to prevent hot air moving back through the rack.

Some type of cabling grommet shall be used to prevent the cold air from entering the space through cable openings. A similar type of air-tight seal should be provided for piping penetrations under CRAC units.

Ceiling plenum shall be used for drawing return air from the hot aisle to CRAC units for minimizing mixing of the hot and cold air.

It shall be noted that due to the limited ceiling height in the existing room 130 the installation of the IT equipment in that room should be avoided because optimized air distribution will be impossible to achieve, thus compromising cooling efficiency and the equipment operation.

The IT contractor shall properly manage cable routing to avoid creating obstructions to air flow through the perforated floor tiles and from front to the rear of the rack. To the extent possible the overheat cable trays shall be utilized.

Air-side Economizers
An air-side economizer shall be provided on the air-handling unit serving office area. An air-side economizer shall not be used for the CRAC units in this project because of the increased energy cost and water consumption required to add moisture to the room due to the extremely dry ambient conditions at the project site.

Increase the Efficiency of Air-Conditioning Units
The Data Center shall be designed with some level of cooling system redundancy (approximately 15%). Most of the time CRAC units are operating at less than 100% capacity. Because operating conditions aren't stable, this requires some method of varying capacity based on operating conditions.

The design shall use multiple CRAC units for Data Center air conditioning. It is very important that operations of all CRAC units are coordinated to maintain uniform design conditions throughout the room. CRAC unit manufacturer-provided Advanced Control System or Data Center Information Management (DCIM) system shall be employed across all CRAC units in a room to enable the units to communicate and coordinate their operation, preventing "fighting mode".

Air-Handling Equipment
Design shall provide outside air and return air volume control with motorized dampers.

Filtration for each air handler for outside air shall include 65% MERV-11 filters.

Positive pressure shall be maintained in the space.

Existing water leak detectors shall be replaced. New detectors shall be installed in the under floor plenum below each CRAC unit if required.

Air Distribution
Server room supply air grilles shall be designed for use in access floor systems and specialized for distributing air to server racks.

Comfort air distribution systems shall be designed for low velocity to minimize noise and fan energy consumption.

All general HVAC ductwork shall be constructed of galvanized steel sheet metal, fabricated and installed in accordance with "HVAC Duct Construction Standards - Metal and Flexible" by SMACNA, Inc., latest edition. Exceptions shall be minimum lengths of double-wall insulated flexible duct to serve as connectors from the sheet metal ducts to the terminal devices. All supply, return and outside air ductwork shall be insulated to conserve energy, eliminate condensation and to reduce noise.

Exhaust fans, air terminal units, turning vanes, balancing dampers, control dampers, diffusers, registers, grilles, flexible connections, etc., shall be selected to provide a complete, easy-to-balance air distribution system free of objectionable noise.

Alarmed outdoor airflow control devices shall be incorporated into the facility HVAC systems to promote occupant comfort and well-being. Ventilation air flow rates shall be continuously monitored at the outdoor air intakes to air-conditioning units.

HVAC systems design shall provide thermal comfort in all occupied spaces according to the requirements of ASHRAE 55.

All HVAC equipment serving IT equipment rooms shall be provided with emergency power supply.

HVAC Piping Systems
Existing piping serving demolished HVAC equipment shall be removed entirely. PVC piping, if present in access floor space, shall be replaced with copper pipes.

All chilled water piping and hot water piping shall be of Type L hard drawn, Schedule 40 copper, or Schedule 40 steel on pipe up to 2-1/2” diameter. Pipe diameters larger than 2-1/2” shall conform to ASTM A53. All steel piping shall be Class 125 unless specifically noted otherwise. Solder joints for copper piping shall be lead-free solder.

Insulated gravity condensate drains shall be provided from HVAC equipment in an approved manner to the points of disposal. Copper pipe shall be used for interior installation. Outdoor condensate drain shall utilize galvanized steel pipe.

Piping insulation for pipes installed within ceiling plenum and within access floor shall meet all applicable requirements for plenum installation.

Phasing
Phasing will be required during construction so that the mission of the facility is not impeded. ICT Department will relocate existing non-essential racks prior to demolition activities. Utilities for the new racks shall be provided at the required locations by the contractor.

HVAC Controls

Existing pneumatic controls serving Data Center shall be removed. New BACnet compatible Building Automation System (BAS) shall be provided. BAS shall provide monitoring, alarm and communication with campus-wide system.

New control system shall integrate CRAC unit manufacturer-provided stand-alone unit controls equal to Liebert Advanced Control System or Data Center Information Management (DCIM) system to enable the CRAC units to communicate and coordinate their operation and maintain desired cooling conditions across IT equipment racks.

The air-handling unit serving the office area shall be provided with stand-alone DDC controls tied into new facility BAS system.

Space temperature control shall be provided through the local control devices to allow for year-round comfort in offices and in IT equipment rooms.

The control system shall be suitable for heating, ventilating and air conditioning systems serving the data center and offices. Control wiring shall be run above the ceiling or below access floor, as applicable, and shall allow for easy removal of ceiling tiles and floor tiles without interference due to control or network wiring and free air distribution in ceiling plenum and in access floor plenum. Control wiring in partition walls, structural walls, or wiring exposed in equipment rooms shall be in dedicated metallic raceways.

The design shall include complete control system drawings and technical specifications for each control system. Temperature control drawings shall be prepared by the control system vendor and shall be similar to shop drawings. No catalog cuts or specific component information is required on the temperature control system design drawings.

Night setback and setup controls shall be provided for the office space to permit flexibility based on building occupancy. Morning warm-up and cool-down must be part of the control system.

The outside air heating temperature controls at all HVAC systems shall be capable of automatically preventing operation of the heating system when the outside temperature is above 62°F (adj.). Controls shall also be designed to energize the heating system and maintain the conditioned space at 55°F (adj.) on a drop in temperature when the system is programmed "off" by the system thermostats. Controls shall be designed to energize the cooling system and maintain the conditioned space at 85°F (adj.) on a rise in temperature when the system is programmed “off” by the system.

Testing, Balancing, and Commissioning of HVAC Systems

Testing, balancing, and adjusting of all HVAC systems shall be performed by a certified AABC or NEBB test and balance firm. Reports of all tests shall be submitted for approval to the client on standard AABC or NEBB forms.

Commissioning of the HVAC systems and controls and other building systems shall be provided to verify that the entire project is designed, constructed and calibrated to operate as intended.

PLUMBING AND FIRE PROTECTION

Plumbing

Existing plumbing fixtures in the break room and in the restroom shall be removed.

New insulated domestic cold water piping shall be provided from existing piping under the access floor with reduced pressure backflow preventer assembly to the humidification section of the CRAC units.

Plumbing Fixtures
Water closets shall be white vitreous china, floor mounted, HET ultra-low flow type with (1.28 gpf) manual flush valve type.

Urinals shall be white vitreous china, wall mounted, HEU ultra-low flow type with (0.125 gpf) manual flush valve type.

Lavatories shall be white vitreous china, wall mounted with (0.5 gpm) manual operated type faucet.

Break Room sink shall be single compartment, stainless steel, self-rimming countertop mounted with (1.0 gpm) manual wide spread faucet.

Existing floor drains shall remain. New floor drains shall be provided with trap protection device.

Domestic Water Piping
Domestic water piping shall be ASTM B88 and ANSI/NSF Standard 61, Type L, Seamless Copper Water Tube. Fittings shall be ASME B16.22 wrought copper and bronze solder type. Solder connections shall be 95-5 tin–antimony.

Domestic hot and cold water piping shall be insulated with 1 inch thick fiberglass insulation.

Domestic water supply and waste piping systems shall be concealed in areas with ceilings and exposed in areas without ceilings.

Domestic water flow in piping shall not exceed 6 FPS velocity.

Water hammer arrestors shall be applied to the domestic water system in accordance with PDI WH201.

Sanitary Waste and Vent Piping.
Sanitary waste and vent piping and fittings shall be polyvinyl chloride (PVC), ASTM D2665 Schedule 40 with solvent cement joints in accordance with ASTM D2564.

Minimum slope on interior sanitary sewer piping shall be 1% (1/8” per foot) for 3” and larger pipe and 2% (1/4” per foot) for 2” and smaller pipe. In addition, sanitary sewer piping slope shall provide a minimum velocity of 2 fps.

Floor drain traps shall be protected from drying out as required by the code. Waterless trap protection devices shall be used.

Fire Protection

The existing facility is currently provided with clean agent fire suppression system by Inergen. Refer to Appendix B for details.

Due to the major deficiencies of the existing clean agent system and to major changes in space layout the existing system shall undergo a complete overhaul. The light hazard occupancy classification of the system will remain.

The clean agent storage tanks shall be reused and rearranged to meet new space zoning requirements and new mechanical room layout. Additional tanks shall be provided if required. Existing clean agent piping can be reused, where possible.

Wet-pipe fire protection system shall be provided for the new office area addition and to mechanical room.

Fire Protection Piping
Clean agent pipe fire protection system piping installed within the building and wet pipe system piping shall be Schedule 40, black steel.

Automatic Sprinklers
Recessed sprinklers shall be used in areas of the building with suspended ceilings where aesthetic appearance is of concern. These areas include IT equipment rooms, offices, break room and corridors. In areas without ceilings, brass uprights shall be used.

Sprinklers in office and training areas shall be quick response standard spray type. Sprinklers within the IT rooms shall be large orifice or other storage sprinkler based on storage arrangements.

ELECTRICAL SYSTEMS

Existing Conditions

Refer to the one line diagrams in Appendix D. The NMSU Campus is fed at 23.9 kV by six feeders from the El Paso Electric Company (EPEC) Tortugas Substation. Two feeders (number 3 and 4) feed to Cool Pool Substation which in turn provides power at 4160 volts to the NMSU College Substation NES (on feeder no. 3) and the Central Plant Switchboard (on Feeder No. 4). Tortugas Feeder 3 also feeds Pad Mount Transformer T25-410 (2000 kVA, 23.9 kV to 4.16 kV) at the computer center.

Both the College Substation and the Central Plant Switchboard are tied together via breaker ENT located in the Central Plant Switchboard allowing the Central Plant to be served from the College Substation upon loss of Tortugas feeder no. 4. Because of the tie breaker ENT, the Central Plant and the College Substation have multiple sources of power and can be supported by either Feeder 3 or Feeder 4 of the Tortugas Substation

The Computer Center is currently fed at 4,160Y/2400 volts via circuit EFCC from the Central Plant essential bus which ties into a manually operated 4.16 kV SF6 switch S5-140 (normally closed). The output of transformer T25-410 also ties into switch S5-140 (normally open) thereby providing Switch S5-140 with a redundant feed. Switch S5-140 feeds transformer T5-820 (1000 kVA, 4.16 kV – 480y/277), manually operated oil switch S5-145 which in turn serves Transformer T5-825 (500 kVA, 4.16kV to 208y/120), and manually operated oil switch S5-150 which servesT5-830 (112.5 kVA, 4.16 kV - 208y/120), and T5-840 (500 kVA, 4.16 kV - 480y/277).

Transformer T5-820 serves the electrical room 145 located at the Northwest corner of the Computer Center. Transformers T5-825 (500 kVA), T5-830(112.5 kVA) and T5-840(500 kVA) serve the electrical equipment room on the south east side of the Computer Center.

All feeds to computer center transformers after Switch S5-140 are radial feeds and by definition are single points of failure.

The maximum electrical demand for the Computer Center was 282.2 kW (340 amperes) which occurred on Jan 25, 2012. Refer to the Computer Center Electrical Energy Use Chart in Appendix F

The transformers serve a system of low voltage electrical panels. A large portion of these panels serve the Data Center and are mounted on the Data Center walls. The existing electrical one-line diagram provided by NMSU for the Computer Center's Data Equipment, Server and Telephone Switch Rooms is shown by the drawings in Appendix E1. These one line diagrams are missing some vital information that is needed to do a proper reliability and electrical system study.

The Data Equipment, Servers and Telephone Switches are served through 3 UPS systems. An 80 kVA, 480 – 208Y/120 volt UPS serves Panelboard CP in the Shared Access Server Room. A 160 kVA, 480 – 208Y/120 volt UPS serves the main data center room. A 30 kVA 208V –

208Y/120 volt UPS serves the NOC equipment room. Loads on the UPS systems are as follows:

Unit	Area	Load @ UPS Panel Readout	Connected Load
80 kVA UPS:	Shared Access	36.7 kVA	Unknown kVA
160 kVA UPS	Data Center	88.0 kVA	161.044 kVA
30 kVA UPS	NOC	4.8 kVA	21.169 kVA

Total Equipment Load 129.5 kVA or 46% of maximum building demand

The remaining 152.7 kVA of building demand is composed of lighting, HVAC, and miscellaneous outlet power.

Spare Capacity

Total building capacity is approximately1,612.5 kVA based on the ampere rating of the existing switchgear. Accounting for the existing maximum demand load, there is approximately 1,330.3 kVA of spare capacity in the distribution system.

Electrical System Backup Power

Backup power for the Computer Center is provided by the University's Cogeneration Turbine powered 1000 kW generator. The cogeneration system has the capacity to provide the backup power for the Computer Center; however, the turbine has to be shut down every month for maintenance, leaving the Computer Center vulnerable to a power interruption if both the normal power source and the cogeneration source suffer an outage simultaneously. .

Observations

Reliability

The Computer Center is served from a two 5kV feeders. One of the feeders comes from the Central Plant, the second feeder comes from the secondary of Transformer T25-410. These two feeds terminate in switch S5-140 which provides a backup source for the computer center only up to the SF6 Switch S5-140.

The cogeneration/essential bus that serves the Computer Center is fed by a turbine powered generation that must be shut down every month for maintenance making the Computer Center vulnerable to a total power outage.

Data Center data processing equipment is fed from 2 different sized UPS units that have an approximate 50% load factor. Failure of one UPS units will render the Data Center fundamentally vulnerable to outages on a portion of the equipment. If critical process servers, switches or SAN or RAID memory devices are on the affected UPS, then these systems could become unavailable.

Data cables are run under the raised floor and restrict airflow of needed cooling air to the equipment racks and can cause the equipment to overheat and shutdown.

Cooling air holes in the raised floor are poorly located. Extraneous holes cause air leaks and reduce the cooling efficiency of the raised floor cooling system.

Rack mounted power distribution units (PDUs) have data communications capability to monitor power conditions and electrical load at the rack level. These communications ports have not been configured or connected to a data network to allow the Data Center IT staff to monitor power usage within the racks.

H-Z could not confirm the use of two circuits to each equipment rack to provide N+1 or 2N redundancy.
The following locations are single points of failure and may cause some or all of the power to the data center to be lost. The Mean Time To Repair/Replace is based on survey data obtained by the Institute of Electrical and Electronics Engineers (IEEE) and published as part of IEEE Standard 493-2007, "IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems"._

Point of Failure	Type	Mean Time to Repair/Replace	Comments
Sw. S5-140	Total	168 hours	Loss of all power feeds to Data Center Building. 45 minute UPS reserve power.
Sw. S5-140 Feeder 4	Partial	Between 8 to 168 hours based on type of failure	Loss of main data center power Transformers T5-825, T5-835, T5- 840, 45 minute UPS reserve power from the 160 kVA UPS.
Sw. S5-140 Feeder 3	Partial	Between 8 to 168 hours based on type of failure	Loss of Transformer T5-820 feeding Swbd MDP, Room 145. Approx 30 minutes reserve power from 80 kVA UPS. Loss of
5 kV Feeder from S5-140 serving Switch S5-145	Total	16 hours	Loss of main Data Center Power Transformers T5-825, T5-835, T5- 840, 45 minute UPS reserve power from the 160 kVA UPS.
5 kV Feeder from S5-140 serving Trans T5-820	Total	16 hours	Loss of Transformer T5-820 feeding Swbd MDP, Room 145. Approx 30 minutes reserve power from 80 kVA UPS.
Transformer T5-820	Total	297 hours	Loss of Swbd MDP, Room 145. Approx 30 minutes reserve power from 80 kVA UPS.
Oil Switch S5-145	Total	160 hours est.	Loss of main Data Center Power Transformers T5-825, T5-835, T5- 840, 45 minute UPS reserve power from the 160 kVA UPS.

Medium Voltage feeder from S5-145 to Oil Insulated Cutout P5-340	Total	4 hours to 160 hours	Loss of Transformers T5-825, Switchboard in the SW. Basement, Panels 1A/2A and 1B/2B and Motor Control Center MCC1 (includes lighting, power and HVAC for the Data Center Building)
Medium Voltage feeder from Oil Insulated Cutout P5-340 to Transformer T5-825	Total	8 hours	Loss of Transformers T5-825, Switchboard in the SW. Basement, Panels 1A/2A and 1B/2B and Motor Control Center MCC1 (includes lighting, power and HVAC for the Data Center Building)
Transformer T5-825	Total	297 hours	Loss of Switchboard in the SW. Basement, Panels 1A/2A and 1B/2B and Motor Control Center MCC1 (includes lighting, power and HVAC for the Data Center Building)
Medium Voltage Feeder from S5-145 to Oil Filled Switch S5-150	Total	16 Hours	Loss of main Data Center Power Transformers T5-835 and T5- 840. 45 minute UPS reserve power from the 160 kVA UPS.
Oil Filled Switch S5-150	Total	160 Hours	Loss of main Data Center Power Transformers T5-835 and T5- 840. 45 minute UPS reserve power from the 160 kVA UPS.
Medium Voltage Feeder from S5-150 to Transformer T5-830	Total	16 Hours	Loss of Panels NON and X
Medium Voltage Transformer T5-830	Total	160 Hours	Loss of Panels NON and X
Medium Voltage Feeder from S5-150 to Transformer T5-840	Total	16 Hours	Loss of switchboard 4SWBD, Data Center HVAC Fans. 160 KVA UPS provides 45 minutes of backup.
Medium Voltage Transformer T5-840	Total	160 Hours	Loss of switchboard 4SWBD, Data Center HVAC Fans. 160 KVA UPS provides 45 minutes of backup

Based on the number of single points of failure in the power system this facility appears to be a Tier I data facility. A tier I data center is susceptible to disruptions from both planned and unplanned activity. It has computer power distribution and cooling, but it may or may not have a raised floor, a UPS, or an engine generator. If it does have UPS or generators, they are single-module systems and have many single points of failure.

Data Center Security

Access control between the Joint Use Server Room and the main Data Center area is poor. Students and faculty can enter the main Data Center through the connecting door fairly easily.

Access control of the main Data Center allows users and visitors to exit the space without presenting valid security credentials.

Access control into the telephone switch room is reversed. Someone can easily enter and get locked in the room if there is not any IT staff to allow them to exit. The access control configuration allows non-cleared individuals to easily enter a space that should be accessible only to qualified, security-cleared staff.

Electrical Code Analysis

The electrical floor plan of the Data Center is shown on the floor plan drawing in Appendix IV.

Panels L and L2 located in Mechanical Room 130C do not have the necessary working clearances required by National Electrical Code Article 110, Part II, Paragraph 110.26. The present clearance is only 24”. Code required clearance is 36”.

The 500 kVA transformer serving switchboard 4SWBD located in room M100 may not have the necessary clearance required by National Electrical Code **Article 110, Part III, Paragraph 110.31**. The required clearance is 48” clear in front or the transformer. This transformer is also placed up tight against the wall in the back closing off the rear ventilation opening in the back of the unit which is a violation of NEC Article **450.9 Ventilation** which states: *“The ventilation shall be adequate to dispose of the transformer full load losses without creating a temperature rise that is in excess of the transformer rating. Transformers with ventilation openings shall be installed so that the ventilation openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.”* The placement of the transformer also blocks access to the wireway located on the west end of the transformer.

Panelboard circuit directories do not comply with the NEC. The existing panel board schedules have been provided in Appendix E5 Blank spaces in these schedules indicate loads that have not been properly identified. Article **408.4 Field Identification Required** states the following:

(A) ***Circuit Directory or Circuit Identification.*** *Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific use. The identification shall include sufficient detail to allow each circuit to be distinguished from all the others. Spare positions that contain unused overcurrent devices and switches shall be described accordingly. The identification shall be included in a circuit directory that is*

located on the face or inside of the panel door in the case of a panelboard, and located at each switch or circuit breaker in a switchboard. No circuit shall be described in a manner that depends on transient conditions of occupancy.

(B) ***Source of Supply.*** *All switchboards and panelboards supplied by a feeder in other than one- or two-family dwelling units shall be marked to indicate the device or equipment where the power supply begins.*

Some electrical equipment does not have Arc flash hazard warnings applied as required by NEC Art. 110.16 **Arc-Flash Hazard Warning**. This article states:

110.16 ***Arc-Flash Hazard Warning****. Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.*

Furthermore, the existing arc-flash warning on other items of equipment is missing information suggested by NFPA 70E Standard for Electrical Safety in the Workplace and ANSI Z535.4-1998 Product Safety Signs and Labels. The information displayed should provide maintenance workers with arc-flash energy available, boundary distances and the minimum required personal protective equipment (PPE) to use when servicing the equipment.

The existing electrical equipment does not meet the present requirements of the NEC with regards to available fault current. NEC **110.24 Available Fault Current** states:

(A) ***Field Marking****. Service equipment in other than dwelling units shall be legibly marked in the field with maximum available fault current. The field marking(s) shall include the date the fault current calculation was performed and be of sufficient durability to withstand the environment involved.*

(B) ***Modifications****. When modifications to the electrical installation occur that affect the maximum available fault current at the service, the maximum available fault shall be verified or recalculated as necessary to ensure the service equipment ratings are sufficient for the maximum available fault current at the line terminals of the equipment. The required field marking(s) in 110.24(A) shall be adjusted to reflect the new level of maximum available fault current.*

Suggested Maintenance and Upgrades

Maintenance

- Update the existing short circuit and overcurrent device coordination study or have one performed if one does not exist. Post the maximum short circuit currents at the existing panels and verify that the available short circuit current does not exceed the short circuit rating of the existing overcurrent devices.

- Update existing Arc Flash Study or perform an arc flash study if one does not currently exist. Post the results at the existing electrical equipment.

- Trace all existing circuits from every panelboard. Install updated and code compliant circuit directories in each panelboard or nameplates at all overcurrent devices in switchboards.

- Include source of supply information on all equipment nameplates.

- Update the Computer Center electrical one-line diagram to show the entire electrical system. Diagram shall include every major item of equipment, equipment ratings, major overcurrent devices, feeder sizes, motor sizes, and magnitude of available short circuit at each item of equipment. Post the one line diagram behind a framed plastic cover within each main electrical room.

- Update the electrical floor plan of the Computer Center locating each and every item of major electrical equipment. Post alongside the one line diagram in each main electrical room.

- Relocate the existing 500 kVA, 4160V-480y/277 volt dry type transformer to a code compliant location.

- Replace panelboards L and L2 and install in a location that will provide code compliant working clearances.

Proposed System Upgrades

The following upgrades are proposed as future upgrades to the Data Center to provide a state-of-the-art data center power system.

IT Equipment and Systems

Huitt Zollars does not specify and recommend IT equipment additions. This practice is best left to NMSU's IT professionals.

Huitt-Zollars does recommend that NMSU implement Data Center Information Management (DCIM) to track the physical layer infrastructure of the data center by connecting all floor mounted PDUs, rack mounted PDUs, rack thermal management, under floor moisture sensors, AHU sensors, CRAC unit sensors, rack space, cable plant connections and routing to allow for Capacity planning, high fidelity visualization, real-time monitoring, cable/connectivity management, environmental management, business analytics, process/change management and integration. Possible software vendors include Altima, APC by Schneider Electric, Carmant-CS, DCM by Lucid Infotech, Device 42, Emerson, FieldView, iTRACS, Nlyte, Norlix, Optimum Path Inc, Rackwise, Raritan, RF Code, Romonet and Sentilla

Relocate as many fiber and copper data cables to above floor pathways (cable rack and fiber trough) to remove as much obstruction to air flow as possible. If data cables have to remain below the raised floor, install wire basket cable trays below the floor and neatly train and lace cable into the tray.

Recommended Power System Upgrades

- Huitt-Zollars recommends raising the tier rating of this facility to at least a Tier II by eliminating as many single points of failure a possible in both the electrical system and mechanical system (reference mechanical section for recommendations). The following is recommended (refer to suggested new Data Center One-Line Diagram):

    - Provide a separate 5 kV feeder from the Cogeneration Switchboard to the data Center.
    - Provide a separate 5kV feeder from the existing transformer T25-410.
    - Connect the 5 kV feeders from the Cogeneration Substation and Transformer T25-410 through new 5 kV pad mount vacuum switches. Upgrade Transformer T25-410 to 1,500 kVA.
    - Combine all the loads presently served by Transformers T5-825, T5-830 and T5-840 under a single new 1,500 kVA Transformer rated 4.16 kV to 480y/277 volts
    - Install a new 2,000 ampere circuit breaker type switchboard in the North Electrical Room.
    - Upgrade/replace the existing Powerware UPSs to 300 kVA each to allow for currently anticipated and future system growth and to allow the full load to be picked up by one should the other fail or require downtime for maintenance.
    - Replace the switchboard in the East Mechanical room with a new 2,000 ampere circuit breaker switchboard.
    - Tie the new switchboard in the North Electrical Room to the new switchboard in the east electrical room with a 2,000 ampere tie circuit breaker to allow either switchboard to carry the full data center load should one size be lost due to an outage. Provide key interlocks on the new switchboard main circuit breakers and the tie circuit breaker.
    - Install 6 ea. 400 ampere 480v to 208Y/120 volt floor mounted Power Distribution Units (PDUs). Each PDU to have network connection for real time load monitoring. Start with 4 PDus then add the others as future load dictates.
    - Install rack mounted dual circuit PDUs with network connections for real time load monitoring of rack loads.

- Install digital panel meters at each service switchboard and connect to the campus energy management system. These meters will provide information of kW and kVA demand at each service and will complement the existing metering being performed at the Central Plant by providing a more detailed breakdown of the existing loads, harmonic content and total harmonic distortion, power factor, and power disturbance events,

- Provide a N+1 feeder connection from the central plant to the Computer Center's main Data Center to provide additional redundancy. Connect this feeder to the Data Center's power system through a 5kV rated static switch that will allow automatic switchover to the standby circuit in case of failure of the preferred feeder circuit.

- Improve the access control and security of the data center by adding card in/card out to the Data Center equipment room to provide a complete audit trail of all traffic entering a leaving the equipment room.

- Improve the security between the joint use server room and the Data Center equipment room by installing a solid door with electric lock and card access from the joint use server room to the data center equipment room.

- Correct the access control into the telecommunication switch room by reversing the location of the card reader and request-to-exit pushbutton. Access to the switch room would be by card access only with exit by pushing the exit button.

- As a “belt and suspenders” solution, an appropriately sized backup generator or provisions for a temporary rental generator could be added to support the existing Data Center in an N+1 capacity (provide backup support to the cogeneration turbine at the Central Plant). Based on the existing maximum demand load a 250-300kW generator would be sufficient to provide backup power to the entire existing data center. An analysis should be performed by the Computer Center staff to forecast the future computing needs of the university, prepare a 10 year master plan of the Computer Center’s future upgrades and/or expansion and include the future power requirements into the generator capacity. This solution has not been indicated on the proposed one-line diagram.

- An additional El Paso Electric feeder could be considered to add some amount of reliability if it was extended from some substation other than the Tortugas substation and was on a separate transmission line from the Tortugas Substation. This may be an extremely expensive option and is not worth further consideration considering the other backup power and data backup options that currently exist or that may exist in the future.

- In addition to the generator, provide N+1 UPS capability. For the present time, the existing 160 kVA UPS appears to be sufficient to carry the entire Data Center equipment load for enough time to allow some primary side switching or to allow a backup generator to start and assume the load.

- Simplify the existing electrical services and distribution to and within the Data Center reducing the number of electrical services, install floor mounted power distribution units (PDUs) and remove the numerous wall mounted electrical panels.

- Provide 2N capacity in PDUs. One half of the PDUs would be connected to each of the N+1 UPS systems.

- Provide every data system equipment rack with rack mount PDUs with dual circuit hot-switch capability to provide 2N under floor plug power at the rack level. Each one of the two plug loads at the rack would be served from a separate PDU which would be served by a separate UPS system.

- Configure the communications ports on the UPSs, and PDUs (floor and rack mount) to provide communications to a central monitoring point so that the Data Center’s power loads can be monitored from the 480 volt service down to the rack level. Individual circuit monitoring can also be added to each rack PDU to provide power consumption to the equipment level.

SECTION FIVE

SECTION FIVE – COST ANALYSIS

Note: *The costs shown on the following estimate are based on the project being built in two phases. Phase One will be the construction of the office area on the north side of the existing building. Phase Two will be the interior renovations to the existing data center. Phase Two will require multiple sub-phases, which will be dictated by the available funding as well as operational limitations to maintain a functioning facility. The sub-phases will be further defined in the next design phase of the project. The cost estimate does not include installation or relocation of computer equipment, cabling or racks.*

RENOVATIONS TO DATA CENTER

COMPUTER CENTER ~ NMSU

PRELIMINARY COST ANALYSIS

4/4/2014

PHASE ONE ~ NEW OFFICE AREAS

	Quantity	Units	$ / Unit	TOTAL $
General Conditions	1	LS	$ 55,000.00	$ 55,000.00
Site Work				
Selective Demolition	1,200	SF	$ 7.50	$ 9,000.00
Excavation and Compaction	1,620	SF	$ 9.00	$ 14,580.00
New Construction				
Slab on Grade	1,620	SF	$ 8.00	$ 12,960.00
CMU Walls	2,020	SF	$ 7.50	$ 15,150.00
Roof Structure	1,620	SF	$ 15.00	$ 24,300.00
Roofing	1,620	SF	$ 9.00	$ 14,580.00
Stucco	2,020	SF	$ 7.50	$ 15,150.00
Windows	8	EA	$ 1,200.00	$ 9,600.00
Doors and Hardware	14	EA	$ 1,800.00	$ 25,200.00
Carpet / VCT	1,620	SF	$ 8.00	$ 12,960.00
Gypsum Board Partitions	2,350	SF	$ 5.75	$ 13,512.50
Acoustic Ceiling	1,620	SF	$ 4.25	$ 6,885.00
Mechanical				
Roof Mounted HVAC	1	LS	$ 20,000.00	$ 20,000.00
Ductwork	1,620	SF	$ 4.50	$ 7,290.00
Mechanical Piping	1,620	SF	$ 8.50	$ 13,770.00
Controls	1,620	SF	$ 5.00	$ 8,100.00
Wet Pipe FP	1,620	SF	$ 3.20	$ 5,184.00
Electrical				
Lighting	1,620	SF	$ 7.00	$ 11,340.00
Power	1,620	SF	$ 6.00	$ 9,720.00
Special Systems	1,620	SF	$ 3.00	$ 4,860.00

TOTAL	**$ 309,141.50**
15% Contingency	**$ 46,371.23**
Overhead & Profit @ 15%	**$ 53,326.91**
TOTAL ESTIMATED COST	**$ 408,839.63**
Cost / SF	**$ 341**

(Note: Total does not include NMGRT, Hazardous Materials Abatement, A/E Fees, etc)

RENOVATIONS TO DATA CENTER

COMPUTER CENTER ~ NMSU

PRELIMINARY COST ANALYSIS

4/4/2014

Data Center Renovations ~ PHASE TWO

	Quantity	Units	$ / Unit	TOTAL $
General Conditions	1	LS	$ 175,000.00	$ 175,000.00
Demolition				
Remove Ceilings	7,200	SF	$ 3.25	$ 23,400.00
Remove Floors	7,200	LS	$ 1.75	$ 12,600.00
Remove Partitions	1	LS	$ 15,000.00	$ 15,000.00
Haul and Dispose	1	LS	$ 15,000.00	$ 15,000.00
Walls				
Gyp BD Walls	7,500	SF	$ 6.25	$ 46,875.00
Paint Walls	7,500	SF	$ 2.25	$ 16,875.00
New Doors				
Doors & HM Frames	18	EA	$ 1,200.00	$ 21,600.00
Hardware	18	EA	$ 750.00	$ 13,500.00
Millwork				
Study Carels	32	LF	$ 120.00	$ 3,840.00
Break Room	15	LF	$ 160.00	$ 2,400.00
Corner Guards	1	LS	$ 6,500.00	$ 6,500.00
Insulation	6,500	SF	$ 1.65	$ 10,725.00
New Ceilings				
2 x 2 Acoustic	7,200	SF	$ 4.25	$ 30,600.00
New Flooring				
New Access Flooring	6,800	SF	$ 26.00	$ 176,800.00
Vinyl Tile	5,200	SF	$ 9.25	$ 48,100.00
Carpet Tile	2,000	SF	$ 4.00	$ 8,000.00
Mechanical				
See Attached	1	LS	$ 455,540.00	$ 455,540.00

Electrical						
Lighting	7,200	SF	$	9.00	$	64,800.00
5 kV Vacuum Switch	3	ea	$	45,000.00	$	135,000.00
1500 kVA transformer	2	ea	$	45,300.00	$	90,600.00
Low Voltage Switchgear	2	ea	$	120,000.00	$	240,000.00
300 kVA UPS	1	ea	$	220,000.00	$	220,000.00
Row Mounted PDU	12	ea	$	10,000.00	$	120,000.00
Medium Voltage Wiring	1	LS	$	250,000.00	$	250,000.00
Low Voltage Wiring	1	LS	$	350,000.00	$	350,000.00
Special Systems	7,200	SF	$	3.00	$	21,600.00

TOTAL	**$**	**2,574,355.00**
10% Contingency	**$**	**257,435.50**
Overhead & Profit @ 15%	**$**	**424,768.58**
TOTAL ESTIMATED COST	**$**	**3,256,559.08**

Cost / SF **$ 479**

(Note: Total does not include NMGRT, Hazardous Materials Abatement, A/E Fees, etc)

NEW MEXICO STATE UNIVERSITY, LAS CRUCES
Data Center Master Plan

OPINION OF PROBABLE COST - HVAC

Alternative 3 - Chilled Water CRAC units						
Unit Tag	**Area Served**	**Description**	**Qty**	**Notes**	**Cost per Unit**	**Total Cost**
CRAC-1 through CRAC-4	Main Machine Room	Hydronic-type CRAC unit with humidifier, electric reheat, condensate pump and controls, equal to Liebert model CW-114, 14,000 cfm	6	Nominal cooling capacity - 25.0 ton, Electric reheat 20 kW	$50,000	$300,000
CRAC-5, CRAC-6	Networking room	Hydronic-type CRAC unit with humidifier, electric reheat, condensate pump and controls, equal to Liebert model CW-084, 5000 cfm	2	Nominal cooling capacity - 10.0 ton, Electric reheat 15 kW	$40,000	$80,000
CRAC-7	UPS room	Hydronic-type CRAC unit with humidifier, electric reheat, condensate pump and controls, equal to Liebert model CW-084, 5000 cfm	1	Nominal cooling capacity - 10.0 ton, Electric reheat 15 kW	$40,000	$40,000
AHU-1	Office area, 2,500 sq.ft.	Variable volume, hydronic cooling and hydronic heating air handling unit, 5,600 cfm	1	Nominal cooling capacity - 10.0 tons	$20,000	$20,000
VAV-1 through VAV-6	Office area	Single duct VAV air terminal units with hot water reheat, 500 cfm through 1,000 cfm	4		$1,500	$6,000
CHP-20, CHP-21 and CHP-22		In-line chilled water pump, 240 GPM, 40 ft head	3		$4,000	$12,000
Exhaust Fans						
EF-1, EF-2	Main Machine room, 3,500 sq.ft.	Roof-mounted exhaust fan - 3,500 cfm	2		$2,500	$5,000
SF-1, SF-2	IT Equipment room 129	In-line supply fan with filter box and VFD, 1,500 cfm	2		$3,000	$6,000

NEW MEXICO STATE UNIVERSITY, LAS CRUCES
Data Center Master Plan

OPINION OF PROBABLE COST - HVAC

Alternative 3 - Chilled Water CRAC units						
Unit Tag	**Area Served**	**Description**	**Qty**	**Notes**	**Cost per Unit**	**Total Cost**
DH-1	SF-1	Hydronic duct heater for ventilation air, 1,500 cfm, 75 kBtu/h	1		$2,000	$2,000
EF-3, EF-4	IT Room 131, 800sq.ft.	Roof-mounted exhaust fan - 800 cfm	2		$1,500	$3,000
						$0
Miscellaneous						
	Allowance for HVAC Demolition	Four air handling units, two condensing units, chilled water piping, refrigerant piping and condensate drain piping, etc.	7,720		$5.80	$44,776
	Allowance for Ductwork and Accessories	Data Center Building, sq.ft	7,720		$4.50	$34,740
	Allowance for hot water piping and condensate drain piping and accessories	Data Center Building, sq.ft	7,720		$1.50	$11,580
	Allowance for chilled water piping and and accessories	Data Center Building, sq.ft	7,720		$4.00	$30,880
	Allowance for Air Distribution Devices, including ceiling-mounted and floor-mounted	Data Center Building, sq.ft	7,720		$3.00	$23,160
	Allowance for HVAC Controls	Data Center Building, sq.ft	7,720		$5.00	$38,600
	HVAC Testing and Balancing	Data Center Building, sq.ft	7,720		$2.75	$21,230
	HVAC Commissioning	Data Center Building, sq.ft	7,720		$2.25	$17,370

Total	**$696,336**

NEW MEXICO STATE UNIVERSITY, LAS CRUCES
Data Center Master Plan

OPINION OF PROBABLE COST - PLUMBING AND FIRE PROTECTION

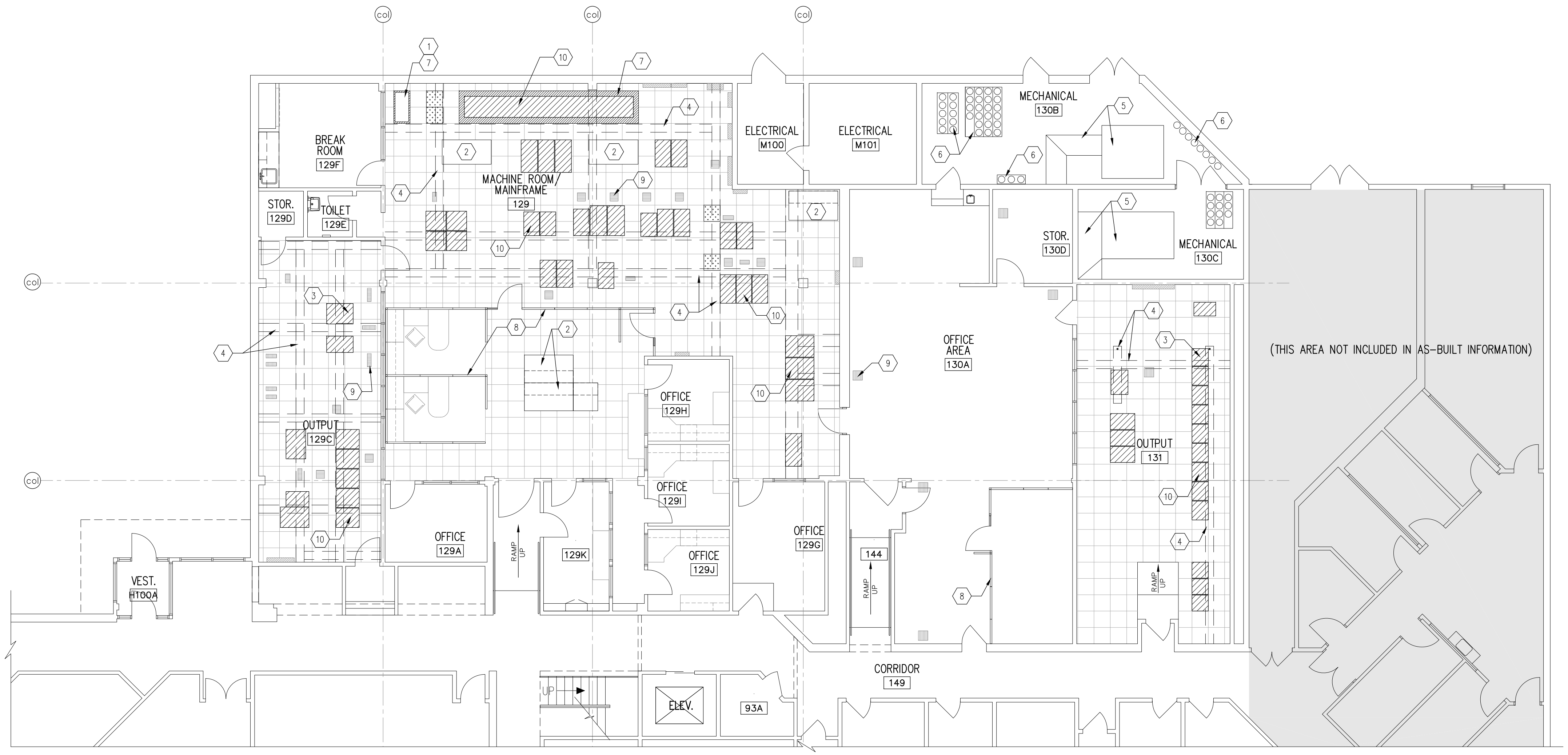
Unit Tag	Area Served	Description	Qty	Notes	Cost per Unit	Total Cost
Plumbing						
	Allowance for Plumbing Demolition	Data Center Building, sq.ft	7,720		$1.00	$7,720
Means Section 5017 00 - 2720	Plumbing system in new office addition	Data Center Building, sq.ft	2,500		$5.45	$13,625
Fire Protection						
	Allowance for Fire Protection Demolition	Data Center Building, cubic feet	45,000		$0.50	$22,500
D 4090 920	Reconfigure existing clean agent FP system	Data Center Building, cubic feet	55,000		$1.80	$99,000
D 4010 410	New wet pipe FP system for new office addition	Data Center Building, sq.ft	2,200		$8.23	$18,106
	Fire Protection Commissioning	Data Center Building, sq.ft	7,720		$1.50	$11,580

Total **$172,531**

APPENDICES

APPENDIX A

- **EXISTING FLOOR PLAN**
- **CONCEPTUAL FLOOR PLAN LAYOUT**
- **3D RENDERING**



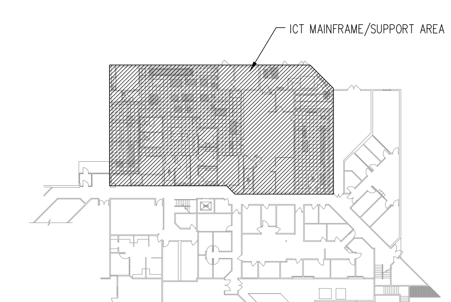
B1 FLOOR PLAN
SCALE: 1/8" = 1' – 0"

SHEET KEYNOTES

1. EXISTING SAFE.
2. EXISTING FREESTANDING WORKSTATION.
3. EXISTING UPS (SEE ELECTRICAL).
4. EXISTING CABLE TRAY ABOVE.
5. EXISTING MECHANICAL UNIT/DUCTWORK.
6. EXISTING INTERGEN FIRE SUPPRESSION CONTAINERS.
7. EXISTING EQUIPMENT SUPPORT STEEL FLOOR PLATE.
8. EXISTING MODULAR FURNITURE.
9. EXISTING FLOOR REGISTER.
10. EXISTING COMPUTER EQUIPMENT RACKS (SEE ELECTRICAL).

LEGEND

- EXISTING COMPUTER EQUIPMENT RACK
- EXISTING EQUIPMENT SUPPORT STEEL FLOOR PLATE
- EXISTING FLOOR REGISTER
- EXISTING 2'X2' RAISED FLOOR ACCESS PANEL
- EXISTING INTERGEN FIRE SUPPRESSION CONTAINERS
- EXISTING WATER VALVE SHUT-OFF ACCESS PANEL
- EXISTING CABLE TRAY ABOVE



KEY PLAN

HUITT-ZOLLARS
ARCHITECTS - PLANNERS - ENGINEERS
6501 Americas Parkway NE, Suite 550
Albuquerque, New Mexico 87110-5372
Phone (505) 883-8114 Fax (505) 883-5022

NM STATE UNIVERSITY

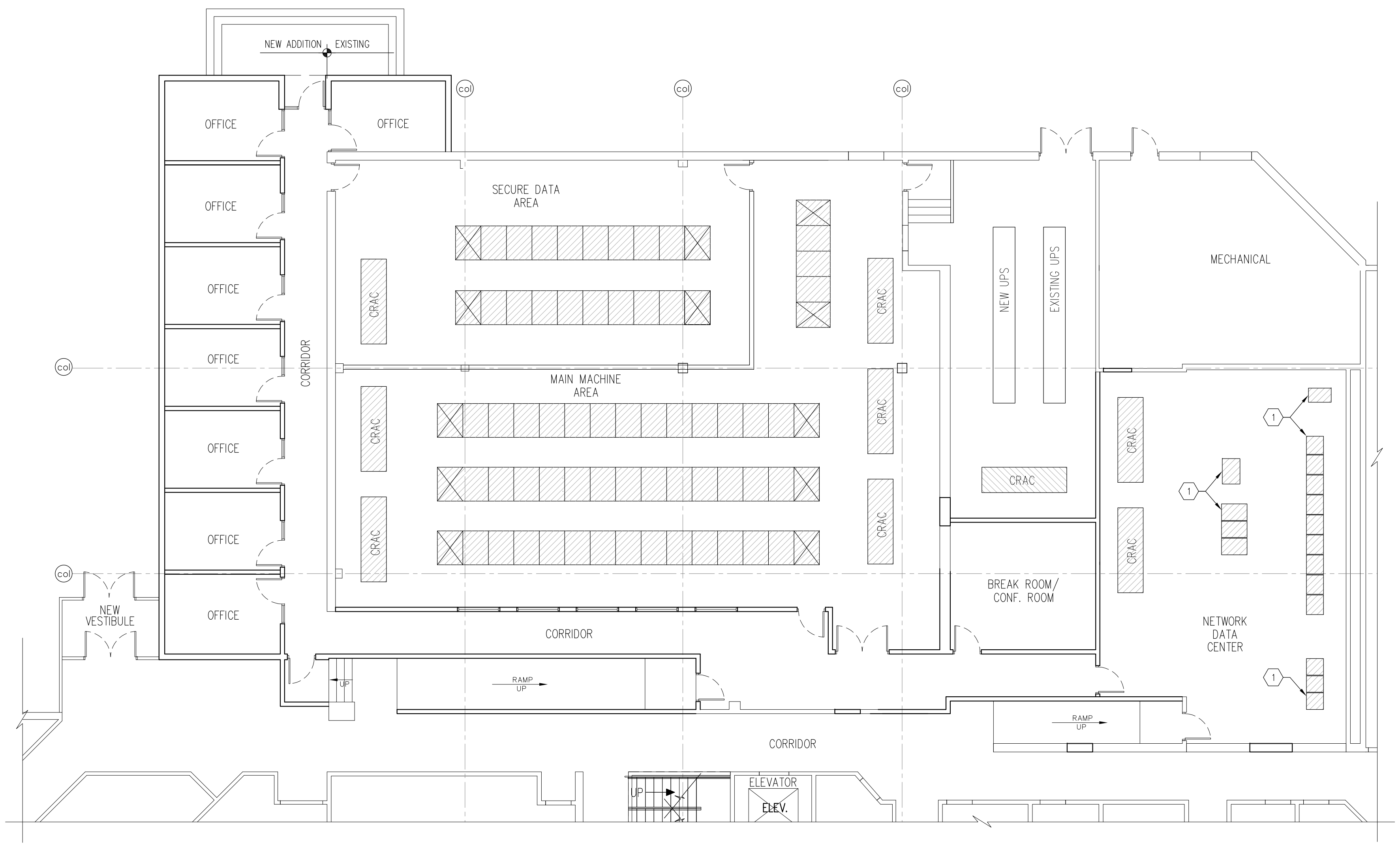
Computer Data Center
Renovation & HVAC Upgrades
NEW MEXICO STATE UNIVERSITY

MARK	DATE	DESCRIPTION

ISSUE:
PROJECT NO.: 14029405
CAD DWG FILE: A-101.dwg
DRAWN BY: WRS
CHECKED BY: JLJ

SHEET TITLE:
FLOOR PLAN

A-101
SHEET OF XX



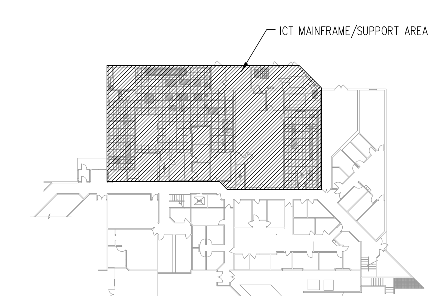
B1 FLOOR PLAN
SCALE: 1/8" = 1' - 0"

SHEET KEYNOTES

1. EXISTING EQUIPMENT

LEGEND

- COMPUTER RACK
- PDV
- CRAC — COMPUTER ROOM AIR CONDITIONING UNIT



KEY PLAN

HUITT-ZOLLARS
ARCHITECTS - PLANNERS - ENGINEERS
6501 Americas Parkway NE, Suite 550
Albuquerque, New Mexico 87110-5372
Phone (505) 883-8114 Fax (505) 883-5022

NM STATE UNIVERSITY

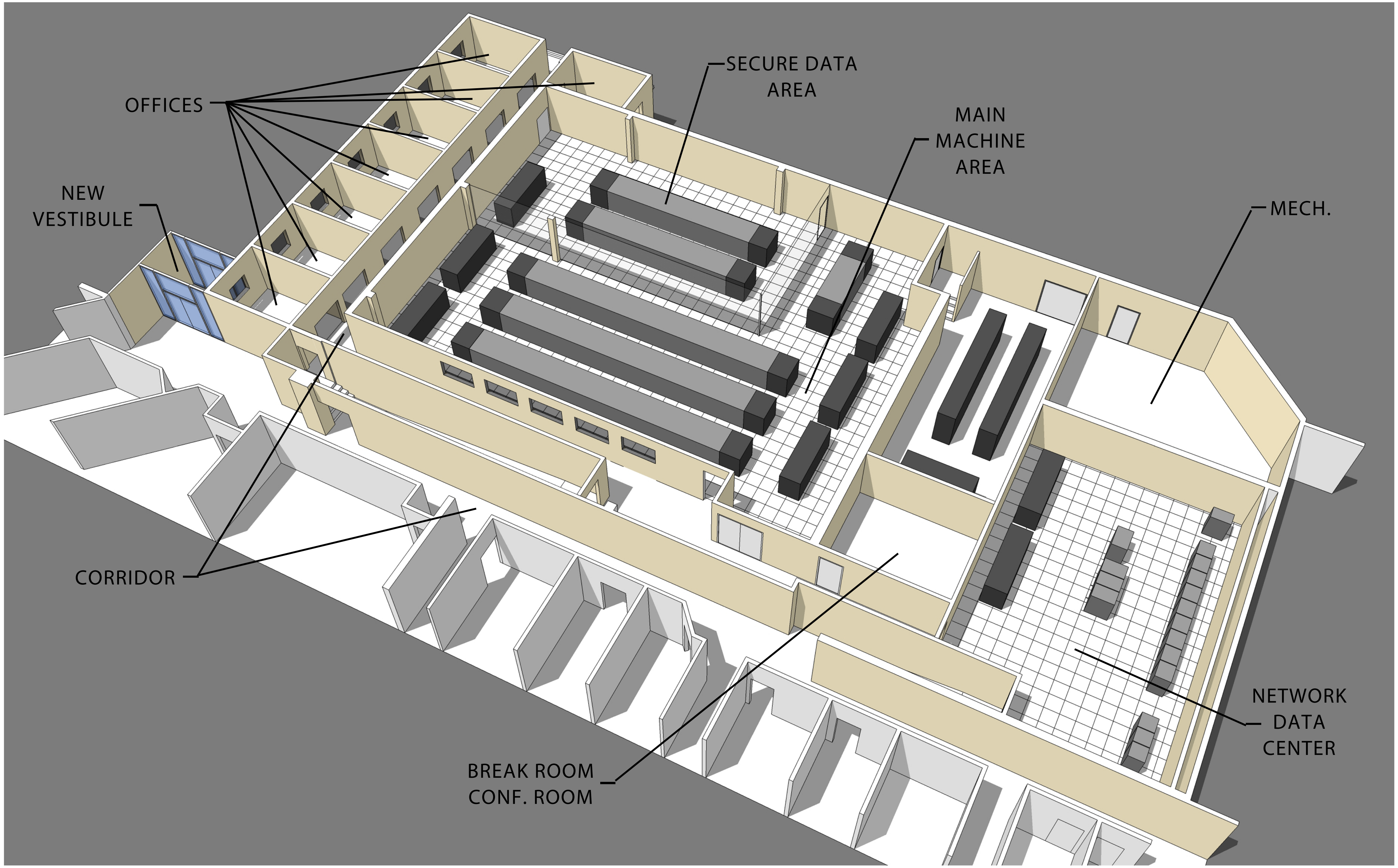
Computer Data Center
Renovation & HVAC Upgrades
NEW MEXICO STATE UNIVERSITY

MARK	DATE	DESCRIPTION

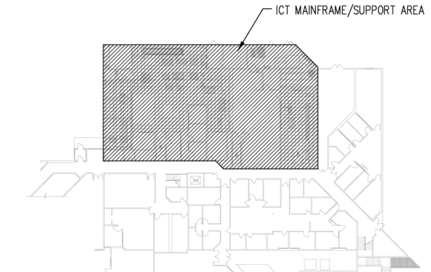
ISSUE:
PROJECT NO.: 14029405
CAD DWG FILE: A-101.dwg
DRAWN BY: WRS
CHECKED BY: JLJ

SHEET TITLE:
CONCEPTUAL FLOOR PLAN

A-101
SHEET OF



B1 PERSPECTIVE
SCALE: NTS



KEY PLAN

HUITT-ZOLLARS
ARCHITECTS - PLANNERS - ENGINEERS
6501 Americas Parkway NE, Suite 550
Albuquerque, New Mexico 87110-5372
Phone (505) 883-8114 Fax (505) 883-5022

NM STATE UNIVERSITY

Computer Data Center
Renovation & HVAC Upgrades
NEW MEXICO STATE UNIVERSITY

MARK	DATE	DESCRIPTION

ISSUE:
PROJECT NO.: 14029405
CAD DWG FILE: A-102.dwg
DRAWN BY: WRS
CHECKED BY: JLJ

SHEET TITLE:

PERSPECTIVE

A-102
SHEET OF

APPENDIX B

FACILITY ASSESSMENT REPORT

BUILDING ASSESSMENT REPORT

for

NMSU COMPUTER DATA CENTER

at

NEW MEXICO STATE UNIVERSITY

LAS CRUCES, NEW MEXICO

HZ PROJECT NUMBER 14.0294.05

95% Review Submittal

September 11, 2012

HUITT-ZOLLARS

6501 Americas Parkway NE, Suite 550

Albuquerque, New Mexico 87110-8154

(505) 883-8114 ph ~ (505) 883-5022 fax

TABLE OF CONTENTS

SECTION ONE
REPORT SUMMARY

This report is the first phase of a two phased study. Phase One is the assessment of the mechanical and electrical systems in the building and preparation of as-built drawings. Phase Two of the project will be to prepare a long range master plan for the necessary upgrades and to develop bid documents for these upgrades based on available funds. If funds do not cover all required upgrades, the project may require additional phases for design and construction.

This mechanical and electrical systems condition assessment report of the New Mexico State University (NMSU) Computer Center is based upon our findings from conducting several site visits in August and September of 2012 by Huitt-Zollars team and representatives from NMSU and information obtained from available construction drawings, interviews with the building occupants and other documentation provided by the University.

Project Team :

<u>NMSU</u>
Orasa Vaught – Project Manager
James Nunez – Mechanical Engineer
Pat Chavez – Manager, Energy Management Services

<u>Huitt-Zollars</u>
John Jarrard – Project Manager
Bill Suttles – Intern Architect
Sergey Aleksanyan – Mechanical Engineer
Richard Dickerson – Electrical Engineer

Data Center is located on east side of the first floor of the Information and Communication Technologies (ICT) Building at the NE corner of Stewart Street and Sweet Avenue on the Main Campus. The Data Center is approximately 6,530 sq. ft. in area. The building was originally built in 1978. In the spring of 1987 its primary computer room was doubled in size. The existing ICT Building is primarily a single-story structure with a small two story area on the north portion of the building. The ICT building construction consists of CMU exterior walls, steel structure and metal frame interior walls with minimal exterior glazing and low slope metal roof with low parapets. The Data Center has raised access flooring throughout the space. Offices in the Center are both private and open cubicle type construction.

The air conditioning in the building is provided from the Central Plant through a 4-pipe chilled water and high-pressure steam distribution system.

SECTION TWO
INFORMATION TECHNOLOGY EQUIPMENT

EXISTING CONDITIONS

Existing IT equipment at the Computer Center includes various servers and telecommunication equipment on chassis installed in numerous equipment racks in three separate computer rooms; 129, 129C and 131.

Room 129 houses approximately twenty six equipment racks scattered throughout the room providing general support for NMSU website and other IT systems. The IT equipment and racks are supplied from various manufacturers, including IBM, Compaq, Cisco Microsystems, etc. One Uninterrupted Power Supply unit (UPS) is installed in that room to support IT equipment. Also installed in the room are several work benches with approximately fifteen computer stations for monitoring, maintenance and repair of the main IT equipment and on campus activities. Four open office cubicles with personal computers and various office appliances are occupying the room, including printers, copiers, etc.

Room 129C houses nine equipment racks, including one “super power” rack scattered throughout the room and providing support NMSU research systems. The IT equipment and racks are supplied from various manufacturers. One UPS unit is installed in electrical room to support IT equipment.

Room 131 is currently housing fourteen IT equipment racks supporting NMSU Networking Department. One UPS unit is installed in that room to support IT equipment.

The following is anticipated heat rejection rate for equipment racks:

- Conventional IT Equipment Rack – 27,280 Btu/h or 8.0 kW
- “Super Power” Equipment Rack – 34,100 Btu/h or 10.0 kW
- Networking Equipment Racks – 17,050 Btu/h or 5.0 kW

The estimated maximum total heat rejection from existing equipment in Computer Center is:

- Room 129: 26 x 27,280 = 709,280 Btu/h or 208 kW
- Room 129C: (8 x 27,280 + 1 x 34,100) = 252,340 Btu/h or 74 kW
- Room 131: 14 x 17,050 = 238,700 Btu/h or 70 kW

According to electrical calculations this estimate is grossly exceeding actual power demand in those spaces. Therefore it is recommended that in the future design the operation diversity of the server racks and the heat rejection load factor to be used for sizing of HVAC equipment cooling capacity. That diversity factor shall be coordinated with NMSU.

SECTION THREE
MECHANICAL / FIRE PROTECTION

ABBREVIATIONS

- ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers
- Btu – British thermal units
- cfm – cubic feet per minute (airflow rate)
- CRAC – computer room air-conditioning unit
- EER – Energy Efficiency Ratio; total cooling capacity (Btu/h)/electrical power required (W)
- ^{o}F – Degrees Fahrenheit
- ft^{2} – Square feet
- h, hr – hour
- HVAC – Heating, Ventilation, and Air Conditioning
- k – One thousand
- LCCA – Life-Cycle Cost Analysis
- therm – 100,000 Btu
- W – Watt

DESIGN CRITIERA

The current operating conditions have been established from the Scope of Work document, user/client meetings, site observation and the applicable codes and standards.

Outdoor Temperature Design Data – Las Cruces, NM:
- 0.4% Cooling Design Dry-Bulb temperature – 100.0ºF
- 0.4% Cooling Design Wet-Bulb temperature – 64.0ºF
- 99.6% Heating Design Dry-Bulb temperature – 21.0ºF
- Climate zone per ASHRAE 90.1 – 3B

Indoor Design Conditions
Office areas: Based on ASHRAE 55-2010 criteria the indoor design conditions for office areas shall be as follows:
- Occupied indoor cooling setpoint temperature – 75ºF
- Occupied indoor heating setpoint temperature – 70ºF
- Unoccupied indoor cooling setpoint temperature – 85ºF
- Unoccupied indoor heating setpoint temperature – 55ºF
- Maximum indoor relative humidity – 60%

IT Equipment Rooms: Based on evaluation of IT equipment and UPS equipment requirements and on the User’s past operational experience the indoor design conditions for the server rooms will be as follows:
- Indoor cooling cycle temperature – 70ºF
- Indoor heating cycle temperature – 70ºF

- Indoor relative humidity – 40%-55%

HVAC ZONES

The area is currently divided into independent temperature controlled zones, including:

- IT equipment room 129
- IT equipment room 129C
- IT equipment room 131
- Break room 129F
- Enclosed office area (rooms 129A and 129K)
- Enclosed office area (rooms 129G, 129H, 129I and 129J)

OCCUPANCY LOAD

- Total occupant load of the Data Center area only is 12 people.

BUILDING ENVELOPE AND HVAC LOAD CRITERIA

U-values (Btu/h-ft^2-^{o}F) of the existing building construction elements have been used for the HVAC load estimates.

Internal Loads, Including Equipment Heat Release Data

People: Cooling loads for people is based upon activity and occupancy as prescribed in ASHRAE Fundamentals Handbook.

Lighting: The values indicated below are the maximum performance values per ASHRAE 90.1.

- Offices – 1.1 W/ft^2
- IT rooms – 1.5 W/ft^2

Existing Miscellaneous Equipment:

- Offices – 2.0 W/ft^2
- Break room 129F – approximately 2.0 kW

Existing IT Equipment:

- IT equipment room 129 – approximately 208 kW
- IT equipment room 129C – approximately 74 kW
- IT equipment room 131 – approximately 70 kW

Ventilation: Minimum outside air rates to the occupied spaces and to server rooms shall be provided according to ASHRAE 62.1 as follows:

- Office areas: 5 cfm per person and 0.06 cfm per sq. ft.
- IT equipment room: 5 cfm per person and 0.12 cfm per sq. ft.

<u>Energy Rates</u>

The following are the energy rates provided by NMSU (Refer to Appendix M1):

- Electricity rates

a) On peak energy charge - $0.24212 per kWh
b) Off peak energy charge - $0.0486 per kWh
c) Demand charge - $7.6 per kW

- Natural gas rate - $0.09902 per therm
- Water rate - $2.23 per thousand gallons

HVAC DESIGN LOAD

Refer to Table 1 below for estimated HVAC design loads:

Table 1

Area	Capacities	
	Heating (kBtu/h)	Cooling (Tons)
IT Equipment room 129 (2,490 sq. ft.)	-	60.0
IT Equipment room 129C (610 sq. ft.)	-	21.0
IT Equipment room 131 (930 sq. ft.)	-	20.0
Break room area 129F (310 sq. ft.)	15.0	2.0
Enclosed Offices (780 sq. ft.)	25.0	3.0
Office area 130A (1,410 sq. ft.)	30.0	12.0
Total (6,530 sq. ft.)	70.0	118.0

The cooling load in this table is estimated based on anticipated heat release rate from equipment racks according to average industry data as indicated in Section three of this report. Available cooling capacity of existing HVAC equipment serving the area in general meets that demand.

It shall be noticed that the heat release rate provided in this report is substantially greater than the electric power demand estimated in Section Four of this report. This discrepancy can be related to several factors:

- Not all of the racks are fully loaded and the diversity of the equipment installed in racks shall be established by the User for proper cooling demand estimate;
- Substantial inefficiency of the HVAC systems serving Computer Center areas as described below;
- Apparent overcooling of some of the area spaces;
- Lack of controls;

More accurately the cooling load in the area shall be evaluated in the next phase during space remodeling efforts.

EXISTING HVAC SYSTEMS

Building Cooling

Chilled water supply to the facility is provided from the Central Plant from two different directions.

The Central Plant is operating at chilled water supply temperature of 44°F with 12°F of temperature differential (temperature differential may vary).

One 4" chilled water supply line is provided from the onsite distribution pipes at the south-west corner of the building. Secondary constant flow chilled water pumps located at the 1st and 2nd floor south-west corner mechanical rooms are providing chilled water distribution throughout the most of the building. Two base-mounted constant volume chilled water pumps (CHP-21, CHP-22) with approximate capacity of 100 GPM, 53 feet head, one operating and one in standby, provide chilled water supply to the air-handling units AHU-1 and AHU-2. One base-mounted constant volume chilled water pump (CHP-20) with approximate capacity of 157 GPM, 63 feet head in the 1st floor mechanical room provides chilled water supply to the penthouse air-handling unit serving the main building area.

The second 4" chilled water supply line is provided from the Science Hall at the north-east corner of the building. Two existing base-mounted constant volume chilled water pumps with approximate capacity of 240 GPM, 80 feet head, 10 HP each, one operating and one in standby provide chilled water supply to the Computer Center air-handling units AHU-3 and AHU-4.

These two branches are tied together at the second floor, with isolation valves above ceiling. This arrangement creates building chilled water loop that essentially provides a backup for chilled water supply to air-handling units serving Computer Center from either source.

Building Heating

High-pressure (100 psi) steam supply to the facility (2" pipe) is provided from the Central Plant at the south-west corner of the building. Steam pressure-reducing station is located at the 2nd floor mechanical room. The low-pressure building steam distribution system is operating at the steam pressure of 15 psi. Steam condensate return back to the central plant is provided by the condensate transfer pumps located in the 1st floor mechanical room 130B and in 1st floor mechanical room 102. Steam is currently being used for heating only. The University has discontinued using steam for supply air humidification in air-handling units at this facility.

Heating hot water supply to the building is provided from existing steam to hot water converter at the 1st floor mechanical room 102. Converter hot water capacity is approximately 120 gpm with hot water supply temperature of 180°F at 20°F of temperature differential. Two base-mounted heating constant volume hot water pumps (HWP-1, HWP-2) with approximate capacity of 120 GPM, 63 feet head, 5 HP each, one operating and one in standby provide hot water distribution from the convertor to the heating coils of air-handling units, and to other terminal units and unit heaters in most of the building.

The second source of the heating hot water supply to the facility is through a 1" line provided from the Science Hall at the north-east corner of the building. The system is operating at heating hot water supply temperature of 180°F with 20°F of temperature differential and is dedicated only to the HVAC equipment serving computer center. One base-mounted constant volume hot water pump with approximate capacity of 70 GPM, 42 feet head, 1.5 HP provides hot water distribution from the convertor to Science Hall and to the Computer Center.

Air-handling equipment and air distribution

Four existing air-handling units provide air-conditioning to the project area.

AHU-1

Air-conditioning unit AHU-1, Trane Climate Changer model L-14, is located at the 1st floor mechanical room 130B and provides air-conditioning to office area 130A. Unit includes constant volume supply fan section with 7.5 hp motor, chilled water cooling coil section, heating coil section, steam humidification section and a mixing box section with angle filters. Humidification system of the unit is disabled. Approximate unit capacity is 20 tons of cooling and 60 MBH of heating at 7,500 cfm of supply airflow. Unit is outdated and is in unacceptable operational condition and must be replaced.

The unit operates using only recirculated air (return air) and does not provide outdoor air for ventilation as required by ASHRAE 62.1. Existing outside air intake louver at the east wall is capped.

Unit is controlled by a space-mounted thermostat. Duct-mounted smoke detectors appear to be missing.

Supply air is distributed to the room 130A through access floor plenum and through floor-mounted supply air grilles. The ceiling plenum is used for return air path back to the unit. Mechanical room is used as a return air plenum. It appears that the return air opening from the ceiling plenum into mechanical room is not large enough. As a result the high negative pressure that occurs in the room prevents proper door closure and impacts the air-handling unit efficiency.

Mechanical room 130B is also housing clean agent fire suppression system by Inergen, including 44 high-pressure storage tanks with fire protection distribution piping.

One wall-mounted 2-speed exhaust fan (EF-1) with backdraft damper and with approximate capacity of 500 cfm is providing emergency exhaust ventilation in the mechanical room.

The underground steam condensate transfer station is also installed in Mechanical room 130B. The station includes 20-inch diameter receiver and a duplex arrangement 3 gpm condensate pumps with ¼ hp motors. The station is outdated and it is not clear if it is operable.

AHU-2

Air-conditioning unit AHU-2, Trane Climate Changer model L-14, is located at the 1st floor Mechanical room 130C and provides air-conditioning to IT room 131. Unit includes constant volume supply fan section with 7.5 hp motor, chilled water cooling coil section, heating coil section, steam humidification section and a mixing box section with angle filters. Humidification system of the unit is disabled. Approximate unit capacity is 20 tons of cooling at 7,500 cfm of supply airflow. Unit is outdated and is in unacceptable operational condition and must be replaced.

The unit operates using only recirculated air (return air) and does not provide outdoor air for ventilation as required by ASHRAE 62.1.

Unit is operating without any temperature control devices. Duct-mounted smoke detectors appear to be missing.

Supply air is distributed to the room 131 through access floor plenum and through floor-mounted supply air grilles. The ceiling plenum and sidewall chase is used for return air path back to the unit. Mechanical room is used as a return air plenum. It appears that the return air plenum size from the IT room into mechanical room is not large enough. As a result the high negative pressure that occurs in the room prevents proper door closure and impacts the air-handling unit efficiency.

Mechanical room 130C is also housing clean agent fire suppression system by Inergen, including 11 storage tanks with fire protection distribution piping.

There is another abandoned air-handling unit suspended from structure in that mechanical room. Miscellaneous abandoned piping and accessories that used to serve abandoned air handling unit and abandoned air-cooled chiller on the roof are still present in the room and should be removed.

<u>AHU-3 and AHU-4</u>
Two central station air-conditioning units, McQuay Seasonmaster model LSL141DH, are located at the 2nd floor mechanical room and provide air-conditioning to IT rooms 129 and 129C. Approximate capacity of each unit is 40 tons of cooling at 20,000 cfm of supply airflow. Each unit includes constant volume supply fan section with 10.0 hp motor, chilled water cooling coil section and a backup DX-type cooling coil section and a mixing box section with outside air and return air intakes with manual dampers. Both units are discharging supply air into common supply air duct without any means of isolation of the airstream in case one of the fans fails.

Both units are installed on approximately 5 inches thick inertia bases. Units are built in 1986 and are beyond their useful life and must be replaced to provide continuous operation in the future.

Two roof-mounted air-cooled condensing units, BDP Company model 566BE360, provide a backup cooling to the DX coil of the air-handling unit via two refrigerating circuits for each unit. Approximate unit capacity is 30 tons each. Both units appear to be beyond their useful life and have to be replaced.

Units are provided with original pneumatic controls and with some backup electronic controls of the discharge air temperature. Smoke detectors are installed on combined supply air duct and inside return air section of each air handling unit. The refrigerant leak controls and emergency ventilation for refrigerant removal from the mechanical room are not provided.

Supply air humidification is provided from electric steam humidifier Nortec model NHB100. Steam is being injected into steam distribution manifold attached to the common main supply duct riser. Approximate humidifier capacity is 100 lbs/hr of steam with the maximum power input of 34.3 kW. Unit is currently operational and may be reused for some time in the future. There is significant air leakage at the steam manifold connection to the supply duct riser that must be eliminated.

Ventilation air intake to both units is provided from existing outside air intake louver at the north wall of the mechanical room.

Supply air is distributed to the IT rooms via common duct riser and through access floor plenum to floor-mounted supply air grilles. Return air from IT rooms is ducted from the ceiling-mounted return air grilles back into mechanical room. Mechanical room is used as a return air plenum.

There are three more air-handling units mounted above the ceiling in various spaces. One unit is located in ceiling plenum of room 129C and two units in ceiling space of room 129. All units include steam heating coil and steam humidifier. All units are disconnected from utilities and are abandoned in place.

One roof-mounted exhaust fan with approximate capacity of 150 cfm provides exhaust ventilation from the toilet room.

Zone Temperature Control

HVAC systems serving project area are being controlled by existing stand-alone pneumatic controllers by Honeywell.

Space-mounted temperature sensors are providing temperature control in all IT rooms, with exception of room 131, by modulating 3-way control valve at chilled water cooling coils of corresponding air handling unit.

Space-mounted humidity sensor and chart recorder in room 129C is providing humidity control and monitoring in rooms 129 and 129C by injecting steam into AHU-3/AHU-4 common duct riser. Steam humidifiers on AHU-1 and AHU-2 are disabled and humidity in corresponding rooms is only being monitored by the chart recorders.

Some of the employees are occupying open office workstations located inside IT rooms with the indoor temperature set for IT equipment operation (70°F). As a result these employees are exposed to the temperatures well below temperature range acceptable for human occupancy (75°F through 77°F).

Temperature in the enclosed office spaces is controlled by modulating control valve at duct-mounted reheat coils as described below:

- Two branch ducts from AHU-3, one 12”x12” and one 18”x12”, with duct-mounted low-pressure steam reheat coils provide cooling and heating to the 1st floor enclosed office spaces. Return air from these rooms is provided through the open doors into adjacent IT equipment room.
- One 14”x8” branch duct from AHU-4 with duct-mounted heating hot water reheat coil provides cooling and heating to the break room 129F. Return air from the rooms is provided through the open doors into adjacent IT equipment room.

The existing constant volume air distribution system does not allow for adequate individual (zone) temperature control at the different areas, including open office areas and individual offices. It appears that building occupants have access to the adjustable settings on the temperature sensors and are able to adjust cooling temperature set points at will. The indoor temperature in the project area is within the range of approximately 70ºF to 73ºF.

The current HVAC systems arrangement has the obvious deficiencies in controlling indoor conditions. For instance most of the time it requires simultaneous cooling and heating of air supplied to the enclosed office areas in order to maintain proper indoor temperature in these rooms due to the low supply air temperature needed for IT equipment cooling and the constant supply airflow from the air-handling units. HVAC system controls shall be modified.

Due to the numerous renovations in the building the current HVAC zoning is not always coordinated with the existing floor plans.

FIRE PROTECTION

Fire Suppression

The existing facility is currently provided with clean agent fire suppression system by Inergen.

The existing system is subdivided into four separate zones being served by the dedicated storage tanks and fire suppression piping as follows:

- Zone 1 - IT equipment room 129 and 129C with 32 storage tanks in mechanical room 130B;
- Zone 2 - IT equipment room 130A with 8 storage tanks;
- Zone 3 – IT equipment room 131 with 11 storage tanks;
- Zone 4 – Under floor plenum space with 4 storage tanks.

The labels (tags), diagrams and or manuals available in the mechanical rooms providing zone designation, safety and operational instructions of fire protection system are missing.

The clean agent gas has ways to escape through supply and return air openings into the spaces, unsealed piping and ductwork penetrations, cracks and holes in the walls, etc. It is likely that due to these deficiencies the clean agent can not be effectively contained inside the protected area, thus greatly reducing effectiveness of the fire protection system to fight potential fire in the area.

Inergen is the clean agent that in some cases requires a design concentration that in certain conditions can be dangerous. Despite this the high-pressure clean agent storage tanks and the main distribution piping are installed in the mechanical rooms used as a return air plenum. These conditions may present danger to the Data Center personal in case of accidental discharge of the agent into mechanical room, particular in the absence of the proper controls and the alarm notification.

An exhaust system for clean agent removal after it is released into the space in the event of fire are not provided.

RECOMMENDATIONS

Recent studies on data centers' energy usage have estimated that 50% of data center energy is consumed by information technology systems. There are a number of strategies that can be evaluated for reducing IT system energy consumption, most notably server consolidation and virtualization. These strategies are not a subject of this study and shall be addressed by the User under the separate scope for space remodeling.

Next to technology systems themselves, the cooling system consumes the most energy in the data center, accounting up to 37% of data center electricity use.

These preliminary recommendations for improving efficiency of the building systems and for reducing energy consumption within the project area are based only on existing building conditions. The recommendations include upgrading and/or replacing some of the HVAC systems and system components and other building systems related to the project area and are arranged according to their urgency and their impact on efficiency of the HVAC systems. Recommendations related to the people safety shall take precedence over all others.

These recommendations shall be reassessed for any future space remodeling or renovation, including any of IT equipment upgrades.

1. Provide labels (tags), diagrams and manuals providing zone designation, safety and operational instructions of fire protection system and training for the employees for actions in the event of fire.

2. It shall be further investigated if the capacity and the layout of existing clean agent fire protection system meet various code requirements.

3. Provide exhaust system for clean agent removal after it is released into the space in the event of fire, if required by the Inergen guidelines and local code.

4. Motorized smoke dampers shall be provided on all supply and return air ductwork entering to the space for its isolation prior to activation of clean agent fire suppression system.

5. Provide refrigerant leak controls per code and emergency ventilation if required for refrigerant removal from the 2nd floor mechanical room AHU-3/AHU-4.

6. Existing HVAC system interface with fire alarm system shall be tested to confirm their operation sequence as required by code (system shutdown in case of fire and smoke detection).

7. Existing access flooring space is used for routing of electrical and telecommunication cables, and miscellaneous piping. Some of the materials used during construction in the past for these systems are not rated for plenum application, including PVC piping and conduits, wooden supports, etc. and shall be removed and replaced in new design with plenum-rated materials.

8. Existing air-handling units AHU-1 and AHU-2 are outdated and must be replaced. New air-handling units shall be suitable for data center application, shall include humidifier option and shall be provided with outside air intakes.

9. Replace or upgrade if feasible existing air-handling units AHU-3 and AHU-4 to provide continuous reliable operation. New air-handling units shall be suitable for data center application, shall include humidifier option and shall be provided with outside air intakes.

10. Convert existing constant volume supply air distribution on all of the air-handling units serving project area to new variable air volume distribution. Provide variable frequency drives and new controls as applicable.

11. Provide three new variable volume air terminal units with hot water reheat coils on the branch ducts from AHU-3 and AHU-4 serving break room and enclosed offices in lieu of existing reheat coils.

12. Replace two existing backup air-cooled condensing units on the roof with two new air-cooled condensing units with appropriate capacity. Replace DX-type cooling coils at AHU-3 and AHU-4 to match new condensing units.

13. Air leakage at the bottom of the steam humidifier manifold at supply duct riser from AHU-3/AHU-4 shall be eliminated.

14. Expand wall opening for return air path into mechanical room 130B in order to eliminate high negative pressure in this room.

15. Provide exterior walls insulation, per code, in the mechanical rooms used as a return air plenum. Otherwise consider using ducted return from ceiling plenum to the intake of the air-handling units.

16. Design shall provide outside air and return air volume control with motorized dampers for all air-handling units.

17. Modify under floor air distribution system in room 130A to allow for proper temperature control in enclosed office and in open office areas.

18. Filtration for each air handler for outside air shall include 85% MERV-13 filters.

19. Replace existing pneumatic controls with new DDC controls. New controls shall meet all current code requirements.

20. HVAC systems serving project area shall be provided with stand alone DDC controls connected to the existing Niagra control panel located in the penthouse mechanical room for interfacing with existing campus-wide Energy Management and Control System (EMCS).

21. The night setback control sequence shall be implemented, where applicable.

22. *Proper sealing of data center environment.* There are miscellaneous unsealed wall penetrations by the electrical conduits and pipes through IT room walls inside the under-floor plenum. These openings allow for supply air to escape into adjacent spaces without reaching the dedicated space. Cooling losses through floors, walls and ceiling, or introduction of dry air from outside of the critical facility, increases cooling system loads and increases cooling energy costs. Therefore the IT equipment rooms shall be isolated from general building and from outside environment as much as practical. Detailed investigation of the area shall be conducted for providing airtight sealing of all openings in doors, windows and walls, as applicable. All cable and piping entrances through the walls and through access floor shall be sealed as well.

23. *Optimizing air flow.* Most equipment racks manufactured today are designed to draw in air through the front and exhaust out of the rear. This allows equipment racks to be arranged to create “hot aisles” and “cold aisles” (Refer to Appendix M2). This approach positions racks so that rows of racks face each other, with the front of each opposing row of racks drawing cold air from the same aisle (the “cold” aisle). Hot air from two rows is exhausted into a “hot” aisle, raising the temperature of the air returning to the air handling unit and allowing unit to operate more efficiently. This approach is most effective when cold air and hot air do not mix. Therefore, perforated floor tiles shall be installed only in cold aisles. Blanking panels shall be used to fill open space in racks to prevent hot air moving back through the rack. Some type of cabling grommet shall be used to prevent the cold air from entering the space through cable openings. Ceiling plenum shall be used for drawing return air from the hot aisle to air-handling units for minimizing mixing of the hot and cold air.

24. In order to accomplish the recommendation above for optimizing the airflow it is highly recommended that all IT equipment to be consolidated into one large dedicated space with a dedicated HVAC system and all open offices to be relocated from IT equipment area and consolidated with enclosed offices within the dedicated office space controlled by its own variable airflow HVAC system.

25. Cable routing shall be properly managed to avoid creating obstructions to air flow through the perforated floor tiles and from front to the rear of the rack.

26. Old air-handling units abandoned in place above ceiling and all associated ductwork, piping and wiring shall be removed.

27. It shall be coordinated with the Owner if backup cooling is required for replaced air-handling units AHU-1 and AHU-2. Additional water-cooled or air-cooled equipment shall be provided for redundancy if confirmed. Providing a loop between two existing chilled water services shall be considered as a main option.

28. Convert existing constant flow chilled water distribution system in the building into variable flow chilled water distribution system. Replace existing 3-way controls valves on chilled water coils with new 2-way control valves. Existing manual isolation valves on chilled water loop inside the building shall be replaced with new motorized valves to improve operation efficiency during the emergency.

29. The ceiling in room 131 housing IT equipment is only 7'-6" high with limited ceiling plenum height. These conditions create limitations to effective cooling of IT equipment and restricted return air path to the mechanical room. It shall be considered if equipment in that room can be relocated to any other area with proper space configuration.

30. Repair existing damaged piping insulation in project area and provide new insulation where it is missing.

31. It shall be verified if any of the existing equipment racks contain IT equipment with high density heat load (greater than 10 kW per rack). If such conditions exist or will occur in the future than the implementation of the overhead cooling system or in-rack cooling system shall be reviewed and considered in order to provide adequate cooling of the IT equipment with high-density heat load.

SECTION FOUR
ELECTRICAL SYSTEM

Building Electrical

The Computer Center is currently fed at 4,160Y/2400 volts via circuit EFCC from the Central Plant essential bus. This bus is normally connected to the EPEC source originating at the Tortugas substation through Feeder No. 4 and transformers T25-385 and T25-390.
The 4,160Y/2400 volt circuit is connected to four transformers. Transformer T5-820 is a 1000 kVA unit serving the electrical room located at the Northwest corner of the Computer Center. Transformer T5-825 (500 kVA), T5-830(112.5 kVA) and T5-840(500 kVA) serve the electrical equipment room on the east side of the Computer Center.

The maximum electrical demand for the Computer Center was 282.2 kW (340 amperes) which occurred on Jan 25, 2012. Refer to the Computer Center Electrical Energy Use Chart in Appendix E2

The transformers serve a system of low voltage electrical panels. A large portion of these panels serve the Data Center. The existing electrical one-line diagram for the Computer Center's Data Equipment, Server and Telephone Switch Rooms is shown by the drawing in Appendix E1.

The Data Equipment, Servers and Telephone Switches are served through 3 UPS systems. An 80 kVA, 480 – 208Y/120 volt UPS serves Panelboard CP in the joint use Server Room. A 160 kVA, 480 – 208Y/120 volt UPS serves the main data equipment room. A 20 kVA 208V – 208Y/120 volt UPS serves the Telephone Switch Room. Loads on the UPS systems are as follows:

80 kVA UPS:	36.7 kVA
160 kVA UPS	88.0 kVA
20 kVA UPS	4.8 kVA

Total Equipment Load 129.5 kVA or 46% of maximum building demand

The remaining 152.7 kVA of building demand is composed of lighting, HVAC, and miscellaneous outlet power.

Spare Capacity

Total building capacity is approximately1,612.5 kVA based on the ampere rating of the existing switchgear. Accounting for the existing maximum demand load, there is approximately 1,330.3 kVA of spare capacity in the distribution system.

Electrical System Reliability

Backup power for the Computer Center is provided by the University's Cogeneration Turbine powered generator. While the cogeneration system has the capacity to provide the backup power for the Computer Center, it is not as reliable as would be expected for such a facility.

The turbine that provides the cogeneration power has to be shut down every 3 months for maintenance, leaving the Computer Center vulnerable to a power interruption when both the normal power source and the cogeneration source suffer an outage simultaneously. During 2012 there have been 2 such significant power interruption events. One occurred in early March and a second occurred in late May. Refer to Computer Center Electrical Energy Use Chart in Appendix E2.

Observations

Reliability

The Computer Center is served from a single 5kV feeder from the Central Plant providing a single point of failure in the electrical system.

The cogeneration/essential bus that serves the Computer Center is fed by a turbine powered generation that must be shut down every three months for maintenance making the Computer Center vulnerable to a total power outage.

Data Center data processing equipment is fed from 2 different sized UPS units that have an approximate 50% load factor. Failure of one UPS units will render the Data Center fundamentally vulnerable to outages on a portion of the equipment. If critical process servers, switches or RAID memory devices are on the affected UPS, then these systems could become unavailable.

Data cables are run under the raised floor and restrict airflow of needed cooling air to the equipment racks and can cause the equipment to overheat and shutdown.

Cooling air holes in the raised floor are poorly located. Extraneous holes cause air leaks and reduce the cooling efficiency of the raised floor cooling system.

Rack mounted power distribution units (PDUs) have data communications capability to monitor power conditions and electrical load at the rack level. These communications ports have not been configured or connected to a data network to allow the Data Center IT staff to monitor power usage within the racks.

H-Z could not confirm the use of two circuits to each equipment rack to provide N+1 or 2N redundancy.

Data Center Security

Access control between the Joint Use Server Room and the main Data Center area is poor. Students and faculty can enter the main Data Center through the connecting door fairly easily.

Access control of the main Data Center allows users and visitors to exit the space without presenting valid security credentials.

Access control into the telephone switch room is reversed. Someone can easily enter and get locked in the room if there is not any IT staff to allow them to exit. The access control configuration allows non-cleared individuals to easily enter a space that should be accessible only to qualified, security-cleared staff.

Electrical Code Issues

The electrical floor plan of the Data Center is shown on the sheet E-101

Panels L and L2 located in Mechanical Room 130C do not have the necessary working clearances required by National Electrical Code Article 110, Part II, Paragraph 110.26. The present clearance is only 24". Code required clearance is 36".

The 500 kVA transformer serving switchboard 4SWBD located in room M100 may not have the necessary clearance required by National Electrical Code **Article 110, Part III, Paragraph 110.31**. The required clearance is 48" clear in front or the transformer. This transformer is also placed up tight against the wall in the back closing off the rear ventilation opening in the back of the unit which is a violation of NEC Article **450.9 Ventilation** which states: *"The ventilation shall be adequate to dispose of the transformer full load losses without creating a temperature rise that is in excess of the transformer rating. Transformers with ventilation openings shall be installed so that the ventilation openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer."* The placement of the transformer also blocks access to the wireway located on the west end of the transformer.

Panelboard circuit directories do not comply with the NEC. The existing panel board schedules have been provided in Appendix E5 Blank spaces in these schedules indicate loads that have not been properly identified. Article **408.4 Field Identification Required** states the following:

(A) ***Circuit Directory or Circuit Identification.*** *Every circuit and circuit modification shall be legibly identified as to its clear, evident, and specific use. The identification shall include sufficient detail to allow each circuit to be distinguished from all the others. Spare positions that contain unused overcurrent devices and switches shall be described accordingly. The identification shall be included in a circuit directory that is located on the face or inside of the panel door in the case of a panelboard, and located at each switch or circuit breaker in a switchboard. No circuit shall be described in a manner that depends on transient conditions of occupancy.*

(B) ***Source of Supply.*** *All switchboards and panelboards supplied by a feeder in other than one- or two-family dwelling units shall be marked to indicate the device or equipment where the power supply begins.*

Some electrical equipment does not have Arc flash hazard warnings applied as required by NEC Art. 110.16 **Arc-Flash Hazard Warning**. This article states:

> *110.16* ***Arc-Flash Hazard Warning****. Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.*

Furthermore, the existing arc-flash warning on other items of equipment is missing information suggested by NFPA 70E Standard for Electrical Safety in the Workplace and ANSI Z535.4-1998 Product Safety Signs and Labels. The information displayed should provide maintenance workers with arc-flash energy available, boundary distances and the minimum required personal protective equipment (PPE) to use when servicing the equipment.

The existing electrical equipment does not meet the present requirements of the NEC with regards to available fault current. NEC **110.24 Available Fault Current** states:

(A) ***Field Marking***. *Service equipment in other than dwelling units shall be legibly marked in the field with maximum available fault current. The field marking(s) shall include the date the fault current calculation was performed and be of sufficient durability to withstand the environment involved.*
(B) ***Modifications***. *When modifications to the electrical installation occur that affect the maximum available fault current at the service, the maximum available fault shall be verified or recalculated as necessary to ensure the service equipment ratings are sufficient for the maximum available fault current at the line terminals of the equipment. The required field marking(s) in 110.24(A) shall be adjusted to reflect the new level of maximum available fault current.*

Suggested Maintenance and Upgrades

Maintenance

- Update the existing short circuit and overcurrent device coordination study or have one performed if one does not exist. Post the maximum short circuit currents at the existing panels and verify that the available short circuit current does not exceed the short circuit rating of the existing overcurrent devices.

- Update existing Arc Flash Study or perform an arc flash study if one does not currently exist. Post the results at the existing electrical equipment.

- Trace all existing circuits from every panelboard. Install updated and code compliant circuit directories in each panelboard or nameplates at all overcurrent devices in switchboards.

- Include source of supply information on all equipment nameplates.

- Update the Computer Center electrical one-line diagram to show the entire electrical system. Diagram shall include every major item of equipment, equipment ratings, major overcurrent devices, feeder sizes, motor sizes, and magnitude of available short circuit at each item of equipment. Post the one line diagram behind a framed plastic cover within each main electrical room.

- Update the electrical floor plan of the Computer Center locating each and every item of major electrical equipment. Post alongside the one line diagram in each main electrical room.

- Relocate the existing 500 kVA, 4160V-480y/277 volt dry type transformer to a code compliant location.

- Replace panelboards L and L2 and install in a location that will provide code compliant working clearances.

Recommended System Upgrades

The following upgrades are suggested as future upgrades to the Data Center to provide a state-of-the-art data center power system.

- Install digital panel meters at each service switchboard and connect to the campus energy management system. These meters will provide information of kW and kVA demand at each service and will complement the existing metering being performed at the Central Plant by providing a more detailed breakdown of the existing loads, harmonic content and total harmonic distortion, power factor, and power disturbance events,

- Relocate as many fiber and copper data cables to above floor pathways (cable rack and fiber trough) to remove as much obstruction to air flow as possible. If data cables have to remain below the raised floor, install wire basket cable trays below the floor and neatly train and lace cable into the tray.

- Improve the access control and security of the data center by adding card in/card out to the Data Center equipment room to provide a complete audit trail of all traffic entering a leaving the equipment room.

- Improve the security between the joint use server room and the Data Center equipment room by installing a solid door with electric lock and card access from the joint use server room to the data center equipment room.

- Correct the access control into the telecommunication switch room by reversing the location of the card reader and request-to-exit pushbutton. Access to the switch room would be by card access only with exit by pushing the exit button.

- Provide a N+1 feeder connection from the central plant to the Computer Center's main Data Center to provide additional redundancy. Connect this feeder to the Data Center's power system through a 5kV rated static switch that will allow automatic switchover to the standby circuit in case of failure of the preferred feeder circuit.

- Provide an appropriately sized backup generator to support the existing Data Center in an N+1 capacity (provide backup support from the cogeneration turbine at the Central Plant). Based on the existing maximum demand load a 250-300kW generator would be sufficient to provide backup power to the entire existing data center. An analysis should be performed by the Computer Center staff to forecast the future computing needs of the university, prepare a 10 year master plan of the Computer Center's future upgrades and/or expansion and include the future power requirements into the generator capacity.

- In addition to the generator, provide N+1 UPS capability. The existing 160 kVA UPS appears to be sufficient to carry the entire Data Center equipment load for enough time to allow a backup generator to start and assume the load. The smaller 80 kVA UPS would be removed and a new 160 kVA UPS installed to provide the N+1 capability.

- Simplify the existing electrical services and distribution to and within the Data Center reducing the number of electrical services, install floor mounted power distribution units (PDUs) and remove the numerous wall mounted electrical panels.

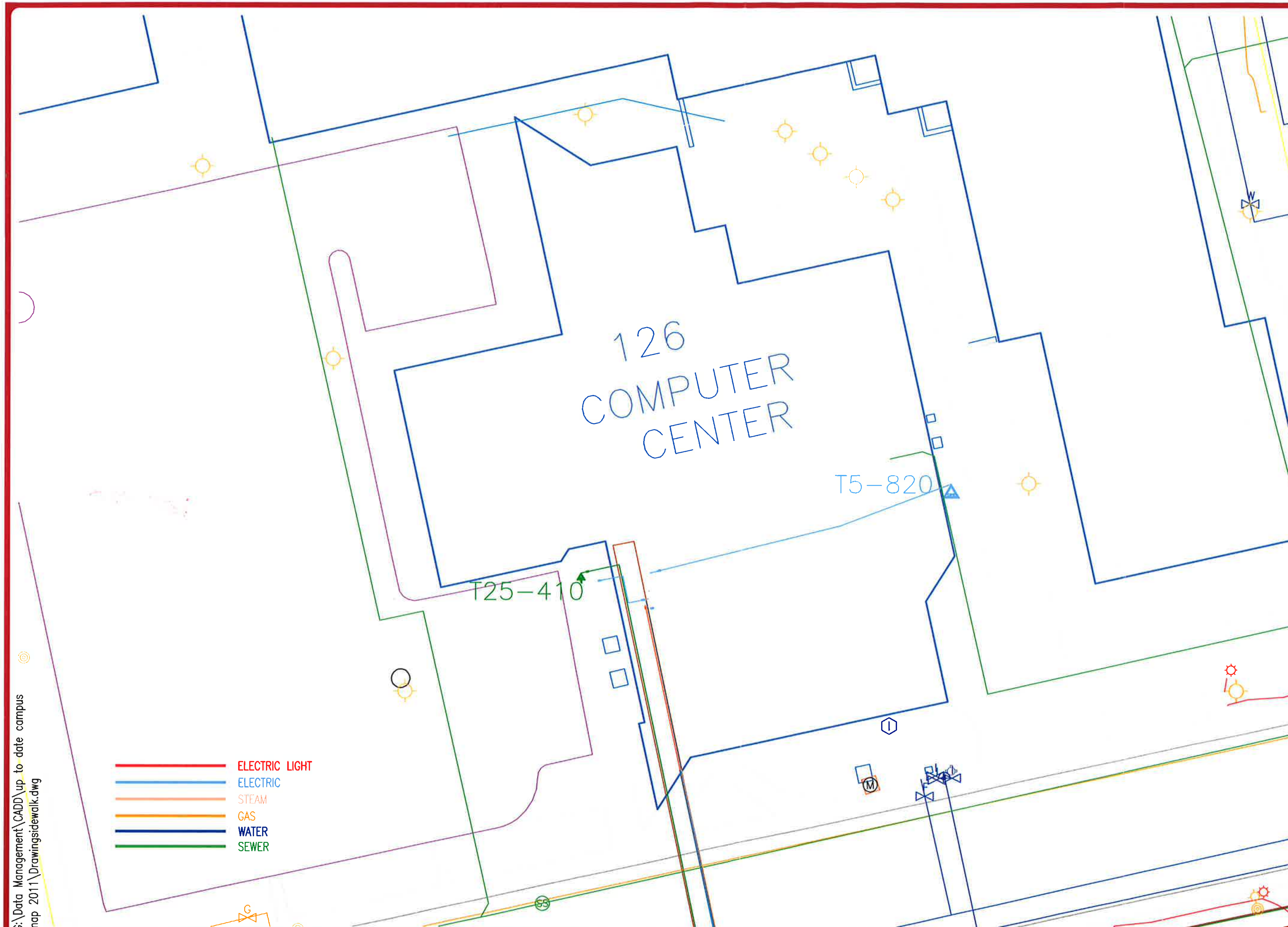
- Provide 2N capacity in PDUs. One half of the PDUs would be connected to each of the N+1 UPS systems.

- Provide every data system equipment rack with rack mount PDUs with dual circuit hot-switch capability to provide 2N under floor plug power at the rack level. Each one of the two plug loads at the rack would be served from a separate PDU which would be served by a separate UPS system.

- Configure the communications ports on the generator, UPS, and PDUs (floor and rack mount) to provide communications to a central monitoring point so that the Data Center's power loads can be monitored.

APPENDIX

- **UTILITY MAP**
- **PANEL SCHEDULES**



NM STATE UNIVERSITY

ENGINEERING
OFS, NMSU

MSC 3545
P.O.Box 30001
Las Cruces, NM 88003-8001

MARK	DATE	DESCRIPTION

UTILITIES AROUND
COMPUTER CENTER

DATE: 8/21/2012 11:42:46 AM
PROJECT NO: 13-032282
SHEET SIZE: 11X17
DRAWING TYPE: DWG
DRAWN BY: R. DAY
CHK'D BY: O. VAUGHT
SHEET TITLE

PANEL L4S

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	20			20		2	-	
	-	3		2			2	4	-	
	-	5	20			20		6	-	
	-	7		2			2	8	-	
	-	9	20			20		10	-	
	-	11		2			2	12	-	
	-	13	20			20		14	-	
	-	15		2			2	16	-	
	-	17	30			30		18	-	
	-	19		2			2	20	-	
	-	21	30	1		20	1	22	-	
	-	23	30	1		30	1	24	-	
	-	25	20	1				26	-	SPACE ONLY
	-	27	30			20		28	-	
	-	29		2			2	30	-	
		31						32		
		33						34		
		35						36		
		37						38		
		39						40		
		41						42		

CONNECTED LOAD

PHASE A KVA -
PHASE B KVA -
PHASE C KVA -

TOTAL CONNECTED KVA -
ESTIMATED DEMAND KVA -
ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

PANEL LB

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	30			20	1	2	-	
SENTREX TVSS	-	3				20		4	-	
	-	5		3			2	6	-	
	-	7	30			30	1	8	-	
	-	9				30		10	-	
	-	11		3			2	12	-	
	-	13	20	1		20		14	-	
	-	15	20	1			2	16	-	
	-	17	20			20		18	-	
	-	19		2			2	20	-	
	-	21	20			20		22	-	
	-	23		2			2	24	-	
	-	25	60			20		26	-	
SPARE (?)	-	27					2	28	-	
	-	29		3		20		30	-	
	-	31	20				2	32	-	
	-	33		2		20		34	-	
	-	35	20				2	36	-	
	-	37		2		60		38	-	
	-	39	20					40	-	SPARE(?)
	-	41		2			3	42	-	

CONNECTED LOAD

PHASE A KVA	-	**TOTAL CONNECTED KVA**	-
PHASE B KVA	-	**ESTIMATED DEMAND KVA**	-
PHASE C KVA	-	**ESTIMATED DEMAND AMPS**	-

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 200A SHUNT TRIP CB

PANEL L3

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	20	1		20	1	2	-	
	-	3	20	1		20	1	4	-	
	-	5	20	1		20	1	6	-	
	-	7	20	1		20	1	8	-	
	-	9	20	1		20	1	10	-	
	-	11	20	1		20	1	12	-	
	-	13	20	1		20	1	14	-	
	-	15	20	1		20	1	16	-	
	-	17	20	1		20	1	18	-	
	-	19	20	1		20	1	20	-	
	-	21	20	1		20	1	22	-	
	-	23	20	1		20	1	24	-	
	-	25	20	1		20	1	26	-	
	-	27	20	1		20	1	28	-	
	-	29	20	1		20	1	30	-	
	-	31	20	1		20	1	32	-	
	-	33	20	1		20	1	34	-	SPARE
SPARE	-	35	20	1		20	1	36	-	
	-	37	30			20	1	38	-	SPARE
SENTEX TVSS	-	39				20	1	40	-	
	-	41		3		30	1	42	-	SPARE

CONNECTED LOAD

PHASE A KVA -
PHASE B KVA -
PHASE C KVA -

TOTAL CONNECTED KVA -
ESTIMATED DEMAND KVA -
ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 100A SHUNT TRIP CB

PANEL FPS

208/120 VOLT, 3 PHASE, 4 WIRE — 150 AMP MCB

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	30			30		2	-	
	-	3		2				4	-	
	-	5	20	1			3	6	-	
	-	7	30			20	1	8	-	
	-	9				20	1	10	-	
	-	11		3		20	1	12	-	
	-	13	30			20	1	14	-	
	-	15		2		20	1	16	-	
	-	17	30			20	1	18	-	
	-	19		2		20	1	20	-	
	-	21	30			20	1	22	-	
	-	23		2		20	1	24	-	
		25						26		
		27						28		
		29						30		
		31						32		
		33						34		
		35						36		
		37						38		
		39						40		
		41						42		

CONNECTED LOAD

PHASE A KVA -

PHASE B KVA -

PHASE C KVA -

TOTAL CONNECTED KVA -

ESTIMATED DEMAND KVA -

ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL LB2

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	20	1		20		2	-	SPARE (?)
	-	3	20	1			2	4	-	
	-	5	20	1		20	1	6	-	SPARE (?)
	-	7	30			20	1	8	-	
	-	9				20	1	10	-	
	-	11		3		30	1	12	-	
	-	13	20			30		14	-	
	-	15		2			2	16	-	
SPARE (?)	-	17	20	1		20	1	18	-	SPARE (?)
	-	19	20	1		20	1	20	-	
	-	21	20	1		20	1	22	-	
	-	23	20	1		20	1	24	-	
SPARE (?)	-	25	20	1		20	1	26	-	
	-	27	30			20	1	28	-	
	-	29		2		20		30	-	SPARE (?)
	-	31	20	1			2	32	-	
SPARE (?)	-	33	20			20	1	34	-	
	-	35		2		20		36	-	SPARE (?)
SPARE (?)	-	37	20				2	38	-	
	-	39		2		20		40	-	SPARE (?)
SPARE (?)	-	41	20	1			2	42	-	

CONNECTED LOAD

PHASE A KVA -
PHASE B KVA -
PHASE C KVA -

TOTAL CONNECTED KVA -
ESTIMATED DEMAND KVA -
ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL FPS2

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	30			30	1	2	-	
	-	3		2		30	1	4	-	
	-	5	30			30		6	-	
	-	7		2			2	8	-	
	-	9	30			30		10	-	
	-	11		2			2	12	-	
	-	13	30	1		30	1	14	-	
	-	15	30	1		30	1	16	-	
	-	17	30			30		18	-	
	-	19		2			2	20	-	
	-	21	30			30		22	-	
	-	23						24	-	
	-	25		3			3	26	-	
SPACE	-	27				20		28	-	
SPACE	-	29					2	30	-	
		31						32		
		33						34		
		35						36		
		37						38		
		39						40		
		41						42		

CONNECTED LOAD

PHASE A KVA	-	**TOTAL CONNECTED KVA**	-
PHASE B KVA	-	**ESTIMATED DEMAND KVA**	-
PHASE C KVA	-	**ESTIMATED DEMAND AMPS**	-

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL NON

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
UFO	-	1	30			30		2	-	UFO
	-	3		2			2	4	-	
UFO	-	5	30			30		6	-	UFO
	-	7		2			2	8	-	
UFO	-	9	30			30		10	-	UFO
	-	11		2			2	12	-	
UFO	-	13	30			30		14	-	UFO
	-	15		2			2	16	-	
	-	17	30			20		18	-	SERVER RM
SENTREX TVSS	-	19					2	20	-	
	-	21		3		20		22	-	SERVER RM
SERVER RM	-	23	20				2	24	-	
	-	25		2		20	1	26	-	
SERVER RM	-	27	20			20		28	-	A/C
	-	29		2			2	30	-	
SERVER RM	-	31	20			30		32	-	TAPE DR
	-	33		2			2	34	-	
	-	35	20	1		30		36	-	NORTH 2770 PRINTER
SPACE	-	37					2	38	-	
SPARE OR UFO (?)	-	39	30			30		40	-	SPARE OR UFO(?)
	-	41		2			2	42	-	

CONNECTED LOAD

PHASE A KVA	-
PHASE B KVA	-
PHASE C KVA	-
TOTAL CONNECTED KVA	-
ESTIMATED DEMAND KVA	-
ESTIMATED DEMAND AMPS	-

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL CS(1)

208/120 VOLT, 3 PHASE, 4 WIRE **400 AMP MCB**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
REMOTE ALARM PANEL	-	1	20	1		30	1	2	-	NETWORK RACK
NETWORK RACK	-	3	30	1		30	1	4	-	NETWORK RACK
NETWORK RACK	-	5	30	1		30	1	6	-	NETWORK RACK
PENGUIN	-	7	20			20		8	-	PENGUIN
	-	9		2			2	10	-	
PENGUIN	-	11	20			20		12	-	PENGUIN
	-	13		2			2	14	-	
PENGUIN	-	15	20			20		16	-	PENGUIN
	-	17		2			2	18	-	
PENGUIN	-	19	20			60		20	-	SGI
	-	21		2				22	-	
PENGUIN	-	23	20				3	24	-	
	-	25		2		60		26	-	SGI
PENGUIN	-	27	20					28	-	
	-	29		2			3	30	-	
BRAINIAC	-	31	30			30		32	-	BRAINIAC
	-	33		2			2	34	-	
	-	35	20	1		20	1	36	-	
	-	37	20	1		20	1	38	-	FLOOR OUTLETS
	-	39	20	1		20	1	40	-	FLOOR OUTLETS
	-	41	20	1		20	1	42	-	FLOOR OUTLETS

CONNECTED LOAD

PHASE A KVA	-
PHASE B KVA	-
PHASE C KVA	-

TOTAL CONNECTED KVA	-
ESTIMATED DEMAND KVA	-
ESTIMATED DEMAND AMPS	-

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL CS(2)

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
FLOOR OUTLET	-	43	20	1		20	1	44	-	FLOOR OUTLET
FLOOR OUTLET	-	45	20	1				46	-	SPACE
FLOOR OUTLET	-	47	20	1				48	-	SPACE
FLOOR OUTLET	-	49	20	1		20	1	50	-	FLOOR OUTLET
PSI OUTLET	-	51	20	1				52	-	SPACE
SPACE	-	53						54	-	SPACE
SPACE	-	55				20	1	56	-	FLOOR OUTLET
SPACE	-	57						58	-	SPACE
SPACE	-	59						60	-	SPACE
SPACE	-	61						62	-	SPACE
SPACE	-	63						64	-	SPACE
SPACE	-	65						66	-	SPACE
SPACE	-	67						68	-	SPACE
SPACE	-	69						70	-	SPACE
SPACE	-	71						72	-	SPACE
SPACE	-	73						74	-	SPACE
SPACE	-	75						76	-	SPACE
SPACE	-	77						78	-	SPACE
SPACE	-	79						80	-	SPACE
SPACE	-	81						82	-	SPACE
SPACE	-	83						84	-	SPACE

CONNECTED LOAD

PHASE A KVA	-	**TOTAL CONNECTED KVA**	-
PHASE B KVA	-	**ESTIMATED DEMAND KVA**	-
PHASE C KVA	-	**ESTIMATED DEMAND AMPS**	-

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL DL

208/120 VOLT, 3 PHASE, 4 WIRE **200 AMP MCB**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	20	1		30		2	-	
	-	3	20	1				4	-	
	-	5	20	1			3	6	-	
	-	7	20	1		20	1	8	-	
	-	9	30			20	1	10	-	
	-	11		2		20	1	12	-	
	-	13	20	1		20		14	-	
	-	15	20	1			2	16	-	
	-	17	20	1		20	1	18	-	
	-	19	20	1		20		20	-	
	-	21	20	1			2	22	-	
	-	23	20	1		30		24	-	
	-	25	20	1			2	26	-	
	-	27	20	1		20	1	28	-	
	-	29	20			20	1	30	-	
	-	31		2		20	1	32	-	
	-	33	20	1		20	1	34	-	
	-	35	20	1		20	1	36	-	
20 KVA UPS SYSTEM	-	37	125			125		38	-	PANEL DR
	-	39						40	-	
	-	41		3			3	42	-	

CONNECTED LOAD

PHASE A KVA -
PHASE B KVA -
PHASE C KVA -

TOTAL CONNECTED KVA -
ESTIMATED DEMAND KVA -
ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL DR

208/120 VOLT, 3 PHASE, 4 WIRE **250 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
SPARE	-	1	20	1		20	1	2	-	
	-	3	20			20		4	-	
	-	5		2			2	6	-	
	-	7	20	1		20		8	-	
	-	9	20	1			2	10	-	
	-	11	20	1		20	1	12	-	
	-	13	20	1		20	1	14	-	
	-	15	20	1		30		16	-	
SPACE	-	17						18	-	SENTEX TVSS
SPACE	-	19					3	20	-	
SPACE	-	21						22	-	SPACE
SPACE	-	23						24	-	SPACE
SPACE	-	25						26	-	SPACE
SPACE	-	27						28	-	SPACE
SPACE	-	29						30	-	SPACE
SPACE	-	31						32	-	SPACE
SPACE	-	33						34	-	SPACE
SPACE	-	35						36	-	SPACE
SPACE	-	37						38	-	SPACE
SPACE	-	39						40	-	SPACE
SPACE	-	41						42	-	SPACE

CONNECTED LOAD

PHASE A KVA -
PHASE B KVA -
PHASE C KVA -

TOTAL CONNECTED KVA -
ESTIMATED DEMAND KVA -
ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL AS

208/120 VOLT, 3 PHASE, 4 WIRE **125 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	20			20	1	2	-	
	-	3		2		20	1	4	-	
	-	5	20	1		20	1	6	-	
	-	7	20			20	1	8	-	
	-	9		2		20		10	-	
	-	11	20	1			2	12	-	
SPACE	-	13				20	1	14	-	
SPACE	-	15				20	1	16	-	
SPACE	-	17				30		18	-	
SPACE	-	19						20	-	SENTEX TVSS
SPACE	-	21					3	22	-	
SPACE	-	23						24	-	SPACE
SPACE	-	25						26	-	SPACE
SPACE	-	27						28	-	SPACE
SPACE	-	29						30	-	SPACE
SPACE	-	31						32	-	SPACE
SPACE	-	33						34	-	SPACE
SPACE	-	35						36	-	SPACE
SPACE	-	37						38	-	SPACE
SPACE	-	39						40	-	SPACE
SPACE	-	41						42	-	SPACE

CONNECTED LOAD

PHASE A KVA -
PHASE B KVA -
PHASE C KVA -

TOTAL CONNECTED KVA -
ESTIMATED DEMAND KVA -
ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL L

208/120 VOLT, 3 PHASE, 4 WIRE **400 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	20			20	1	2	-	
	-	3				20	1	4	-	
	-	5		3		20	1	6	-	
	-	7	20			20	1	8	-	
	-	9				20	1	10	-	
	-	11		3		20	1	12	-	
	-	13	20	1		20	1	14	-	
	-	15	20	1		20	1	16	-	
	-	17	20	1		20	1	18	-	
	-	19	20	1		20	1	20	-	
	-	21	20	1		20	1	22	-	
	-	23	20	1		20	1	24	-	
	-	25	40			20	1	26	-	
	-	27				20	1	28	-	
	-	29		3		20	1	30	-	
		31						32		
		33						34		
		35						36		
		37						38		
		39						40		
		41						42		

CONNECTED LOAD

PHASE A KVA	-	**TOTAL CONNECTED KVA**	-
PHASE B KVA	-	**ESTIMATED DEMAND KVA**	-
PHASE C KVA	-	**ESTIMATED DEMAND AMPS**	-

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

PANEL L2

208/120 VOLT, 3 PHASE, 4 WIRE **225 AMP MLO**

10 KAIC BRANCH CIRCUIT

LOAD SERVED	PHASE LOAD	CKT BKR #	CKT BKR AMP	CKT BKR P	PHASE A B C	CKT BKR AMP	CKT BKR P	CKT BKR #	PHASE LOAD	LOAD SERVED
	-	1	20	1		20	1	2	-	
	-	3	20	1		20	1	4	-	
	-	5	20	1		20	1	6	-	
	-	7	20	1		20	1	8	-	
	-	9	20	1		20	1	10	-	
	-	11	20	1		20	1	12	-	
	-	13	20	1		20	1	14	-	
	-	15	20	1		20	1	16	-	
	-	17	20	1		20	1	18	-	
	-	19	30			25		20	-	
	-	21						22	-	
	-	23		3			3	24	-	
	-	25	20	1		20	1	26	-	
	-	27	20	1		20	1	28	-	
	-	29	20	1		30		30	-	
	-	31	20	1				32	-	
SPACE	-	33					3	34	-	
SPACE	-	35				70		36	-	
SPACE	-	37						38	-	
SPACE	-	39					3	40	-	
SPACE	-	41						42	-	SPACE

CONNECTED LOAD

PHASE A KVA -

PHASE B KVA -

PHASE C KVA -

TOTAL CONNECTED KVA -

ESTIMATED DEMAND KVA -

ESTIMATED DEMAND AMPS -

LOAD DESCRIPTION	CONNECTED KVA NON-CONT	CONNECTED KVA CONT	DEMAND KVA
LIGHTING	-	-	-
RECEPTACLES	-	-	-
MOTORS	-	-	-
TRANSFORMERS	-	-	-
KITCHEN	-	-	-
OTHER	-	-	-
	-	-	-

FED FROM 150A SHUNT TRIP CB

APPENDIX C
EQUIPMENT / MATERIAL CUT SHEETS

MECHANICAL
- Computer Room Air-conditioning Units
- Air-handling Units
- Variable Volume Air Terminal Units
- Access Floor Diffusers
- Powered Ventilators and Wall Louvers

ELECTRICAL
- Switchgear
- PDV Equipment
- UPS Equipment

MECHANICAL CUT SHEETS

Pad-Mounted Switchgear

Electrical Apparatus

RVAC, Vacuum-Break Switchgear, Oil-Insulated or SF_6-Insulated

285-50

GENERAL

RVAC pad-mounted vacuum switchgear (Figure 1) from Eaton's Cooper Power Systems is designed for applications including industrial parks and shopping malls where frequent 600-amp main line switching plus fuse protection are required. It incorporates vacuum switching, which has an excellent field performance record since 1983; and a mechanism designed specifically for repetitive switching duty.

RVAC pad-mounted vacuum switchgear features deadfront construction for optimum safety. Oil, E200™ fluid, Envirotemp™ FR3™ fluid* or SF_6 insulation provides a compact, low-profile design that is unobtrusive in commercial and industrial / office park applications. A wide range of current-limiting fusing options provides simple, easy coordination with system requirements.**

Available in single- or three-phase units, RVAC switchgear is offered in 15, 25 and 35 kV ratings as listed in Table 1.

* Application of Envirotemp™ FR3™ fluid is limited to minimum ambient temperatures of 0 °C (32 °F) or higher.

** Cannot provide fuses with SF_6 insulation.

Figure 1.
RVAC pad-mounted vacuum switchgear offers a low-profile, unobtrusive appearance that blends into surrounding landscaping.

TABLE 1
Ratings of RVAC Pad-mounted Switchgear

Nominal Voltage	15 kV	25 kV	35 kV
Maximum Design Voltage	15.5	27	38
BIL	95	125	150
1-minute Withstand Switch* and Terminators	35	60	70
Continuous Current, amps	600	600	600
Load Switching, amps	600	600	600
Momentary Current 10 Cycles, amps (asym.)	20,000	20,000	20,000
1 Sec., amps (sym.)	12,500	12,500	12,500
Fault Making (sym./asym.), kA	12.5/20.0	12.5/20.0	12.5/20.0
Interrupting Rating**, (kA)	50	20 - 50	12.2 - 50

* The withstand rating of the switch is higher than that of the connectors (IEEE Std C37.74™-2003 standard)
**Interrupting rating for fused units depends on the selected fuses and the application voltage.

ORDERING INFORMATION REQUIRED

To order an RVAC vacuum-break switch use the catalog number noted in Table 3. Modify the last two digits, as required, to adapt the unit to the specific application.

1. From Table 3, choose the applicable base catalog number; select the operating voltage and circuit configuration.

   Note: To order a Single-Phase unit, change the second-to-last digit from a "3" to a "1" (i.e. KPRV931, three-phase; KPRV911, single-phase). Consult factory for price and availability.
2. From Table 2 identify the required bushing arrangement. Change the last digit of the catalog number to the number identified in the table (i.e. KPRV931 identifies 15 kV with 600 A on both source and tap, KPRV935 identifies 25 kV with 600 A source and 200 A tap).
3. From Table 3 specify the catalog number for any optional bushing inserts required for the given pad-mounted unit.
4. From Tables 4-10 specify the catalog numbers of all required accessories and options.

Constructing Catalog Numbers

To order a basic 15 kV, RVAC Model 9 switch; 600-Amp source side bushings, 200-Amp tap wells only, the catalog number would be:

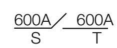
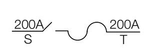
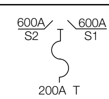
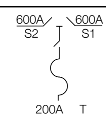
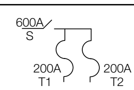
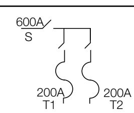
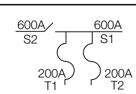
KPRV932 Basic RVAC Model 9 vacuum break switch, three-phase, 15 kV, with 600 A source bushings and 200 A tap wells.

TABLE 2
Bushing Guide

Voltage Rating	Amperage Rating (Source/Tap)		
	600 A/600 A	**600 A/200 A***	**200 A*/200 A***
15 kV	1	2	3
25 kV	4	5	6
35 kV	7	8	9

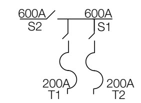
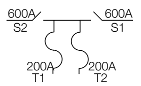
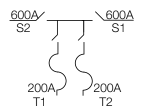
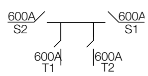
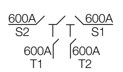
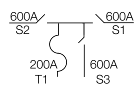
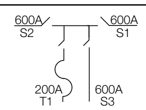
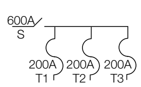
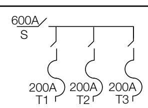
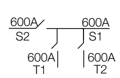
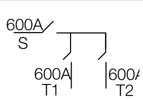
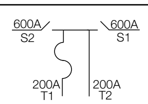
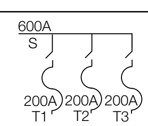
*RVAC's ordered with 15 or 25 kV voltage rating are equipped with wells only on the 200-amp side.

TABLE 3
RVAC Selection and Ordering Guide*

Model	One-Line Diagram	Nominal Voltage** (kV)	BIL (kV)	H/W/D*** (in.)	OIL INSULATED Catalog No.	SF6 INSULATED Catalog No.
3		15 25 35	95 125 150	48/40/66 48/40/66 48/40/78	KPRV331 KPRV334 KPRV337	KPSRV331 KPSRV334 KPSRV337
5		15 25 35	95 125 150	44/32/64 44/40/75 44/40/75	KPRV533 KPRV536 KPRV539	N.A. N.A. N.A.
6		15 25 35	95 125 150	42/62/70 44/70/81 44/70/81	KPRV632 KPRV635 KPRV638	N.A. N.A. N.A.
6B		15 25 35	95 125 150	42/62/70 44/70/81 48/70/81	KPRV6B32 KPRV6B35 KPRV6B38	N.A. N.A. N.A.
7		15 25 35	95 125 150	42/62/70 44/70/81 44/70/81	KPRV732 KPRV735 KPRV738	N.A. N.A. N.A.
7B		15 25 35	95 125 150	42/62/70 44/70/81 48/70/81	KPRV7B32 KPRV7B35 KPRV7B38	N.A. N.A. N.A.
8		15 25 35	95 125 150	42/62/70 44/70/81 44/70/81	KPRV832 KPRV835 KPRV838	N.A. N.A. N.A.

* Contact factory for information on configurations not listed.
** For models using fuses: The 15 kV rated units are provided with 15 kV ELSG fuse holders; 25 kV rated units are provided with 25/35 kV ELSG fuse holders; 35 kV rated units are provided with 35/35 kV ELSG fuse holders. Consult catalog section 240-82 for fuse ratings and catalog numbers. Fuses are not included with the unit and should be ordered separately.
*** Approximate overall dimensions for typical units. For footprint, reduce dimension "D" by 2 inches.

TABLE 3
RVAC Selection and Ordering Guide* (continued)

Model	One-Line Diagram	Nominal Voltage** (kV)	BIL (kV)	H/W/D*** (in.)	OIL INSULATED Catalog No.	SF6 INSULATED Catalog No.
8B		15 25 35	95 125 150	42/62/70 44/70/81 48/70/81	KPRV8B32 KPRV8B35 KPRV8B38	 N.A. N.A.
9		15 25 35	95 125 150	42/62/70 44/70/81 44/70/81	KPRV932 KPRV935 KPRV938	N.A. N.A. N.A.
9B		15 25 35	95 125 150	42/62/70 44/70/81 48/70/81	KPRV9B32 KPRV9B35 KPRV9B38	N.A. N.A. N.A.
10		15 25 35	95 125 150	48/70/76 48/70/76 48/70/84	KPRV1031 KPRV1034 KPRV1037	KPSRV1031 KPSRV1034 KPSRV1037
10T		15 25 35	95 125 150	48/84/76 48/84/76 48/84/84	KPRV10T32 KPRV10T34 KPRV10T37	KPSRV10T31 KPSRV10T34 KPSRV10T37
11		15 25 35	95 125 150	42/62/76 44/70/87 44/70/87	KPRV1132 KPRV1135 KPRV1138	N.A. N.A. N.A.
11B		15 25 35	95 125 150	42/62/76 44/70/87 48/70/87	KPRV11B32 KPRV11B35 KPRV11B38	N.A. N.A. N.A.
12		15 25 35	95 125 150	44/62/91 44/70/104 44/70/104	KPRV1232 KPRV1235 KPRV1238	N.A. N.A. N.A.
12B		15 25 35	95 125 150	44/62/91 44/70/104 48/70/104	KPRV12B32 KPRV12B35 KPRV12B38	N.A. N.A. N.A.
13		15 25 35	95 125 150	48/70/76 48/70/76 48/70/84	KPRV1331 KPRV1334 KPRV1337	N.A. N.A. N.A.
13A		15 25 35	95 125 150	48/70/76 48/70/76 48/70/84	KPRV13A31 KPRV13A34 KPRV13A37	KPSRV13A31 KPSRV13A34 KPSRV13A37
14		15 25 35	95 125 150	42/62/70 44/70/81 44/70/81	KPRV1432 KPRV1435 KPRV1438	N.A. N.A. N.A.
15B		15 25 35	95 125 150	44/62/91 44/70/104 44/70/104	KPRV15B32 KPRV15B35 KPRV15B38	N.A. N.A. N.A.

* Contact factory for information on configurations not listed.
** For models using fuses: The 15 kV rated units are provided with 15 kV ELSG fuse holders; 25 kV rated units are provided with 25/35 kV ELSG fuse holders; 35 kV rated units are provided with 35/35 kV ELSG fuse holders. Consult catalog section 240-82 for fuse ratings and catalog numbers. Fuses are not included with the unit and should be ordered separately.
*** Approximate overall dimensions for typical units. For footprint, reduce dimension "D" by 2 inches.

TABLE 4
Optional Bushings

Current Rating	Nominal kV Class	Description*	Catalog Number
200-Amp Loadbreak	15	3 Bushing inserts	KPA1033
200-Amp Loadbreak	25	3 Bushing inserts	KPA1034
600-Amp Deadbreak	15 or 25	3 PUSH-OP bushings **	KPA1151-3
600-Amp Deadbreak	35	3 PUSH-OP bushings **	KPA1153
600-Amp Deadbreak	15 or 25 †	3 U-OP systems with aluminum VBJ's & U-Connectors ††, †††	KPA1052-1-1
600-Amp Deadbreak	15 or 25 †	U-OP provisions ††††	KPA1053-1

* Eaton's Cooper Power Systems bushings and bushing wells provided. Contact an Eaton's Cooper Power Systems representative for alternatives.
** PUSH-OP™ bushings include PUSH-OP 600 A deadbreak bushing and front plate latch assembly.
† 35 kV is not available.
†† Includes installation of mounting provisions for U-OP™ systems, KPA1053-1, on the tank.
††† U-OP is added for each bushing of a three-phase position. When ordering, customer to specify which three-phase positions will be equipped with U-OP.
†††† Installation of mounting provisions for U-OP systems for all 600 A bushings on the tank.

TABLE 5
Construction and Finish

Description	Catalog Number
304L Stainless steel construction (in lieu of standard mild steel construction)	*
Special paint color, top coat on external surfaces only, (specify at time of ordering)	KPA-1044-X**

* Contact an Eaton's Cooper Power Systems representative.
** "X" will be replaced with proper number. Standard paint is bell green Munsell 7GY.

TABLE 6
Ground Options*

Description	Catalog Number
1/2" Copper ground rod	KPA-1037-X**
3" Stand-off bracket for 1/2" Rod	***
Copper flat ground bus	KPA-1047-X**

** Standard construction units have source and cable compartments; order optional ground accessories in quantities of two per unit.
** "X" will be replaced with proper assembly number.
*** Contact an Eaton's Cooper Power Systems representative.

TABLE 7
Fault Indicators

Description	Catalog Number
RCR fault indicator provisions*	**
S.T.A.R.™ fault indicator provisions, small remote*	KPA-110-1
S.T.A.R. fiber optic remote display*	KPA-110-2
S.T.A.R. FISHEYE™ display*	**

* Fault indicator provisions are located in the source or tap compartment sill. Six required.
** Contact an Eaton's Cooper Power Systems representative.

TABLE 8
Accessories Available on RVAC units with Switches Only

Description	Catalog Number
Two-stage auxiliary switch	*
Motor operator provisions, one-way	*
Motor operators	
one way	*
additional motor operated way	*
Semaphore, for one way	*

* Contact an Eaton's Cooper Power Systems representative.

TABLE 9
Service Items

Description	Catalog Number
1" drain valve with 3/8" sampler (in lieu of standard 1" drain plug and 3/8" sampler)*	KPA1051*
Spare fuse storage rack	**
SF_6 refill kit; hoses, valves, regulator	KPA-1043-1
SF_6 refill kit; hoses and valves (without regulator)	KPA-1043-2
Hex head door bolt accessory***	KPA1056-1
Operation Counter	KPA113-4
Kirk key interlock provision (specify location at time of ordering)	KPA-1067-1

* Non applicable to SF_6 switchgear.
** Contact an Eaton's Cooper Power Systems representative.
*** One per cable compartment.

TABLE 10
Miscellaneous

Description	Catalog Number
Decals	
Danger High Voltage	KPA1063-4
Internal Mr. Ouch, bi-lingual	KPA1046-3
External Mr. Ouch, bi-lingual	KPA1046-4
Non PCB	KPA1040-1

FEATURES AND DETAILED DESCRIPTION

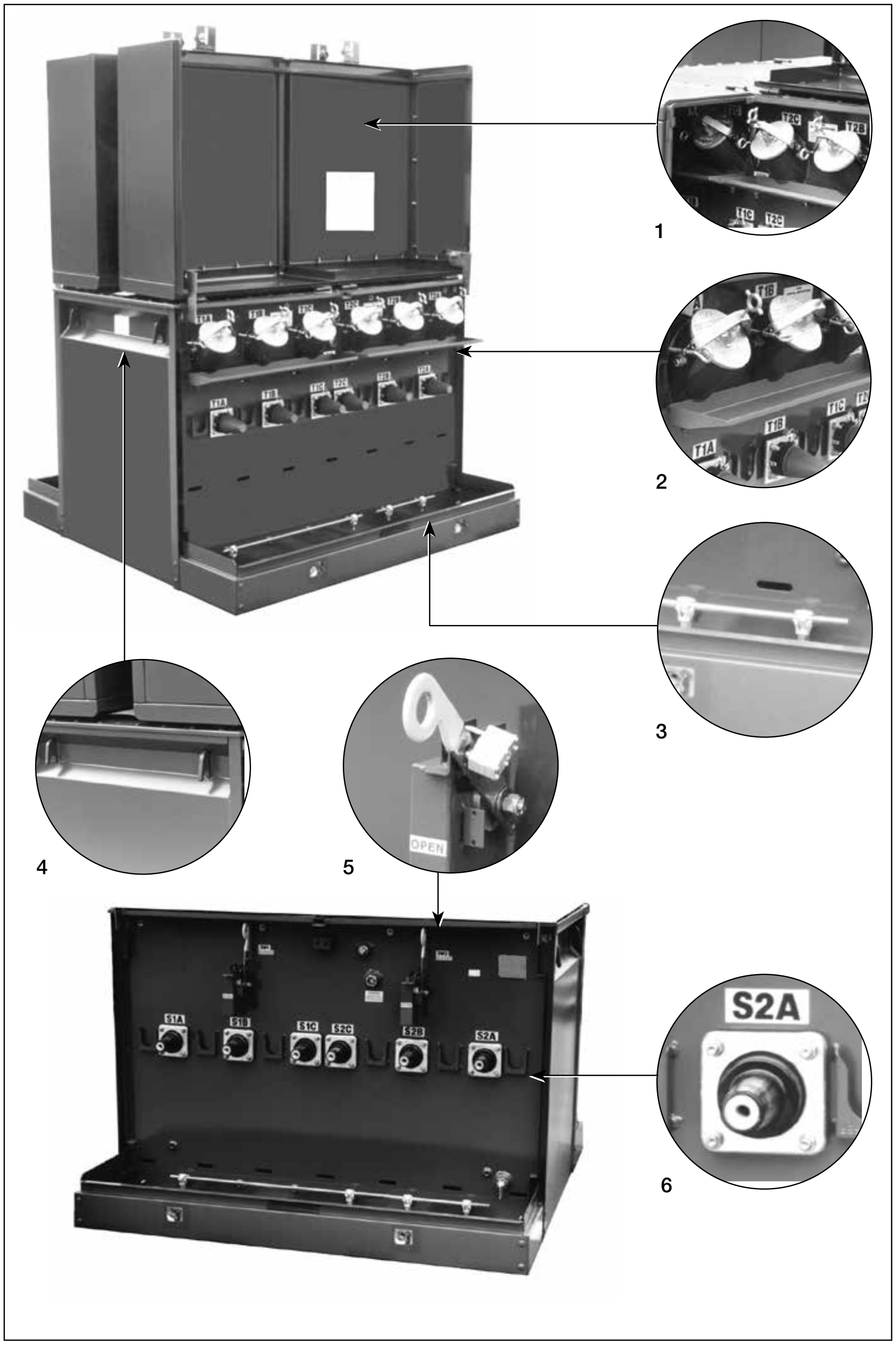


Figure 2.
RVAC pad-mounted switchgear, with field-proven components and protective devices, is designed for fast installation and easy operation.

1. **Split doors on both source and tap sides enable simple, one-man operation.**
2. **Fuse oil drip tray.**
3. **Optional solid copper grounding rod makes grounding simple and convenient.**
4. **Recessed lifting provisions are located for a balanced lift.**
5. **Switch lever provides simple push/pull operation for closing and opening; can be padlocked in either position.**
6. **Component bushings from Eaton's Cooper Power Systems assure dependable operation. Standoff brackets are provided for each bushing.**

RVAC pad-mounted switchgear (Figure 2) offers the superior performance of vacuum loadbreak interruption for switching underground distribution systems. Service-proven vacuum interrupters combine with an interrupting mechanism designed specifically for repetitive switching duty to provide a unit ideally suited to such applications as industrial parks and shopping malls where frequent switching is required. Vacuum interrupters offer the further advantages of long life in repetitive service, low maintenance, quiet operation, and high interrupting ratings.

To further serve these loads, RVAC pad-mounted switchgear offers 600 amp main line switching capability and current-limiting fuse protection. RVAC vacuum pad-mounted switchgear is available in single- and three-phase units in ratings of 15, 25 and 35 kV.

The low profile of RVAC pad-mounted switchgear blends into landscaping and is unobtrusive. Deadfront construction is tamper-resistant, and provides a high margin of safety for utility personnel and the general public.

All internal energized parts are insulated in either oil, SF_6 gas or the more environmentally desirable and less flammable Envirotemp™ FR3™ and E200 fluid alternatives.* Prior to shipment, the switchgear is filled with the specified insulating medium, eliminating both field filling and the resultant danger of contamination.

RVAC switchgear and components are designed in conformance with IEEE Std C37.74™-2003 standard.

Switching is easily accomplished with a simple push-pull operating lever that moves in and out. The lever can be padlocked in the open or closed position.

A wide selection of current-limiting fuse options is available with amperage ratings and coordination curves to meet your system requirements.

* Application of Envirotemp™ FR3™ fluid is limited to minimum ambient temperatures of 0 °C (32 °F) or higher.

Vacuum Interrupter

Vacuum interruption offers a number of advantages in service, reliability and maintenance. The RVAC interrupter offers many times the number of switching operations in a lifetime compared to an air or oil interrupter. Contacts are hermetically sealed, eliminating any source of contamination. Vacuum interruption is fast—on the first current zero. Arcing is minimized. The RVAC interrupter is restrike-free. The dielectric strength of the contact gap recovers much more rapidly than the recovery voltage can rise, therefore eliminating restriking.

Vacuum interrupters from Eaton's Cooper Power Systems (see Figure 3) have been in service since 1983 and have established a superior record of field performance.

Figure 3.
Vacuum switching provides many times the service life of air switches and is ideal for applications requiring repetitive switching operations.

Interrupter Mechanism

The advantages of vacuum interruption extend to the interrupter mechanism. The short contact stroke minimizes the mass being moved and therefore mechanical shock. This in turn permits a substantial reduction in the size and total weight of the interrupter assembly.

As a result, the interrupter mechanism for RVAC switchgear is simple, dependable and easy to operate. The operating lever (Figure 4) requires only an easy push or pull action to close or open, and the switch can be padlocked in either position. A key interlock is available for added security.

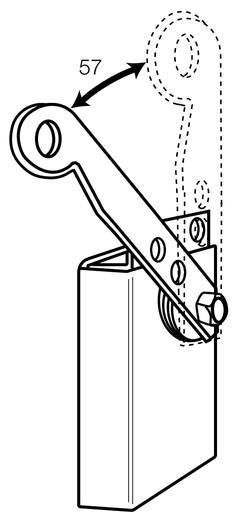


Figure 4.
The RVAC switch is simple and easy to operate, requiring only a push to close or pull to open. The switch can be padlocked in either position, and a key interlock is available for added security.

Current-Limiting Fuse Protection

For fault protection with RVAC oil-insulated units, Eaton's Cooper Power Systems offers a complete line of fuses available for pad-mounted switchgear. Consult Catalog Section 240-82 for fuse ratings and catalog numbers.

Cabinet Construction

The deadfront, non-ventilated, tamper-resistant construction of RVAC switchgear makes it suitable for operation in areas subject to excessive moisture, occasional flooding* and blowing snow. Additional sealing is provided by the Buna-N rubber gasket in the bolted cover (liquid-filled units only-SF_6 covers are welded in place.) RVAC pad-mounted switchgear consists of a sealed insulation tank which houses energized components, and separate main and tap compartments. The main compartment, located at the front of the tank, houses the source bushings and source switches, and has a minimum depth of 22 inches when provided with 600 A bushings. At the rear of the tank, the tap compartment contains tap bushings, tap switches if specified, and fuses. It has a minimum depth of 16 inches when provided with 200 A bushing wells.

Split side-hinged doors are provided for both compartments, with door stops for each section. Fused units have swing-up doors in lieu of the standard side-hinged door. Door hinges are equipped with stainless steel pins. A door extender allows both source and tap doors to be opened at the same time. Doors are secured with recessed stainless steel pentahead bolts, with provisions for padlocking.

Figure 5.
ELSG fuses provide current-limiting protection in series with an expulsion fuse, mounted in the wet-well holder.

* Occasional flooding applies only to the RVAC unit and not any controls or motors attached to the unit. Per IEEE Std C37.74™-2003 standard , submersible units are able to operate at their standard ratings provided the water head does not exceed 3m above the top of the switchgear during occasional submersion.

Recessed lifting provisions are provided for a balanced lift.

Finish

RVAC switchgear is finished in a green color which conforms to Munsell 7GY 3.29/1.5 Green.

The coating meets the following specifications: IEEE Std C57.12.28™-2005 standard, ASTM B1117 1000-hour humidity test, ASTM G53 500-hour ultraviolet accelerated weathering test, and ASTM D2794 impact test. Certified test data is available upon request.

Bushings

600-amp bushings furnished on RVAC pad-mounted switchgear are Eaton's Cooper Power Systems deadbreak aluminum type, and conform to IEEE Std 386™-1995 standard.

200-amp interfaces are either Eaton's Cooper Power Systems 200-amp bushing wells or Eaton's Cooper Power Systems 200-amp one-piece 35 kV bushings and conform to IEEE Std 386™-1995 standard.

Bushings are mounted in-line and located a minimum of 24 inches above the pad.

Pressure-Relief Valve

For oil-insulated units only, an automatic pressure-relief valve, operated by clampstick, is mounted above the liquid level on the switchgear.

UL® Listed and Labeled

For non-fused RVAC switchgear, the UL® listing and labeling is available for units where required with the following features considered to be UL® listed and labeled:

- 15 kV and 25 kV voltage ratings
- Fluid Dielectrics (mineral oil, E200, and Envirotemp™ FR3™ fluids)
- Visible-breaks (two- and three-position)
- Mild and stainless steel construction

Standard Features

- Removable sill
- Oil sight gauge/SF_6 pressure gauge
- Door lifting handles
- Pressure-relief valve for oil tanks
- Oil fill plug/SF_6 fill port
- Stand-off brackets for each bushing
- Removable oil fuse drip tray
- Door stop
- Split doors
- Designed for use with Eaton's Cooper Power Systems M.O.V.E. surge arresters
- Stainless steel hinges
- Recessed pentahead bolts
- Recessed lifting provisions
- Bolted cover
- Switch padlock provisions
- Complete operating, maintenance and installation instructions
- ANSI® 1/2-13 ground nut mounted beneath each bushing
- Oil drain plug with sampler

Optional Accessories

- 200-amp bushing inserts
- 200-amp one-piece bushings
- Drain valve with sampler
- 1/2-inch copper ground rod on source and tap sides
- Fault indicator provisions
- Spare fuse storage rack
- Type 304L stainless steel construction
- SF_6 refill hoses, valves and regulator
- Auxiliary switch, 2 stage
- Control position semaphore
- PUSH-OP bushings
- U-OP bushings
- Envirotemp™ FR3™ and E200 fluids options*
- Motor actuator and control
- Low pressure alarm for SF_6 units
- Externally-replaceable bushings

Production Testing

Before shipping, RVAC switchgear is fully assembled, filled with selected insulating medium, and subjected to the following factory tests:

- Continuity testing to ensure correct internal connections
- Hi-pot testing to ascertain dielectric integrity
- Leak tested to ensure that tank is completely sealed
- Resistance testing to ensure positive electrical connections
- Mechanical operations test of RVAC switches to ensure problem-free operation

* Application of Envirotemp™ FR3™ fluid is limited to minimum ambient temperatures of 0 °C (32 °F) or higher.

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Cooper Power Systems Business
2300 Badger Drive
Waukesha, WI 53188
United States
Cooperpower.com

Printed in USA
Publication No. 285-50
March 2014

For Eaton's Cooper Power Systems RVAC switchgear product information call 1-877-277-4636 or visit: www.cooperpower.com.

Powering Business Worldwide

Configurable Power Distribution

InfraStruxure PDU 60kW 208V/208V

More Images

Designed to increase flexibility and agility of data center power distribution through a design that does not require a raised floor.

Includes: Installation guide, User Manual

Standard Lead Time: Usually Ships within 3 Weeks

PD60F6FK1

Contact Sales

Email Technical Specifications

Printer Friendly

Product Category

Rack Power Distribution (7)

Row Power Distribution

> Modular Power Distribution

> Modular Power Accessories

> Configurable Power Distribution

> Configurable Power Accessories

> iBusway for Data Center

> MGE Static Transfer Switches

Room Power Distribution (1)

Transfer Switches (2)

Return to Power Distribution

Technical Specifications | Product Overview | Documentation | Software & Firmware | Options

Output

Nominal Output Voltage	120V, 208V 3PH
Maximum Total Current Draw per Phase	167A

Input

Nominal Input Voltage	208V 3PH
Input Frequency	60 Hz +/- 3 Hz
Number of Power Cords	1
Maximum Line Current per phase	167A

Physical

Net Weight	1012.00 lbs. (460.00 kg)
Maximum Height	81.00 inches (2057 mm)
Maximum Width	24.00 inches (610 mm)
Maximum Depth	35.98 inches (914 mm)
Shipping Weight	1034.00 lbs. (470.00 kg)
Shipping Height	86.00 inches (2184 mm)
Shipping Width	36.00 inches (914 mm)
Shipping Depth	48.00 inches (1219 mm)
Color	Black

Environmental

Operating Environment	32 - 104 °F (0 - 40 °C)
Operating Relative Humidity	0 - 95%
Operating Elevation	0-3333 feet (0-999.9 meters)
Storage Temperature	5 - 113 °F (-15 - 45 °C)
Storage Relative Humidity	0 - 95%
Storage Elevation	0-30000 feet (0-9000 meters)

Conformance

Regulatory Approvals	UL 60950
Standard Warranty	1 year repair or replace

Sustainable Offer Status

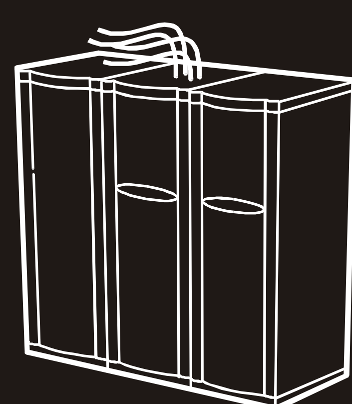
*Except where noted, all prices are Estimated Resale Price (ERP) - Without Tax/VAT. Pricing in other locations and sites may vary.

www.apc.com

Installation and Start-Up

60kW InfraStruXure™ System

Large Data Centers
208/480/600 V Input



About this Manual

This manual is intended for APC Field Service Engineers or APC-trained installers of a 60 kW InfraStruXure system. It covers basic installation and start-up.

For information about installing specific components in your InfraStruXure system, see the documentation included with each component. Before installing or operating any component, refer to the safety instructions in the component's manual.

The illustrations of products in this manual may vary slightly from the products in your InfraStruXure system.

Note: You can check for updates to this manual by clicking on the **User Manuals** link on the **Support** page of the APC Web site (**www.apc.com**). In the list of InfraStruXure manuals, look for the latest letter revision (A, B, etc.) of the part number on this manual.

Contents

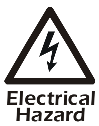
Safety

Overview

Save these instructions

This manual contains important instructions that must be followed during installation, operation, and maintenance of the InfraStruXure System.

Safety symbols used in this manual



Indicates an electrical hazard, which, if not avoided, could result in injury or death.

Indicates a hazard, which, if not avoided, could result in personal injury or damage to product or other property.

Indicates a potential hazard which could result in damage to product or other property.

Indicates important information.

Indicates a heavy load that should not be lifted without assistance.

Indicates a standby state. When in standby, the unit is not operating, but it may still contain hazardous voltage. It is not safe to service until the equipment is disconnected from all sources of electrical power.

Cross-reference symbols used in this manual

Indicates that more information is available on the same subject in a different manual.

Indicates that more information is available on the same subject in a different section of this manual.

Warnings

Receiving/moving

Do not tilt the PDU greater than 45° from its vertical axis. Never lay the PDU on its side.

Installation/Maintenance

Only a certified electrician can:

- Connect the PDU to its power source
- Connect a switch to the EPO interface on the PDU
- Install a customer-specified, hard-wired power cable

Only a certified electrician or an APC Field Service Engineer can perform maintenance of the PDU.

When you connect the PDU to its power source, you must install a circuit breaker to protect the PDU against over-current. Determine the type of circuit breaker that you need to install:

Input Voltage	Circuit Breaker Sizing
208V	225A
480V	90A
600V	75A

Maintenance performed while the PDU is receiving input power

APC does not recommend that you perform maintenance of the PDU while it is receiving input power. However, due to the critical nature of data center loads, this may occur. If you must perform maintenance while the PDU is receiving input power, observe the following precautions to reduce the risk of electric shock:

1. Never work alone.
2. Perform the maintenance only if you are a certified electrician who is trained in the hazards of live electrical installation.
3. Know the procedure for disconnecting electricity to the PDU and the data center in case of an emergency.
4. Wear appropriate personal protective equipment.
5. Use double-insulated tools.
6. Always follow local and site regulations when working on the PDU.

Total Power Off

1. Set the PDU **Main Input** to OFF.
2. Set the upstream power source feeding the PDU to OFF.

Emergency Power Off (EPO)

Hazardous voltage from the branch circuit must be isolated from the 24 VAC, 24 VDC, and contact closure. 24 VAC and 24 VDC are considered Class 2 circuits as defined in Article 725 of the National Electrical Code (NFPA 70) and Section 16 of the Canadian Electrical Code (C22.1).

A Class 2 circuit is a source having limited voltage and energy capacity as follows:

a. If an Inherently Limited Power Source, voltage and energy are limited to less than 30 VAC, less than 30 VDC, and 8 A.

b. If not an Inherently Limited Power Source, voltage and energy are limited to less than 30 VAC, less than 60 VDC, 250 VA, and the current is limited to 1000/V max. The fuse is limited to 5 A if less than 20 VAC or 20 VDC, or 100/V maximum if less than 30 VAC or 60 VDC.

If you choose to use a 24 VAC, 24 VDC, or contact closure connection to the EPO, use one of the following UL-listed wire types:

- CL2 Class 2 cable for general purpose use
- CL2P Plenum cable for use in ducts, plenums, and other space used for environmental air
- CL2R Riser cable for use in a vertical run shaft from floor to floor
- CL2X Limited Use cable for use in dwellings and for use in a raceway
- For installation in Canada, the cable should be CSA Certified, type ELC (extra-low-voltage control cable).

If you do not use a CL2 cable, route the EPO wiring in conduit that does not contain any branch circuit wiring.

EMI

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this user manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference.The user will bear sole responsibility for correcting such interference.

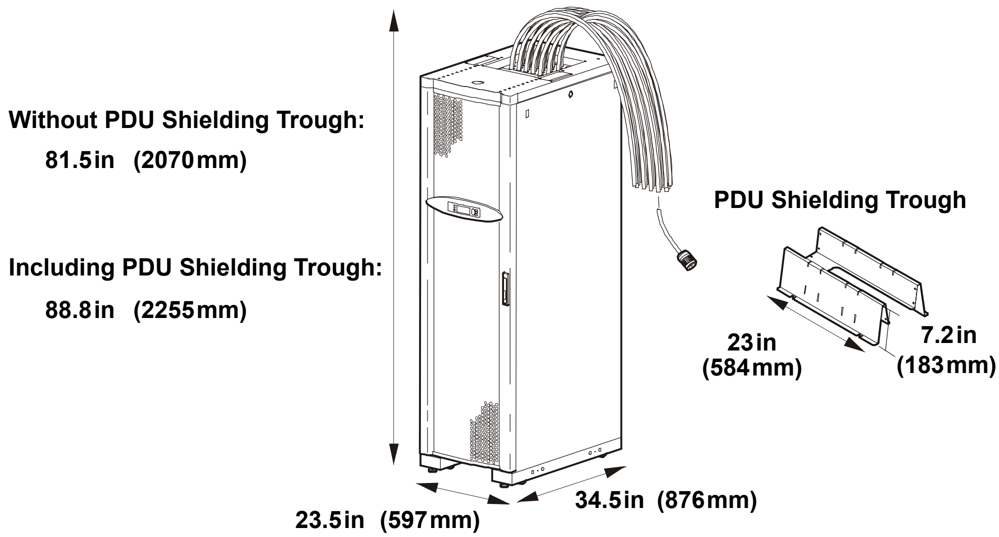
This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numerique de la classe A est conformé à la norme NMB-003 du Canada.

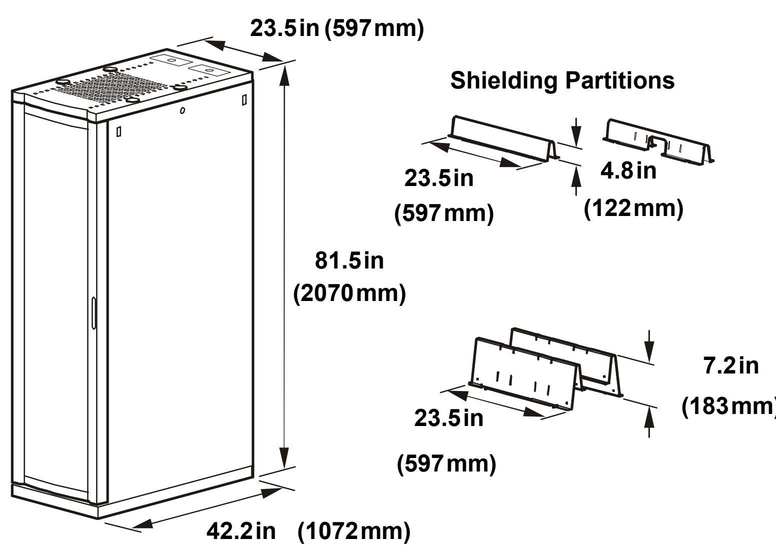
Site Planning

Dimensions

InfraStruXure PDU

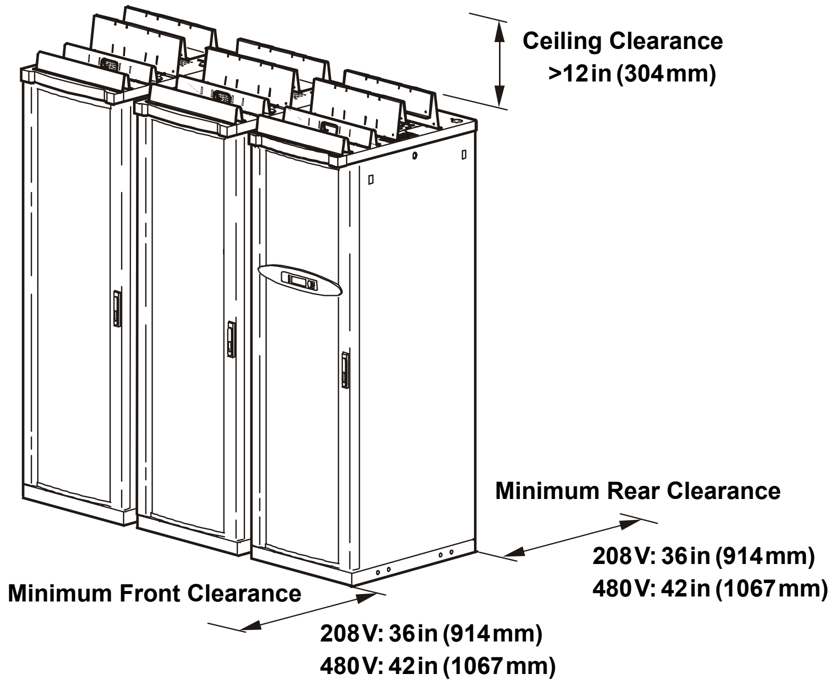


NetShelter VX Enclosure



Space Considerations

Study the figure below to determine your space requirements for installing the InfraStruXure PDU. Consult your local codes and the NEC for additional requirements.



Weight Considerations

Ensure that the floor and sub-floor can support the total weight of the configuration when concentrated on the leveling feet. If you are placing equipment on a raised floor, consult the flooring manufacturer for loading requirements before installing equipment.

Component	Maximum Weight
InfraStruXure PDU	
With a transformer	1225 lb (556 kg)
Without a transformer	775 lb (352 kg)
NetShelter VX Base Enclosure (empty)	351 lb (160 kg)

Heat Output

Consider the heat dissipation ratings of equipment to determine cooling requirements. Additional cooling equipment may be required. Heat output of the InfraStruXure PDU is shown below.

	Voltage	
InfraStruXure PDU with a transformer	208 V input	7169 BTU/hr (2.10 kW)
	480 V input	7412 BTU/hr (2.17 kW)
	600 V input	4894 BTU/hr (1.43 kW)

Note: The heat output is higher while batteries are charging. Under normal operating conditions, battery recharging periods are infrequent.

Electrical Requirements and Specifications

Procedures requiring a licensed electrician

Electrical Hazard

Procedures requiring a licensed electrician include:

- **Connection of utility conductors**
- **Installation of a 225-, 90-, or 75-amp circuit breaker**
- **Connection to the Main Input switch**
- **Wiring under the floor**

See also

To connect utility conductors, see *Certified Electrician's Instructions* included with your PDU documentation.

Electrical requirements

	208V Input	480V Input	600V Input
Service distribution breaker †‡	225A	90 A	75 A
Conductors to main input switch†	Transformer: 3W + G + GEC No Transformer: 4W + G	3W + G + GEC	3W + G + GEC
Recommended wire sizing‡			
L1, L2, L3, N	4/0 AWG	3 AWG	4 AWG
G	6 AWG	8 AWG	8 AWG
GEC	4 AWG	8 AWG	8 AWG

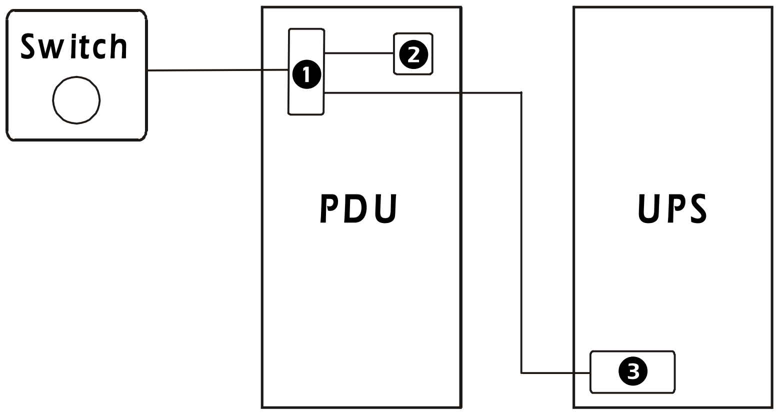
† Provided by customer.

‡ The specifications are recommendations. Consult the NEC and local codes for requirements specific to your installation.

Emergency Power Off (EPO)

Overview

To provide a mechanism for emergency power off, attach a remote switch to the EPO interface on the PDU monitoring unit through the user connection plate. The EPO interface (❶) is connected to the PDU Main Input switch (❷) and to the UPS internal EPO switch (❸).



When the EPO is activated, the main input breaker to the PDU transformer is opened, the UPS DC Disconnect breaker is opened, and the UPS System Enable switch is turned off. In this sequence, there is no power from the PDU transformer and there is no power from the UPS inverters and batteries.

Note

APC offers an optional InfraStruXure EPO system (EPW9). Contact your APC sales representative, or visit the APC Web site **(www.apc.com)** for more information.

See "Connect an Emergency Power Off Switch" on page 18 for instructions on how to connect an EPO switch to the PDU.

Basic Installation Procedure

This section provides the basic steps that you need to perform when installing InfraStruXure power and rack components. Follow the references provided with each step for detailed instructions.

Warning

Do not begin installing your InfraStruXure system without an APC Field Service Engineer present.

1. Unpack the components according to the unpacking instructions included on the outside of the packaging or in the component's manual.

   Note

   Search all boxes and packaging to make sure that they are empty before discarding.

2. Determine the correct placement of your system components by studying your InfraStruXure Configure-To-Order (CTO) report. Move the InfraStruXure PDU and NetShelter VX Enclosures to their final location.

   Warning

   If installing InfraStruXure on a raised floor, make sure that the raised-floor structure has a lb/in^2 rating that will support the full weight of the InfraStruXure installation. See "Weight Considerations" on page 7.

3. Level the PDU and NetShelter enclosures, using the 13/14-mm wrench included with each unit.

   See page 13 for detailed instructions.

4. Join adjacent NetShelter enclosures.

   See also

   For instructions on joining adjacent NetShelter VX Enclosures, see the installation manual included with your enclosures.

5. Ensure total power off.

   See page 33 for detailed instructions.

6. Connect the power source to the PDU.
   A licensed electrician must connect the power source.

   See page 14 for detailed instructions.

7. Connect an EPO switch to the PDU monitoring unit.

   See page 18 for detailed instructions.

8. Install Shielding Troughs, Shielding Partitions, and Cable Ladders.

   See also

   For instructions, see the manuals included with your Shielding Troughs, Shielding Partitions, and Cable Ladders.

9. Install the Rack Automatic Transfer Switches (ATS), Rack Power Distribution Units, and other InfraStruXure rack-mount devices.

   See also

   For instructions, see the manuals included with your Rack ATS, Rack PDU, or other InfraStruXure rack-mount device.

10. Route and attach power cables to each Rack ATS and/or Rack PDU.

    See page 25 for detailed instructions.

11. Route and attach communication cables to the InfraStruXure Manager hub (or switch).

    See page 30 for detailed instructions.

12. Start the system.
    Only qualified, APC-trained personnel may perform a system start-up.

    See page 31 for detailed instructions.

13. Configure the InfraStruXure Manager.

    See also

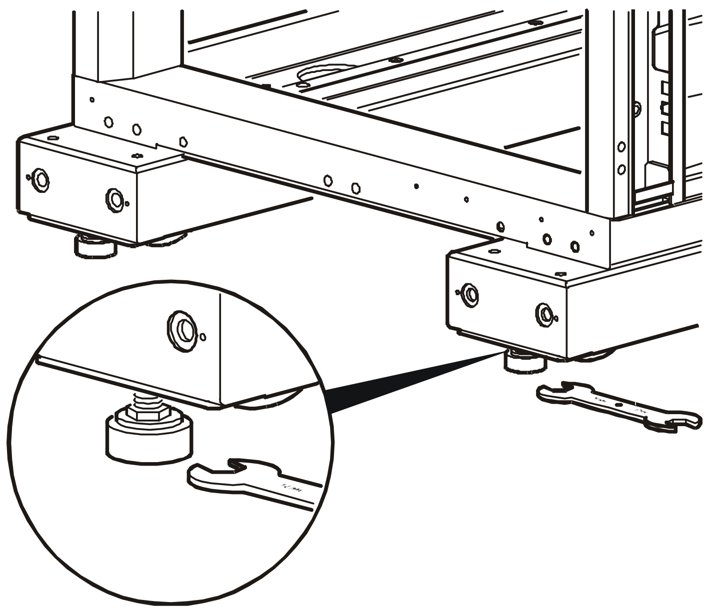
    For instructions, see the manual included with your InfraStruXure Manager.

Installation Procedures

Level the PDU and NetShelter Enclosures

Leveling feet are attached under the enclosure at each corner. The leveling feet can help provide a stable base if the selected floor space is uneven, but they are not intended to compensate for a badly sloped surface. To level the enclosure:

1. Fit the 14-millimeter end of the open-ended wrench (provided) to the hex head just above the round pad on the bottom of the leveling foot. Turn the wrench clockwise to extend the leveling foot until it makes firm contact with the floor.

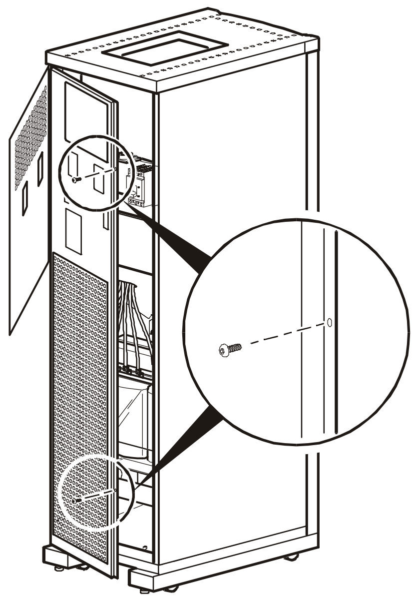


2. Repeat step 1 for each of the remaining leveling feet.
3. Use a level to determine which feet need further adjustment to level the enclosure. Adjust as necessary.

Connect the Power Source to the PDU

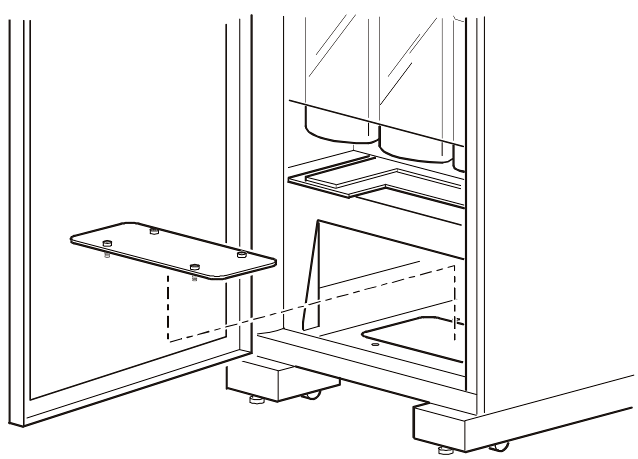
Access the PDU Main Input switch

Open the back doors of the PDU, unlock the top, smaller door, using the provided red key, and loosen the two screws holding the larger, hinged door in place.

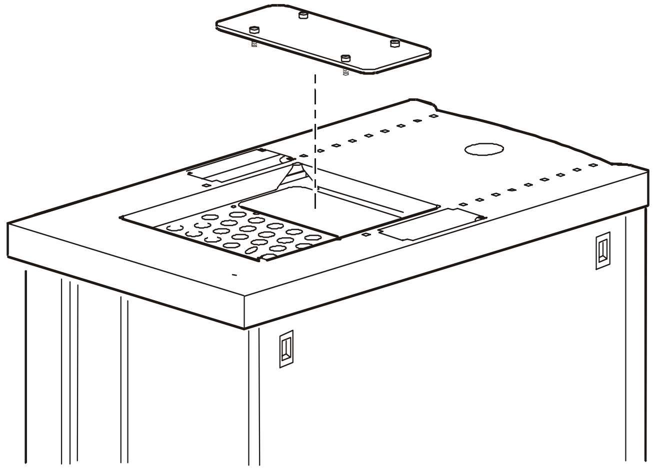


Attach conduit to the PDU for the input conductors

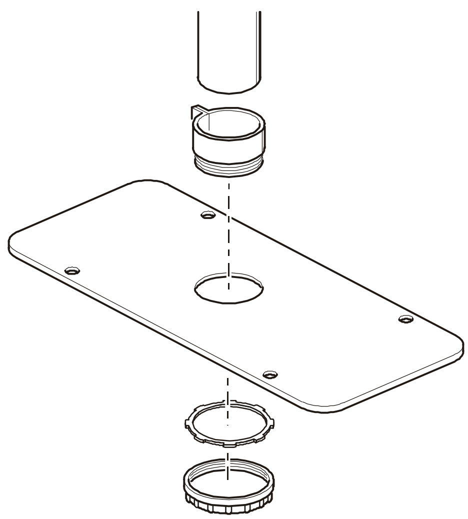
1. Remove the rectangular gland plate by loosening the captive screws, using a Phillips or standard screwdriver:
   – In the bottom of the PDU for wiring under a raised floor



– In the top of the PDU for overhead wiring



2. Cut an appropriately-sized hole in the gland plate for the conduit.
3. Re-attach the gland plate.
4. Install a lock-nut and bushing to the conduit.
5. Thread the conduit through the hole.



Install a circuit breaker

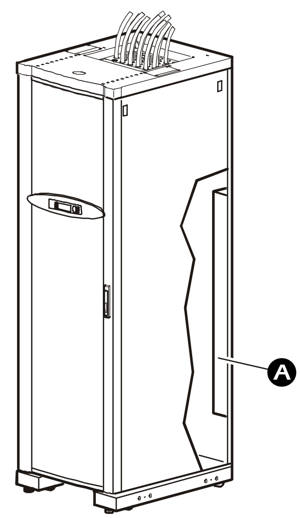
Make sure the cables used for power input are sufficiently protected by a circuit breaker.

Determine the amperage of circuit breaker that you need to install:

Input Voltage	Circuit Breaker Amperage
208 V	225 A
480 V	90 A
600 V	75 A

Route the input conductors to the Main Input circuit breaker (or switch)

1. Route the input conductors to the Main Input circuit breaker (or switch) of the PDU, as follows:
   – For overhead wiring, run the input conductors directly to the Main Input circuit breaker (or switch).
   – For wiring under a raised floor, run the input conductors through the wireway (A) within the PDU to the Main Input circuit breaker (or switch).



Torque specs and tools required

Before connecting to the terminals, verify the torque specs below by checking the specifications on the Main Input circuit breaker (or switch).

Terminal	Torque	Tools
L1, L2, L3, N	150 in-lb	6-mm Allen wrench
G, GEC	4 – 6 AWG: 45 in-lb 8 AWG: 40 in-lb	Slotted screwdriver

Connect input conductors

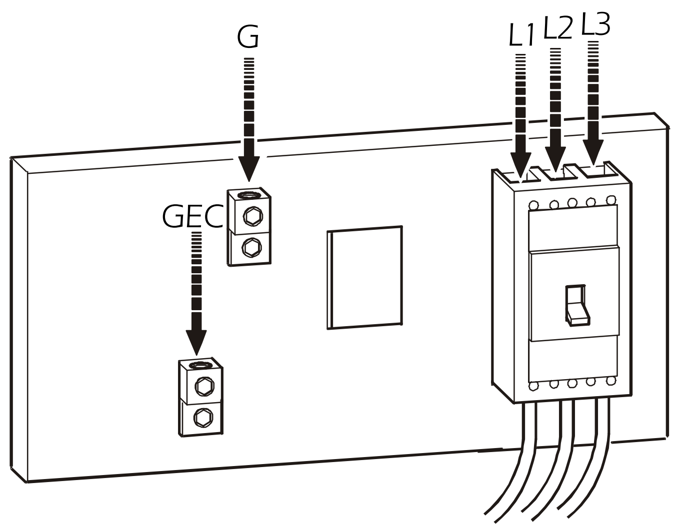
A licensed electrician must connect input conductors to the PDU.

At the Main Input circuit breaker (or switch), connect the input wiring according to the labels on the circuit breaker (or switch) and the illustrations below. See the table, “Torque specs and tools required” on page 16 for specific information about connecting to each terminal.

Connect the conductors to the terminals according to the labels on the terminals. Use copper conductors only.

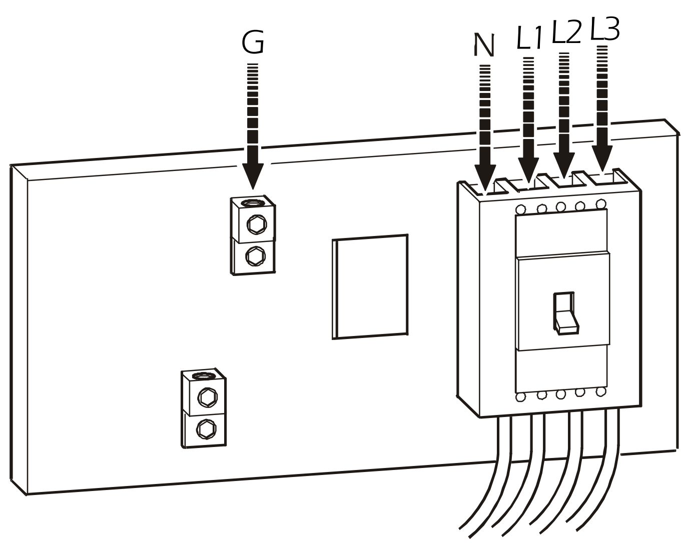
208/480/600 V input with a transformer:

3-phase, 3-wire + ground +
GEC to building steel



208 V input without a transformer:

3-phase, 4-wire + ground

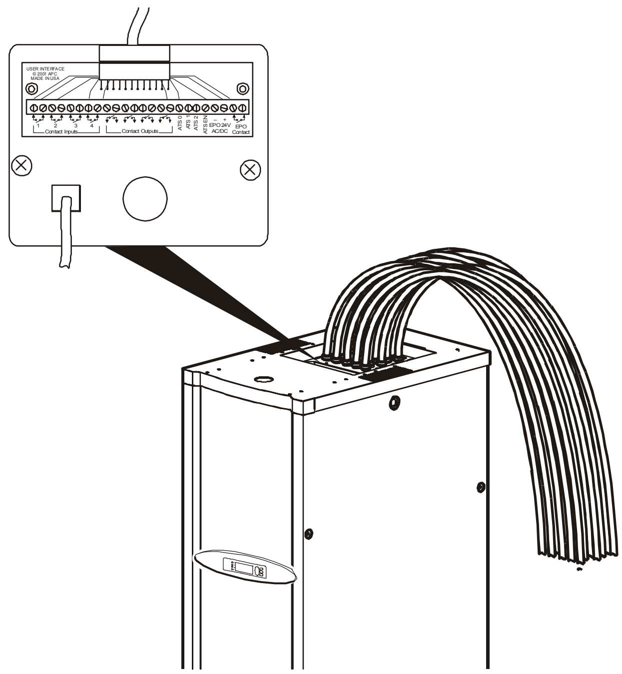


Connect an Emergency Power Off Switch

Overview

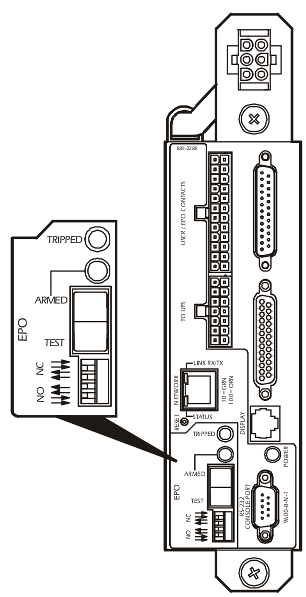
Connecting the switch. The Emergency Power Off (EPO) switch connects to the PDU user connection plate. The figure on the right shows the location of the user connection plate on the roof of the PDU. Connect a switch using one of three following connections:

- Contact closure
- 24 VAC
- 24 VDC



Note Contact closure is recommended.

Configuring and testing. Configuring and testing of the switch is done through the EPO interface on the PDU monitoring unit. The figure to the right shows the PDU monitoring unit and the location of the EPO LEDs and switches.

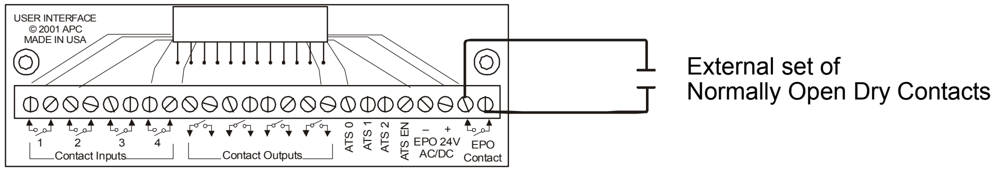


Note APC offers an optional InfraStruXure EPO System (EPW9). Contact your APC sales representative, or visit the APC Web site **(www.apc.com)** for more information.

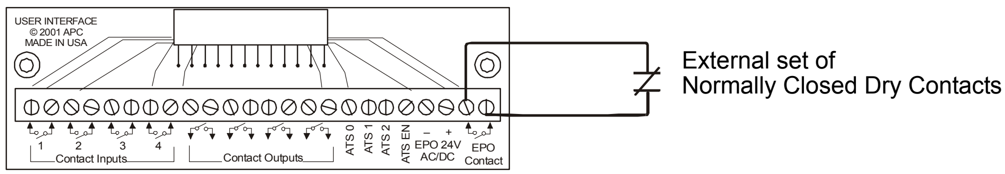
Connect an EPO switch to the user connection plate and test the switch

1. Connect the switch to the EPO connection point terminals located on the bottom side of the PDU user connection plate. Read the label next to the terminal block to determine which terminals to connect to for the signal type you are using:

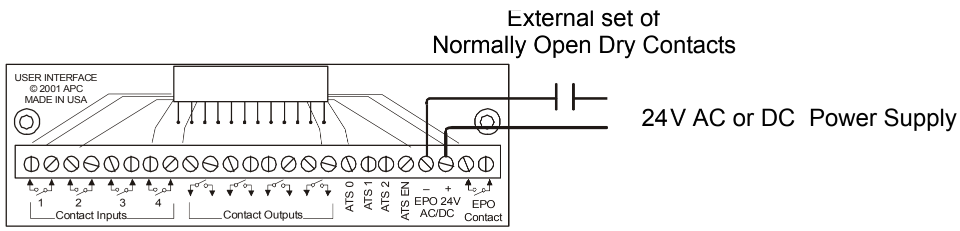
   – Contact Closure—Normally Open



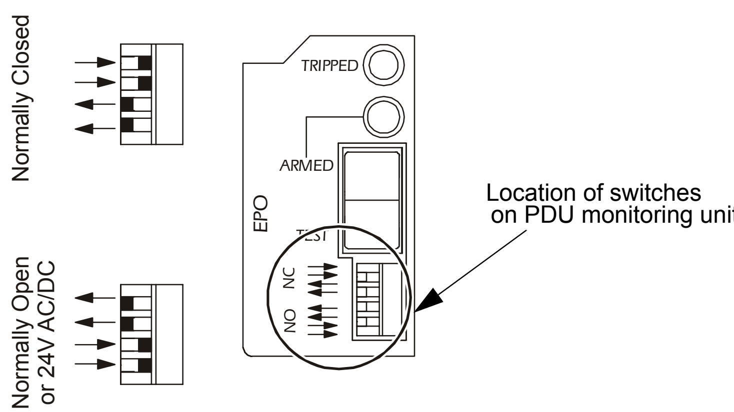
   – Contact Closure—Normally Closed)



   – 24VAC/VDC—Normally Open



2. Verify that the EPO DIP switches on the PDU monitoring unit are configured properly for the signal type you are using. The labels above the switches and the figure below show the correct settings for both the Normally Open (NO) and Normally Closed (NC) position.



Note: The default setting on the EPO interface on the PDU monitoring unit is for a **Normally Open (NO)** switch.

3. Test the EPO switch to ensure that it is wired and working correctly:
   a. Place the Arm/Test rocker switch in the **Test** position. The EPO state LEDs will be off and the PDU display interface will show the following alarm (in addition to any other active alarms):

```
Active Alarm xxofxx
EPO Ready To Test
```

   b. Engage the EPO switch. (If your switch is momentary, engage it with one person watching the EPO state LEDs, and another at the EPO switch.)
   c. Observe the EPO LEDs. If the switch is wired and working properly, when the switch is engaged, both of the EPO state LEDs are red.
   d. If the test was successful, place the Arm/Test rocker switch back to the **Arm** position. The PDU display interface will clear the EPO test mode alarm. If the test was not successful, see the troubleshooting chart:

Problem	**Action**
Neither state LED was red when EPO switch was engaged	• Check the wiring to your EPO switch. • Check to make sure the EPO DIP switch configuration is correct for your switch (NO or NC). See step 2 on the previous page for proper configuration instructions.
Only one of the state LEDs was red when EPO switch was engaged	• Check to make sure the EPO DIP switch configuration is correct for your switch (NO or NC) and test again. See step 2 on the previous page for proper configuration instructions. • If the switch is configured correctly and both LEDs are not red after testing again, contact customer support at a number on the back cover of this manual.

   e. Repeat this test for each EPO switch installed.
4. Ensure that the Arm/Test rocker switch is in the **Arm** position on the monitoring unit.

Safety warnings

Hazardous voltage from the branch circuit must be isolated from the 24 VAC, 24 VDC, and contact closure. 24 VAC and 24 VDC are considered Class 2 circuits as defined in Article 725 of the National Electrical Code (NFPA 70) and Section 16 of the Canadian Electrical Code (C22.1).

A Class 2 circuit is a source having limited voltage and energy capacity as follows:

a. If an Inherently Limited Power Source, voltage and energy are limited to less than 30 VAC, less than 30 VDC, and 8 A.

b. If not an Inherently Limited Power Source, voltage and energy are limited to less than 30 VAC, less than 60 VDC, 250 VA, and the current is limited to 1000/V max. The fuse is limited to 5 A if less than 20 VAC or 20 VDC, or 100/V maximum if less than 30 VAC or 60 VDC.

If you choose to use a 24 VAC, 24 VDC, or contact closure connection to the EPO, use one of the following UL-listed wire types:

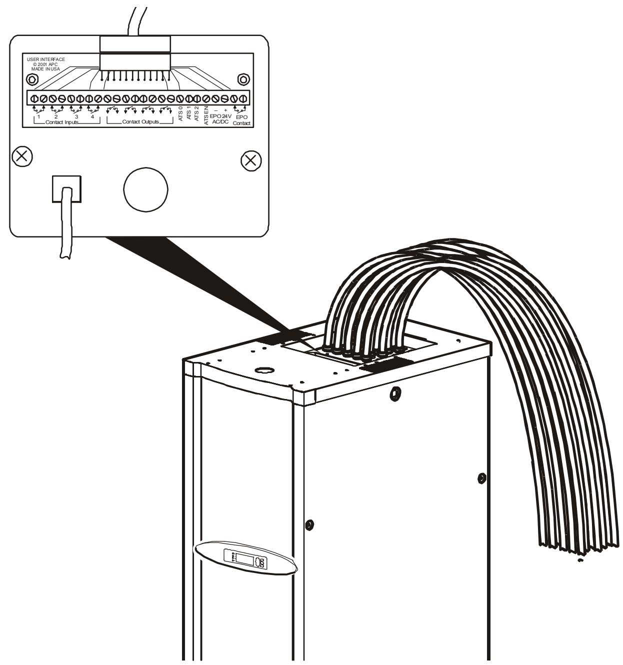
- CL2 Class 2 cable for general purpose use
- CL2P Plenum cable for use in ducts, plenums, and other space used for environmental air
- CL2R Riser cable for use in a vertical run shaft from floor to floor
- CL2X Limited Use cable for use in dwellings and for use in a raceway
- For installation in Canada, the cable should be CSA Certified, type ELC (extra-low-voltage control cable).

If you do not use a CL2 cable, route the EPO wiring in conduit that does not contain any branch circuit wiring.

Connect User Input Contacts and Relay Outputs to the User Connection Plate

Overview

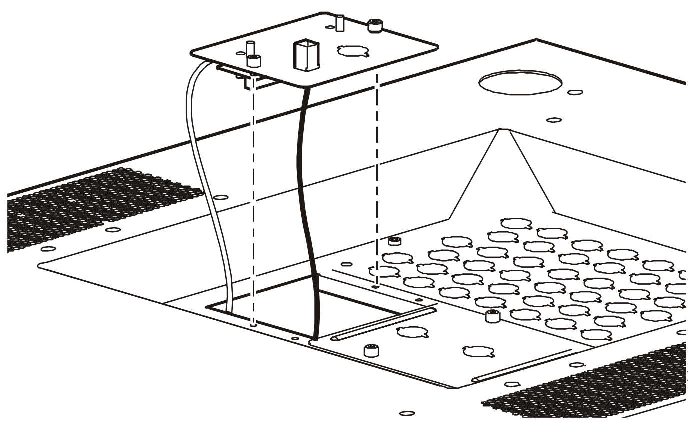
Make contact closure connections (NO or NC) at the user connection plate to monitor dry contacts. You can make eight connections—four input contacts and four relay outputs.



The figure at the right shows the location of the user connection plate on the roof of the PDU enclosure.

You can make connections from inside the enclosure, or you can remove the user connection plate and make your connections.

Remove the plate using a Phillips or standard screw driver to loosen the two captive screws. Use the knockout in the plate to route cables to and from the user connections on the plate. If you remove the plate, make sure that you do not disturb the existing connections.



How to connect contacts to the PDU Monitoring Unit

1. Choose one or more contact numbers on the user connection plate to which you will connect the contacts. The user connection plate is connected to the **User/EPO port** on the PDU monitoring unit.
2. From the PDU display interface:
   a. Press the ESC or ENTER key to go to the top-level menu screen.
   b. Select **Contacts** on the top-level menu screen and press the ENTER key.
   c. Press the ENTER key to select the number of the contact you are connecting. The continue arrow ↕ will appear next to the contact number.
   d. Press the Up or Down arrow key to select the appropriate contact number and press the ENTER key.
   e. Press the Down arrow key to enter a unique **Name** for the contact and to configure the **Normal** state of the contact (Open or Closed). The default **Normal** state is Open. Press the ENTER key to select the item you wish to configure.

   Note: You will be prompted for your password to configure these items.

3. Connect contact wires (300 V-rated cabling required) to the terminal block on the user connection plate. You will need a 2.5-mm standard screwdriver.
4. Run the wires from the terminal block out the roof or under the floor of the PDU to your contact's location.

   Warning: **Ensure that wires are properly retained and away from high voltage lines and breakers.**

Relay output specifications

Nominal switching capacity	1 A at 30 VDC
Maximum switching power	30 W
Maximum switching voltage	60 VDC
Maximum switching current	2 ADC
Maximum carrying current	2 ADC
Surge ratings	2 kV per Bellcore TA-NWT-001089 1.5 kV per FCC part 68

Install Shielding Troughs, Shielding Partitions, and Cable Ladders

Shielding Troughs and Shielding Partitions for overhead wiring along rows

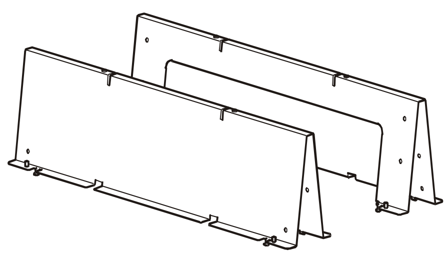
If you ordered APC Shielding Troughs, Shielding Partitions, and Cable Ladders to route overhead wiring for your system, assemble the Shielding Troughs and the Shielding Partitions along the rows of enclosures and assemble the Cable Ladders between rows

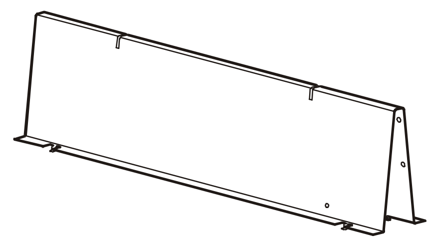
See also

For detailed installation and grounding instructions, see the instruction sheet included with the Shielding Troughs and Shielding Partitions (990-1393B).

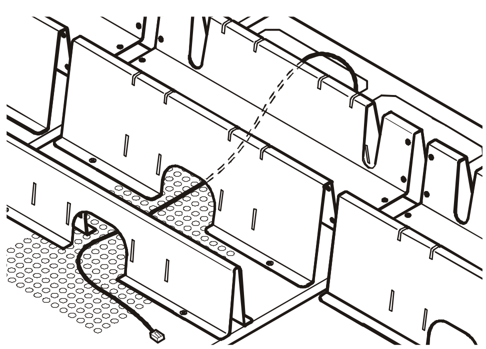
Shielding Troughs. There are two types of Shielding Troughs:

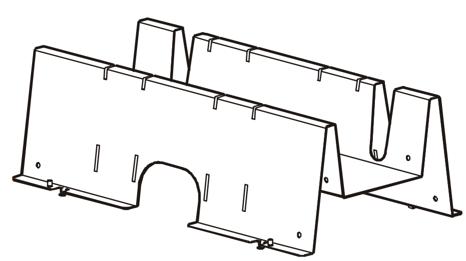
- The PDU Wide Shielding Trough is 610mm in length and is not adjustable. The trough sits on top of the PDU and accommodates power cables as they exit the roof of the PDU. The PDU Shielding Trough is two pieces. The power cables sit in between the two pieces when installed on the roof of the PDU.





- The NetShelter Shielding Trough is 610mm in length and is not adjustable. The Shielding Troughs haves an opening in each side through which you route data cables to the Shielding Partitions.



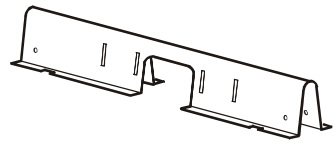


Shielding Trough accessories. APC offers the following accessories for Shielding Troughs:

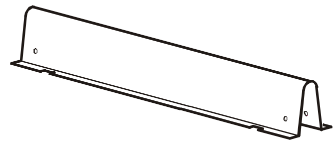
- Shielding Trough Covers for both 600-mm wide (AR8174BLK) and 750-mm wide (AR8175BLK) enclosures. Contact APC for more information.
- Shielding Trough End Caps (AR8167BLK) to place on the side of a Shielding Trough at the end of a row. Contact APC for more information.

Shielding Partitions. There are two types of Shielding Partitions, each of which forms a side wall of a trough for data cables. You can customize the width of the trough for each row of your system — wider for rows carrying many data cables, narrower for rows carrying fewer.

- As the back wall, use a Shielding Partition that contains an opening for routing data cables.



- As the front wall, use a solid Shielding Partition to hide data cables for a clean appearance.

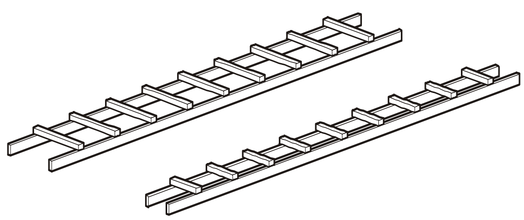


Cable Ladders for overhead wiring across rows

After installing the Shielding Troughs and Shielding Partitions, install the Cable Ladders between rows of enclosures. You can also run Cable Ladders across Shielding Troughs in the same row, using the hardware provided in the ladder kit.

For more information on installing the Cable Ladders, see the instruction sheet included with the Cable Ladders (990-1576).

Use wide Cable Ladders (12 in; 30.5 cm) where many power cables or data cables will run between rows; use narrow Cable Ladders (6 in; 15.2 cm) where few power cables or data cables will run between rows.



The Cable Ladders are 9 feet, 8 inches long. You can adjust the length of the Cable Ladders in the following ways:

- Cut the ends with a hacksaw to shorten them.
- Insert the connectors only partially into the side rails to extend them.

Do not change the spacing between rows or the length and position of the Cable Ladders from the layout you planned with your APC representative when you placed your order. For overhead wiring, each PDU power cable is provided at a pre-determined length. Changes to the physical configuration of your system could cause some PDU power cables to be too short or too long.

Install InfraStruXure Rack-Mount Devices

Install the Rack Automatic Transfer Switches (ATS)

Install a Rack ATS in the top of each enclosure for overhead wiring, and in the bottom of each enclosure for wiring under the floor.

See also

See the installation instructions in the manual included with your Rack ATS.

The Rack ATS is an optional component and not all InfraStruXure systems will include them.

Install the Rack Power Distribution Units (PDU)

Install Rack PDUs in the rear of the NetShelter VX enclosure, in the channel directly behind the rear vertical mounting rails. For overhead wiring, make sure that the power cord is pointing toward the roof of the enclosure. For under the floor wiring, make sure that the power cord is pointing toward the floor.

See also

See the installation instructions in the manual included with your Rack PDU.

Install the InfraStruXure Manager and Hub (or Switch)

Install the InfraStruXure Manager in the enclosure closest to the PDU. The CAT-5 data cables included with your configuration are of varying lengths, based on the distance components will be installed from the PDU.

See also

See the installation instructions in the manual included with your InfraStruXure Manager.

Install the Environmental Monitoring Unit or Environmental Management System

The Environmental Monitoring Unit and the Environmental Management System are optional components and not all InfraStruXure systems will include them.

See also

See the installation instructions in the manual included with the Environmental Monitoring Unit or Environmental Management System.

Route and Attach Overhead Wiring

Route and attach power cables to equipment racks

If you ordered overhead wiring, connect the prewired power cables of the PDU as follows:

1. Install the Shielding Troughs, Shielding Partitions, and Cable Ladders so that you can route power cables from the PDU to the NetShelter VX Enclosures.

   See also For installation instructions, see the manual included with your Shielding Troughs, Shielding Partitions, and Cable Ladders.

2. Find the numbers that indicate the enclosure to which each power cable will supply power. These numbers appear on the roof of the PDU where the power cables exit, and on the ends of each power cable.

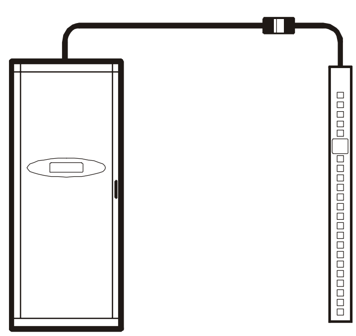
   Note The enclosures are not numbered. Consult your APC InfraStruXure Configure-To-Order (CTO) report to determine the enclosure associated with each power cable.

3. Beginning with the power cables for the enclosures farthest from the PDU, run each power cable within the Shielding Trough along the row and, if necessary, across one or more Cable Ladders to the enclosure to which it will provide power.

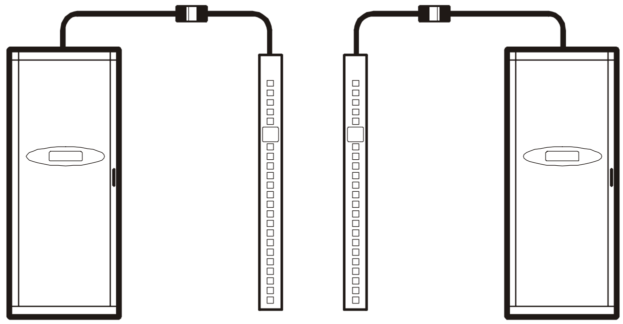
   Note Ensure that the L21-20 twist-lock connector at the end of each power cable always lies on top of any longer power cables in the Shielding Trough.

4. Connect the appropriate power cable to APC power management equipment in the enclosure in one of the four following ways:

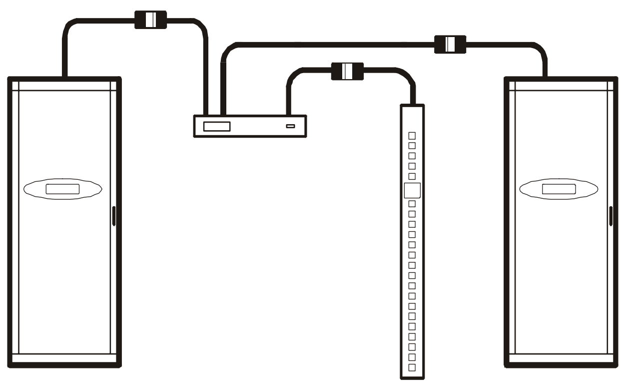
   – *For single-feed devices without redundancy*: attach a power cable directly to a Rack PDU installed in a NetShelter VX Enclosure.



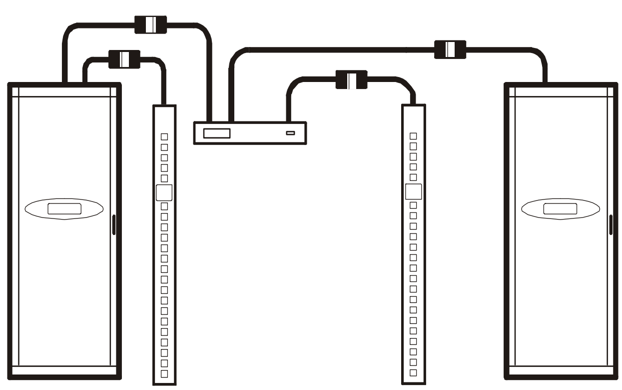
– *For dual-feed devices within a redundant system*: attach a power cable from each PDUto two different Rack PDUs in the NetShelter VX Enclosure.



– *For single-feed devices within a redundant system with an Automatic Transfer Switch*: connect a power cable to the Automatic Transfer Switch (A and B feeds) and connect the Automatic Transfer Switch power cord to a Rack PDU in the NetShelter VX Enclosure.



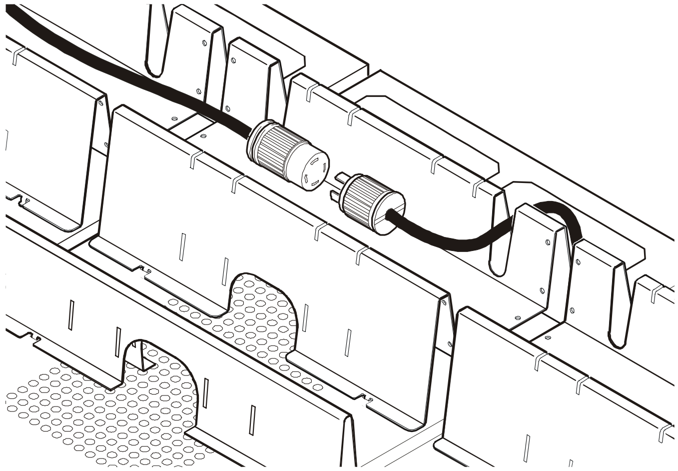
– *For dual-feed devices in a redundant system with an Automatic Transfer Switch*: connect a power cable from each PDU to the Automatic Transfer Switch's A and B feeds, and another power cable from one PDU to a Rack PDU, and the Automatic Transfer Switch's power cord to a second Rack PDU in the NetShelter VX Enclosure.



Note

Lay the cables neatly in the Shielding Trough to minimize cable build-up.

5. From each NetShelter VX Enclosure, run the power cable of the appropriate APC power management device out the roof of the enclosure, through the notch in the rear side of the Shielding Trough, to the connector of the appropriate power cable from the PDU. Plug the two connectors together, and twist them clockwise to lock.



Note

The APC InfraStruXure Build-Out Tool allows you to attach three 20A, single-pole breakers to one three-phase power cable if you are powering 120V (L-N) loads. However, if you are powering 208V (L-L) loads, you must attach a three-phase power cable to one three-pole, 20A breaker.

Wiring Under the Floor

Electrical Hazard

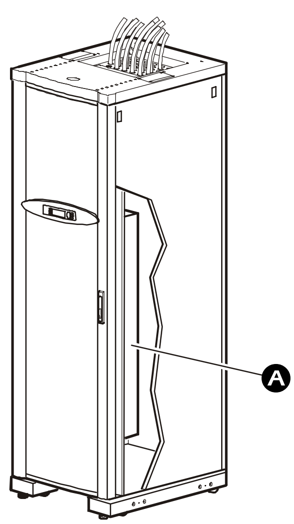
A licensed electrician must route and connect the power cables for under-floor wiring.

Warning

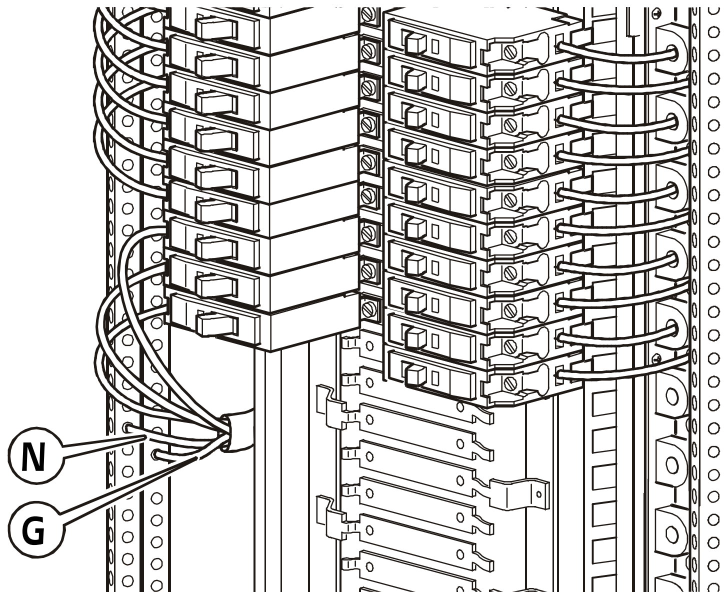
Make sure all wire connections and circuit breaker connections are properly torqued.

If you are routing power cables to the enclosures under a raised floor, you must provide the appropriate power cables and equipment for installation, and a licensed electrician must route and connect the power cables to the PDU circuit breakers. To wire each power cable to an enclosure:

1. Push out a knock-out filler in the floor of the PDU to create an opening for the cable.
2. Install Liquidtite™ waterproof conduit under the floor from each enclosure to the PDU.
3. From the Rack PDU or Rack ATS in each enclosure, thread the appropriate power cable (for your application) from the enclosure through the Liquidtite conduit to the PDU.
4. At the PDU, route the cable through the opening you created in step 1 and then up through the wireway (A) at either side of the PDU. This will allow you to connect cable to the upper circuit breaker panel.



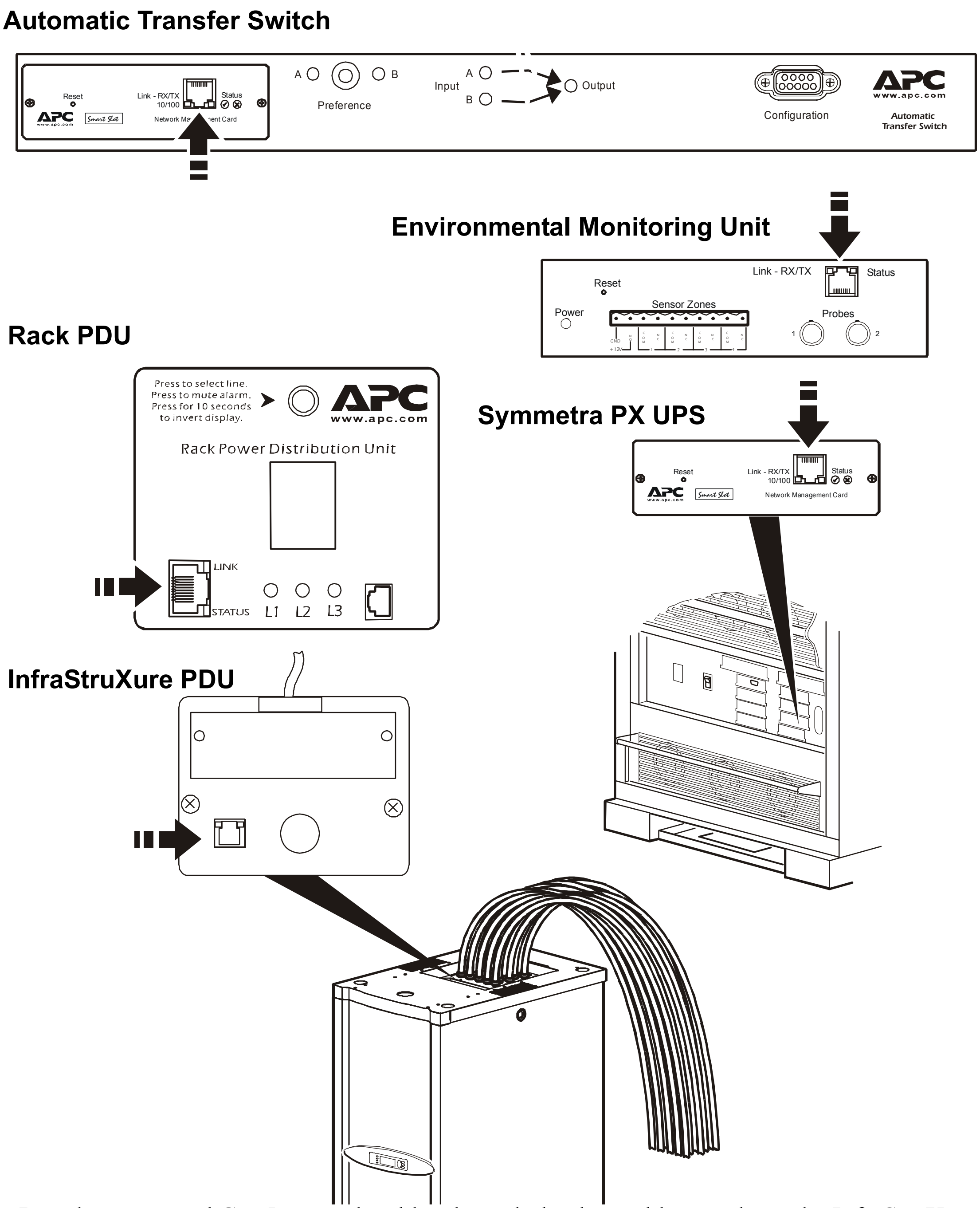
5. At the circuit breaker panel, cut the wires to the proper length, and connect the power cable's individual wires:
   a. If you have branch current monitoring installed, route each phase conductor through a current sensor. If it is a three-phase cable, route the L1, L2, and L3 wires through a separate current sensor.
   b. Connect the L1, L2, and L3 wires to the circuit breaker(s). The illustration below shows a three-phase cable connecting to three single pole breakers; however, you can also connect a three-phase cable to a three-pole breaker, or a single-phase cable to a single-pole breaker.
   c. Connect the neutral wire to the closest open termination point on the Neutral Bar (N).
   d. Connect the ground wire to the closest open termination point on the Ground Bar (G).



Note: Any customer-specified, hard-wired, multi-circuit power cable that is installed by an electrical contractor must be installed with a 3-pole circuit breaker.

Route Data Cables to the InfraStruXure Manager Hub (or Switch)

1. Connect a Cat-5 network cable (provided) to the network or 10Base-T ports on your APC InfraStruXure devices. The following devices need to be connected:



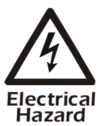
2. Run the connected Cat-5 network cables through the data cable troughs to the InfraStruXure Manager Hub (or Switch).
3. Connect each device's network cable to any available station port in the InfraStruXure Manager Hub (or Switch). Station ports are those with an *x* after the number (e.g., 2x).

Start-Up Procedure

Safety warnings

This section provides instructions on how to perform a system start-up. Do not skip any steps in this procedure.

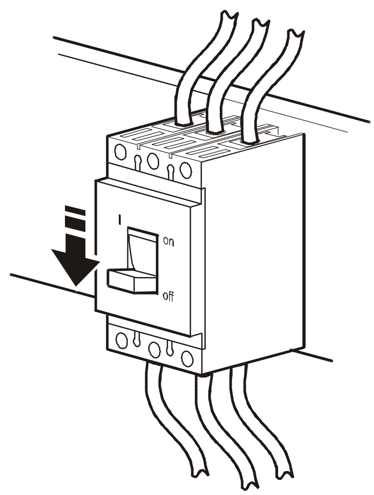
Only APC Field Service Engineers or qualified, APC-trained personnel may perform a system start-up.



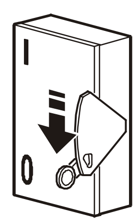
Before you proceed, ensure that power is off by following the procedure in this section.

Ensure that all power is off

1. Set the PDU **Main Input** to OFF.

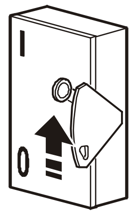


2. Set the upstream input circuit breaker (utility or UPS) to the OFF or Locked Out position.

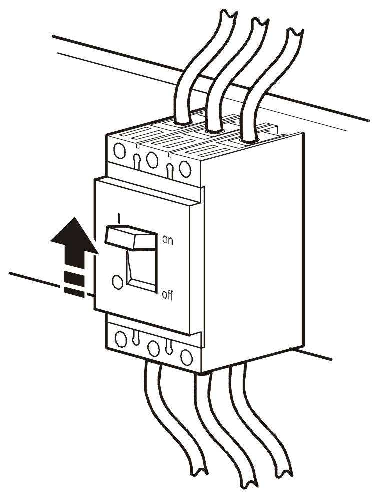


Apply power to the system

1. Set the upstream input circuit breaker (utility or UPS) to ON.

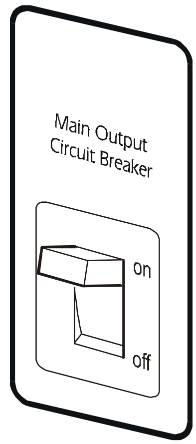


2. Ensure A-B-C clockwise phase rotation at the top of the **Main Input** on the PDU, using a phase rotation meter.
3. Set the **Main Input** on the PDU to ON.



4. Verify A-B-C clockwise phase rotation at the top of the primary winding of the transformer, using a phase rotation meter.
5. Verify that the proper voltage is present on the secondary winding of the transformer (208 V, metered phase-to-phase), using a true RMS voltmeter.

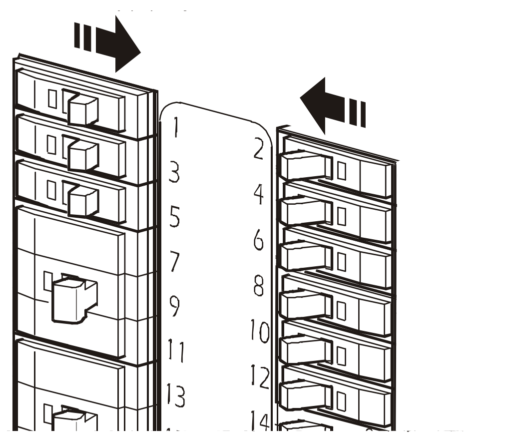
6. If applicable, set the **Main Output** circuit breaker on the PDU to ON.



Note

When the **Main Output** circuit breaker is closed, the power distribution circuit breaker panels are energized.

7. Close (turn ON) the PDU **distribution panel** circuit breakers.



Note

When the distribution panel circuit breakers are closed, the PDU power cables and connected equipment are energized.

Configure the InfraStruXure Manager

Once all equipment is installed, the network cables are connected to the InfraStruXure Manager hub (or switch), and start-up of the system is complete, configure the InfraStruXure Manager.

See also

For instructions, see the *InfraStruXure Manager Installation and Quick-Start* manual included with your InfraStruXure Manager.

Note

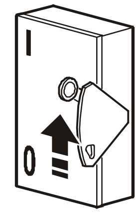
If you use PowerChute Network Shutdown (PCNS) software with your InfraStruXure UPS, your UPS must have a connection to the “User LAN” (public network) for PCNS to function correctly. If the Network Management Card installed in your UPS is connected to the InfraStruXure Manager’s “APC LAN,” you must install a second Network Management Card in your UPS and connect it to the “User LAN” (public network) to use PCNS.

Appendix A: Operation

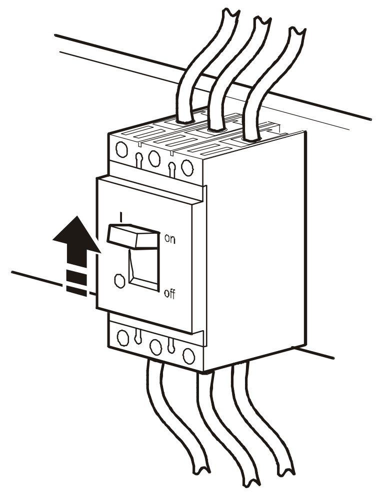
How to Apply Power to the System

This procedure instructs on how to apply power to a system that has already been installed. For initial start-up instructions, see the Start-up section of this manual.

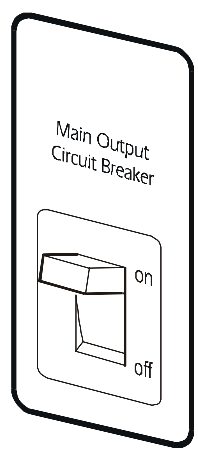
1. Close (turn ON) the main circuit breaker of the **power source** supplying power to the PDU.



2. Set the **Main Input** on the PDU to ON.



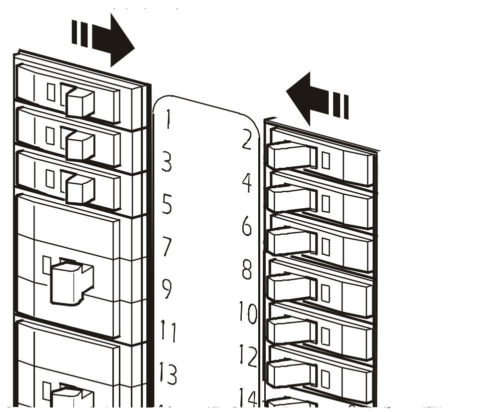
3. Power the PDU distribution circuit breakers:
   a. *For* PDU *with transformer*: Set the **Main Output** circuit breaker on the PDU to ON.



Note

After the **Main Output** breaker has been closed, both PDU distribution panels will be energized.

b. *For PDUs with and without a transformer:* Close (turn On) the PDU **distribution panel** circuit breakers.

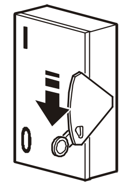


Note

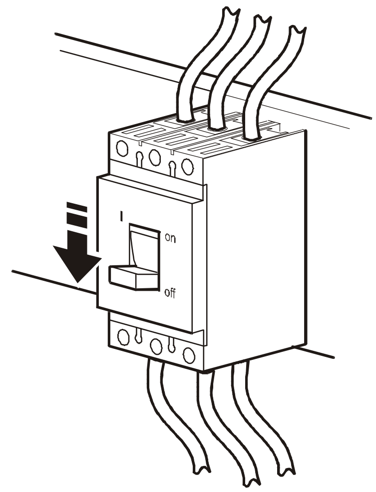
When the **distribution panel** circuit breakers are closed, the PDU power cables and connected equipment are energized.

How to Ensure Total Power Off

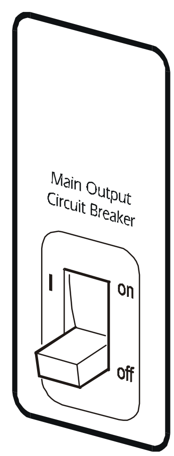
1. Open (turn OFF) the main circuit breaker on the **power source** feeding the PDU.



2. Set the **Main Input** on the PDU to OFF.



3. *For PDU with transformer*: Set the **Main Output** circuit breaker on the front of the PDU to OFF.



Appendix B: Changes in This Manual

Overview

The following list references the specific changes made to this manual since its last release (990-1638A).

General changes

An index was added to the end of this manual. See pages 43–44.

Changes by page number

Pages 18–21	Updated section on connecting the EPO switch to the user connection plate.
Pages 22–23	Replaced “Connect User Contacts to the PDU Monitoring Unit” with “Connect User Input Contacts and Relay Outputs to the User Connection Plate.”

Index

T

U

W

APC Worldwide Customer Support

Customer support for this or any other APC product is available at no charge in any of the following ways:

- Visit the APC Web site to access documents in the APC Knowledge Base and to submit customer support requests.
  - **www.apc.com** (Corporate Headquarters)

    Connect to localized APC Web sites for specific countries, each of which provides customer support information.
  - **www.apc.com/support/**

    Global support searching APC Knowledge Base and using e-support.
- Contact an APC Customer Support center by telephone or e-mail.
  - Regional centers:

Direct InfraStruXure Customer Support Line	(1)(877)537-0607 (toll free)
APC headquarters U.S., Canada	(1)(800)800-4272 (toll free)
Latin America	(1)(401)789-5735 (USA)
Europe, Middle East, Africa	(353)(91)702000 (Ireland)
Japan	(0) 35434-2021
Australia, New Zealand, South Pacific area	(61) (2) 9955 9366 (Australia)

  - Local, country-specific centers: go to **www.apc.com/support/contact** for contact information.

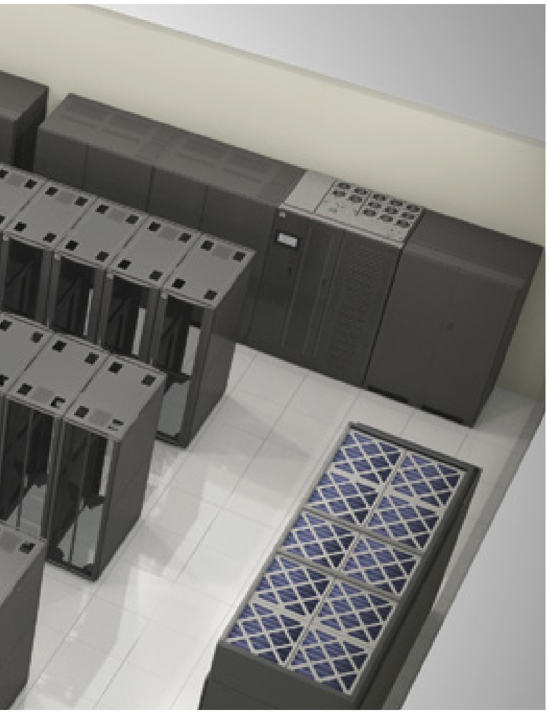
Contact the APC representative or other distributor from whom you purchased your APC product for information on how to obtain local customer support.

990-1638B

06/2004

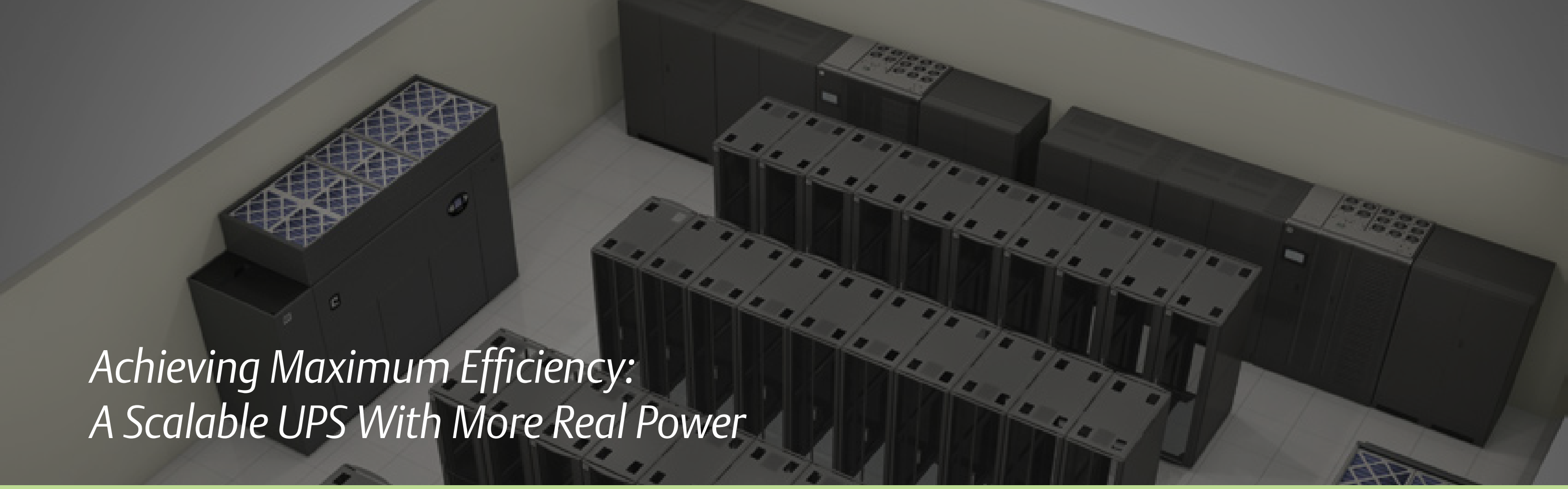
Liebert® NX™, 225-600 kVA/kW UPS

Maximum Efficiency in a transformer-free, High Efficiency, Scalable On-line UPS



EFFICIENCY. AVAILABILITY. CAPACITY

EMERSON
Network Power



Achieving Maximum Efficiency: A Scalable UPS With More Real Power

Every business has unique needs for their data center. Frequently, these needs focus on maximum protection in terms of availability or providing maximum efficiency in terms of significant operating savings and low total cost of ownership.

The Liebert® NX™ UPS is a scalable system with features that make it the right solution for a Maximum Efficiency data center – with a design that supports high operating efficiency, lower TCO, and intelligent operation.

- Cost-efficient operation
- Flexibility to match increasing power demands
- Small footprint
- Liebert Services support

The Liebert NX 225-600 kVA UPS is ideally suited for:

- Mid to large data centers
- Server rooms
- Production areas
- Labs and testing facilities
- Telecommunications

- **Active Eco-Mode is standard in every system** – no upcharge for this feature or for the continuous-duty static switch
- **More watts for your money** – Unity Power Factor rated
- **Reduced operating costs** – up to 95% efficiency at partial load, and 98% efficiency in Active Eco-Mode
- Optimizes PUE through loweroperating losses and reduced cooling requirements

EFFICIENCY & ECONOMY

Lowest Total Cost of Ownership

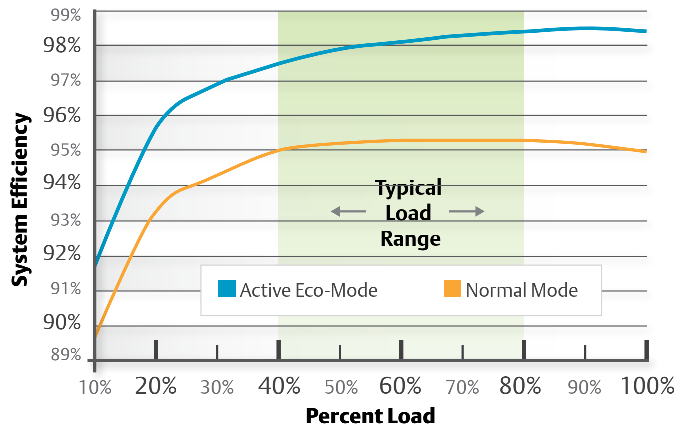
- Provides high efficiency in both double conversion and Active Eco-Mode operation – up to 98% efficiency.
- Active IGBT Rectifier reduces size requirements for generator sets, circuit protection, cabling and transformers, minimizing installation and operation costs.
- Optimizes battery life with temperature-compensated battery charging in both double conversion and Active Eco-Mode.
- Supports a full range of leading and lagging power factor loads without derating.
- Unity input and output power factor ratings deliver more real power for your money.

The Liebert NX 225-600 kVA no-break Active Eco-Mode is optimized for the transformer-free design in three important ways:

- The rectifier stays on to provide maximum power on-demand if the inverter should need to take the load.
- The battery charger is always able to maintain charge for optimal battery life.
- Active Eco-Mode is no-break, so the inverter remains energized and synchronized with the input for fast transfer to full double-conversion mode.

When compared with the efficiency mode design used by others, the Liebert NX balanced approach provides excellent dynamic response, avoids potential battery damage while providing fast seamless transitions, and still delivers significant energy savings.

Efficiency Curve for Liebert NX UPS



Liebert NX delivers extremely high efficiencies in both normal mode and Active Eco-Mode™ operation.

Standard and Optional Features Ensure System Availability

AVAILABILITY

Higher Availability

- True on-line, double conversion technology corrects for all types of power fluctuations.
- Provides the highest output power quality, with advanced inverter control technology.
- Optional dual bus synchronization of multiple UPS units when feeding independent distribution paths.
- Continuous-duty static switch standard - enables Ecomode operation, and is more robust and reliable than a momentary static switch design.
- Higher overload capacity results in more robust operation.
- Seismic certification - models available with OSHPD approval for use in essential facilities.

Liebert® NX™ Matching Battery Cabinet

- System matched for all Liebert NX UPS.
- Optional Albér® BDSi™ integrated battery monitoring.
- Breaker for safe battery service without shutdown.
- Parallelable for extended runtime or redundancy.
- Internal bussing between attached cabinets to minimize site wiring.

Battery Monitoring – Albér BDSi and Albér BDS-256-XL

Preventing battery failure is essential for delivering maximum availability and effective data center management. Albér battery monitoring technologies continuously monitor battery health, allowing proactive battery replacement and optimized availability.

- Continuously monitor and diagnose battery parameters.
- Ensure that data center personnel are informed of battery health.
- Also allows for battery monitoring management by Liebert Services, ensuring proper, timely maintenance by local, trained Customer Engineers.

Flywheel – Battery-free alternative

- Less than 30 second runtimes or battery cycling protection.
- Placement flexibility - small footprint; no special space conditioning requirements; light weight.
- Low maintenance; over 20 year life.
- Parallel with lead-acid battery to limit battery cycling.
- Parallelable for capacity and redundancy.

Liebert NX Power Conversion Cabinet. Add matching battery cabinets and bypass/distribution cabinet to create a robust, flexible UPS system.

Liebert NX Matching Battery Cabinet

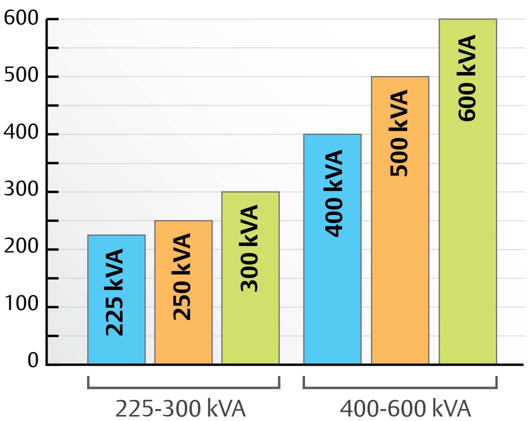
Albér BDSi Integrated Battery Monitoring for Liebert NX Matching Battery Cabinets

Vycon Flywheel Solution

Designed For Ease of Installation, Operation And Service

FLEXIBILITY

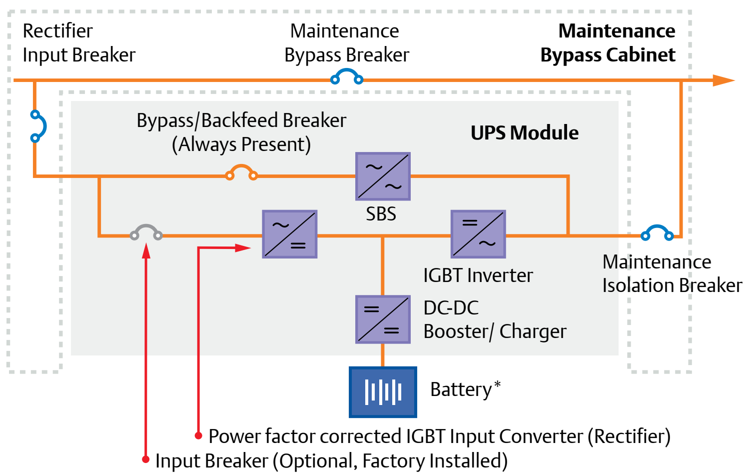
- Softscale technology conserves capital while providing an economical expansion path with minimal disruption.
- Simple 1+N paralleling provides low initial cost and additional levels of redundancy.
- Parallel up to 6 systems for capacity or redundancy.
- High power density and small footprint deliver more kilowatts per square foot for efficient space utilization.
- Automatically adapts to dynamically changing load power factors (leading and lagging) without derating, modification or recalibration.



Growth through Softscale:
Step One Step Two Step Three

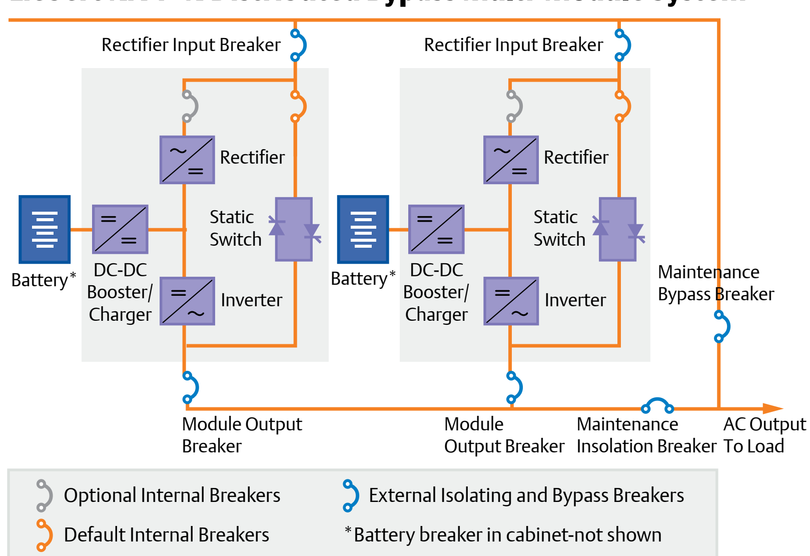
> Softscale technology allows your system to efficiently grow with IT operations without adding to the system footprint

Single Module System



The Liebert® NX™ 225-600 kVA is designed for use with an external maintenance bypass cabinet to assure compliance with the latest OSHA requirements.

Liebert NX 1+N Distributed Bypass Multi-Module System



The Liebert NX 225-600 is offered with 1+N multimodule capability. This design uses distributed static switches in each module, which provides a low initial cost due to simplified paralleling switchgear. It also provides high reliability due to the redundancy of all UPS functional blocks including the static switch. The static switches in the Liebert NX 225-600 are 100% continuous duty rated (based on capacity of the UPS module).

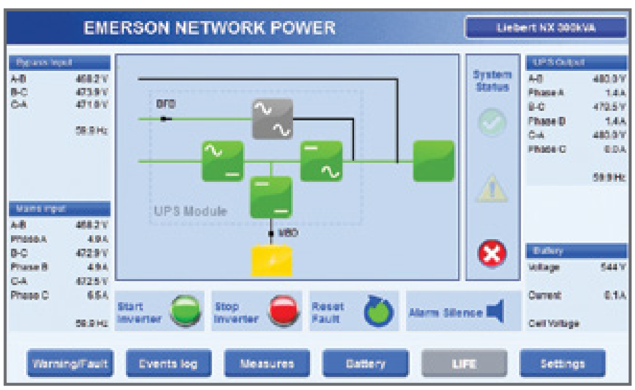
Monitoring Capabilities Keep You Informed And In Control

Simple and Comprehensive Monitoring

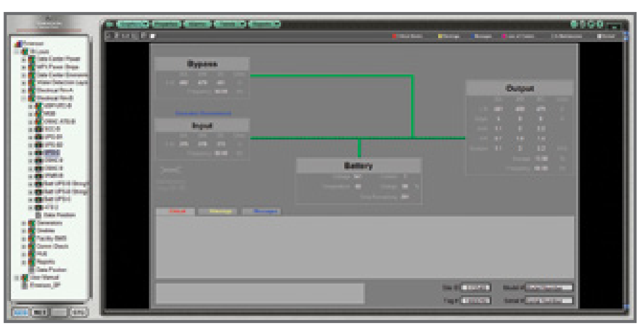
The menu-driven 9" touch screen monitor panel on Liebert® NX™ is large and easy to read. Multiple parameters are monitored; data is recorded, stored and easily viewable. Unit metering and status information is displayed in a logical format, and is selectable in English, Spanish, French, and Portuguese.

The UPS also Includes two Liebert IntelliSlot ports for web-based communications ability:

- Liebert SiteScan® centralized monitoring option – software offers maximum control, monitoring and visibility to Liebert NX.
- Liebert Nform™ centralized monitoring option – enables authenticated alarm management, trend analysis and event notification to support effective infrastructure monitoring.



Large intuitive, interactive display with on-line help.



Liebert SiteScan Centralized Site Monitoring Provides Visibility and Control of All Data Center Support Equipment.

Embedded LIFE™ Technology

Ensures that your critical power protection system is maintained in an optimum state of readiness at all times.

Service enabled by LIFE™ Technology delivers increased uptime and operational efficiency through continuous monitoring, expert data analysis, and field engineer expertise.

IMPROVE RELIABILITY

Service enabled by LIFE™ Technology provides early warning of more than 150 separate parameters, allowing real-time diagnosis and swift identification, and resolution of operating anomalies–leading to an increased mean time between failures (MTBF).

MINIMIZE DOWNTIME

Should an emergency condition arise, an engineer in the 24/7 manned service center carries out an immediate fault analysis and initiates appropriate corrective action to quickly, safely, and accurately restore the equipment to its proper operating condition, significantly reducing the mean time to repair (MTTR).

ACTIONABLE INFORMATION

LIFE™ Technology provides operational data and events at regular intervals. This information is analyzed by product experts in service center. Any anomalies in data is triaged using a comprehensive technical knowledge base. The goal is to provide a recommendation to correct the situation, and in some cases even dispatch, trained field service engineer to take corrective action.

Tested To Be The Best

QUALITY

The Liebert® Power Systems Test Center

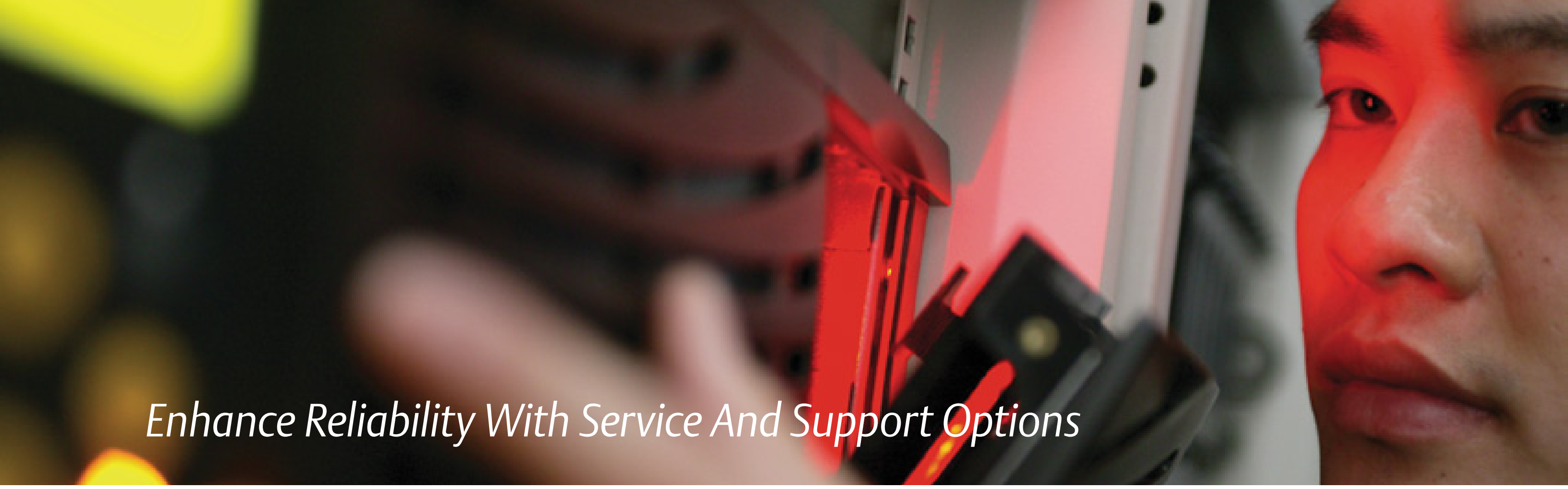
The Liebert Power Systems Test Center for large UPS systems is a state-of-the-art test facility designed to provide customers with pre-installation testing of the performance, interoperability, and efficiency of Liebert UPS modules and systems under a variety of conditions. Located in Delaware, Ohio, the 25,600 square-foot facility, including a 2,600 square-foot customer observation station, is the largest and most comprehensive in the industry.

Testing includes individual modules as well as the complete power system — including large UPS units such as the Liebert NX™, Liebert STS2 static transfer switches and associated switchgear support systems — and is essential to the smooth, rapid installation and commissioning of large power systems. Customers leave the Liebert Power Systems Test Center with documented proof and confidence that their complex power system will operate seamlessly in accordance with business-critical availability requirements.

Offering you the UPS industry's largest power systems testing center is another way that Emerson Network Power strives to make sure our product solutions are a perfect match for your critical power requirements.

Typical UPS system verification, testing and test capabilities include but are not limited to the following:

- DC functions.
- Transfer functions.
- Alarms and display verification.
- Parallel module tests.
- Module and system Internal fault testing such as component failures or power supply failures.
- Module and system loading from no load up to 150% load.
- Unbalanced loading.
- Battery discharge simulation.
- Module and system step loading from 0 to 100%.
- Integrated tests with UPS, flywheels, switchboards, static switches, power distribution, etc.
- Integrated Load Bus Sync testing with multiple UPS systems.
- Integral switchgear testing.
- Power quality meters.
- Power monitoring.
- Mimic panels.
- Current and voltage harmonic analysis.
- Key interlock systems.
- PLC or relay based transfer controls.
- Module and system level full load heat runs.
- Infrared scanning.
- Thermal scanning.



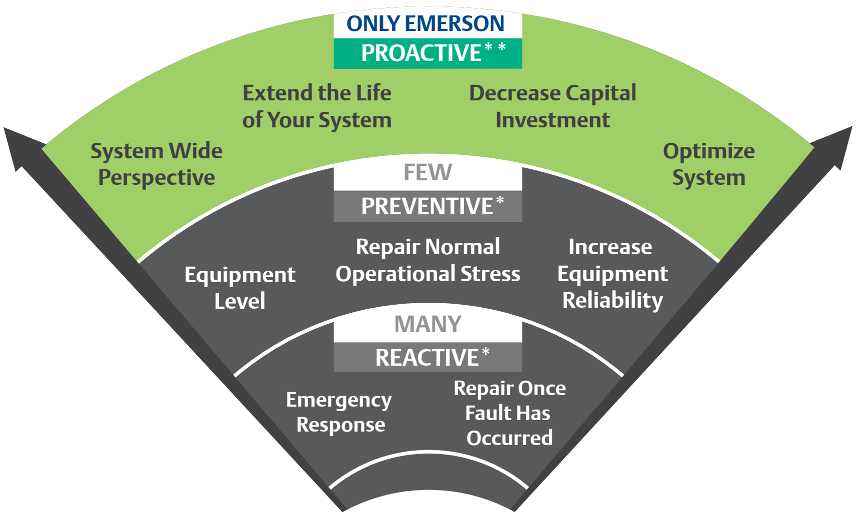
Enhance Reliability With Service And Support Options

SUPPORT

Maximizing the performance and efficiency of your data center's uninterruptible power supply (UPS) and other power distribution systems requires they be properly maintained by factory-trained technicians.

Emerson Network Power, Liebert® Services has the only service organization in the world that has been factory trained on Liebert power equipment and is continuously supported and updated by the engineers who built the equipment.

No one knows your Liebert equipment better than we do. We are the service arm of the Liebert equipment manufacturer, we are the factory. Our Customer Engineers have a better knowledge of how to maintain Liebert equipment and integrate it into the overall data center infrastructure support strategy than any service provider.



The Emerson Difference

Many service organizations can perform basic repair activities and maintain equipment at some level of competency, but Emerson Network Power, Liebert Services can take your critical maintenance to the next level — proactive maintenance that can significantly extend the life of your power systems, decrease your capital investment, optimize system efficiency and effectiveness, and increase overall system availability.

Emerson Network Power, Liebert Services

Industry Experience
As long as data centers have existed, Liebert Services has been supporting data center infrastructure and providing integrated services for mission-critical environments.

System Wide Expertise
Nobody understands Liebert power equipment, precision cooling units and electrical infrastructure better than the experts at Liebert Services.

Technical Expertise
Our knowledge of systems and how they integrate into your overall facility makes us uniquely qualified to apply the latest technology and best practices to your power, precision cooling, and battery systems.

Unparalleled Responsiveness
With Liebert Services, you have 24/7 access to a network of data center infrastructure specialists armed with the knowledge and parts to resolve your problems. Anytime. Anywhere.

Fast, Efficient Problem Resolution
Only Liebert Services offers the right combination of industry, system, and technical expertise along with the extensive resources necessary to identify and understand any data center need and provide proactive solutions.

Liebert® NX™ System Specifications

System Rating kVA(kW)		225(225)	250 (250)	300 (300)	400 (400)	500 (500)	600 (600)
Maximum Upgradable Capacity (Softscale units only)		300 (300)	300 (300)	N/A	600 (600)	600 (600)	N/A
General Specifications							
UPS Technology		Online Double Conversion with Energy Optimization Mode Capability					
Battery Technology*		Non-Spillable, Flame Retardant, Valve Regulated Battery, 10- and 20-Year Design Life; Flooded Cells; Flywheels					
AC-AC Efficiency		Up to 95% in double-conversion mode; up to 98% in Active Eco-Mode					
Input AC Specifications							
Power Factor		>0.99 at full load					
Nominal Input Voltage VAC		480 V, 3-wire +Ground					
Input Voltage Range VAC		480 VAC, 3-wire plus Ground +10%, -15%**					
Frequency		60 Hz					
Input THDi		< 3% Double Conversion Mode					
Nominal Input Current	**SoftScalable**	380A	380A	380A	760A	760A	760A
	Fixed Capacity	285A	317A		506A	633A	
Maximum Input Current	**SoftScalable**	399A	399A	399A	799A	799A	799A
	Fixed Capacity	299A	332A		530A	663A	
Output AC Specifications							
Nominal Output Current	**SoftScalable**	361A	361A	361A	722A	722A	722A
	Fixed Capacity	271A	301A		481A	601A	
Power Factor Rating		1.0					
Loads Supported		0.7 Leading to 0.7 Lagging without derating					
Physical Specifications							
UPS Dimensions (WxDxH) in. (mm)		53.2 (1,350) X 33.5 (850) X 76.8 (1,950)			90.6 (2,300) X 33.5 (850) X 76.8 (1,950)		
UPS Weight lb (kg)		2,425 (1,100)			4,800 (2,177)		
Matching Battery Cabinet Dimensions (WxDxH) in. (mm)		Top Terminal: 56.3 (1,430) X 33.5 (850) X 76.8 (1,950)					
		Front Terminal: 68.8 (1,750) X 33.5 (850) X 76.8 (1,950)					
Battery Weight – Per Single Cabinet Max-lb (kg)		Top Terminal: 5,140 (2,331)					
		Front Terminal: 8,990 (4,076)					
Monitoring Specifications							
UPS Monitoring		Optional: SNMP/Web, Modbus RTU, Modbus 485, SiteScan, Nform					
Environmental Specifications							
Operating Temperature Range °F (°C)		32 to 104 (0 to 40)					
Storage Temperature Range °F (°C)		-4 to 104 (-20 to 40)					
Audible Noise		70 dBA					
Safety Certification		UL 1778, CSA C22.2 NO. 107.3-05					
Seismic Certification | OSHPD:		IP = 1.5, (Fp/Wp) =1.63, SDS = 2.27, ap = 1.0, Rp =2, Ω0 = 2.5, z/h = 1.0					
Product Support							
Warranty		1 Year, Full Parts and Labor					

*Contact Liebert sales representative or contact factory for application support for flooded cells.
**Conditions apply.

Consulting-Specifying engineer 2013 PRODUCT OF THE YEAR FINALIST

Emerson Network Power Global Headquarters
1050 Dearborn Drive
P.O. Box 29186
Columbus, Ohio 43229
United States Of America
800 877 9222 Phone (U.S. & Canada Only)
614 888 0246 Phone (Outside U.S.)
614 841 6022 FAX
Contact@EmersonNetworkPower.com

Emerson Network Power Caribbean and Latin America
Office – United States of America
+1-954-984-3452 Phone
Ask.Cala@Emerson.com

Emerson Network Power Canada
3580 Laird Rd Unit 1
Mississauga
Ontario L5L 5Z7
+1 905 569 8282
Ask@EmersonNetworkPower.com

liebert.com
24 x 7 Tech Support
800 222 5877 Phone
614 841 6755 (outside U.S.)

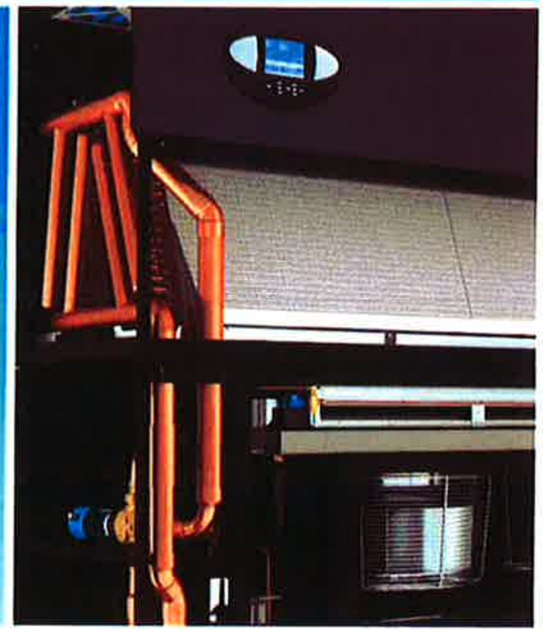
EmersonNetworkPower.com

ELECTRICAL CUT SHEETS

Precision Cooling
For *Business-Critical Continuity*™

Liebert® CW™ 26-181kW

Chilled Water Cooled Precision Air Conditioning For Data Centers



EMERSON.
Network Power

A Chilled Water Precision System That Handles The Most Demanding Conditions

Based on the historically reliable design of the Liebert Deluxe System/3, the Liebert CW continues this reputation for dependability, and improves upon the design with energy saving upgrades. The Liebert CW chilled water based precision cooling system is specifically designed to handle the high heat loads generated by computers and other electronic equipment, using an existing building chiller as a source of chilled water cooling.

Built to the highest specifications in the industry with proven components and design, the Liebert CW is ideal for critical applications including:

- Data centers
- Telecommunications central switching offices.
- Industrial process control centers.
- Laboratories.
- Medical facilities.

EC Plug Fans are available on downflow models. Shown in underfloor configuration.

The Industry's Premier Chilled Water System

Flexibility

- Provides a complete environmental control package, including both precision air conditioning and humidity control.
- Both upflow and downflow configurations are available to cover raised floor and non-raised applications.
- Liebert iCOM control system brings high-level supervision to multiple units, allowing them to work together as a single system to optimize room performance.

Higher Availability

- Designed with the highest quality components selected for their proven reliability and performance.
- Provides around-the-clock operation to protect critical installations.
- Operates with a high sensible heat ratio, assuring that proper humidity levels will be maintained.
- Liebert iCOM control system adds automatic sequencing of components to even wear and extend service life.

Lowest Total Cost of Ownership

- Uses existing building chilled water systems to provide cooling.
- Higher efficiency fan options include EC Plug Fan on larger downflow models and variable speed drive centrifugal fans available on all models.

Service Solutions

Liebert Services capabilities can increase the availability of your precision cooling equipment by reducing downtime due to component failure. This is especially valuable to companies who do not have a dedicated technician on-site to troubleshoot equipment. Field service is provided by a nationwide network of locally-based, factory-trained technicians for installation, support and maintenance of Liebert precision environmental products. Liebert Services offerings include warranty service, emergency coverage and preventive maintenance. We also offer an environmental equipment site management program that creates a customized solution for your site by offering a single point of contact for your service needs.

A Choice Of Configurations

More Configurations to Fit More Applications

High performance, sensitive electronic equipment requires precise, reliable control of room temperature, humidity and airflow for proper operation. Liebert CW meets these needs for environmental control in computer dependent operations. It is available in sizes from 26-181kW, and in airflow configurations to meet unique applications.

Downflow Supply

Designed for raised-floor applications, the downflow air supply configuration is commonly found in data centers and other similar facilities housing sensitive electronic equipment.

EC Plug Fans — Under Floor Configuration

With EC Plug Fans below unit in raised floor space, the system is 30 percent more energy efficient than centrifugal blowers, while providing more efficient airflow.

EC Plug Fans — In-Unit Configuration

Designed for applications with limited under floor space, the fans are located within the Liebert CW unit itself. This configuration provides significant energy savings over standard centrifugal fans.

Centrifugal Fans With Variable Speed Drives

Variable speed fans are located within the Liebert CW unit. This option offers considerable savings over standard fans, and is available for both upflow and downflow system configurations.

Top Front Supply With Plenum & Grille And Front Return

In-the-space applications without ductwork, such as Telecommunications, Networks and Switching Centers, benefit from this economical configuration. Optional high filtration may be desirable.

Top Front Supply And Front Return

Engineered for in-the-space applications utilizing duct work, this airflow design is commonly used for Telecommunications or Industrial applications. High static pressure and filtering options may be selected.

Top Rear Supply And Rear Return

Designed for use in out-of-space applications, this configuration is typical for Industrial Processes such as Control Rooms, and Labs. Many of these sites will select a higher static pressure and optional high efficiency filters. (Customer ducted supply and return)

Top Front Supply With Plenum & Grille And Bottom Return

Specifically designed for use in raised floor, in-the-room applications, this configuration takes advantage of typical computer room construction. Additional filtering may be requested to protect sensitive computers and peripherals.

Economical Chilled Water Systems

By taking advantage of your existing central air conditioning chiller, the Liebert CW provides economical, durable cooling and humidity control around the clock, throughout the year.

The Liebert CW chilled water system offers rugged, yet affordable cooling and humidity control where a central water chiller is available as a year-round cooling source. In these applications, a single chiller can be used for multiple air conditioning units, providing savings on additional heat rejection components.

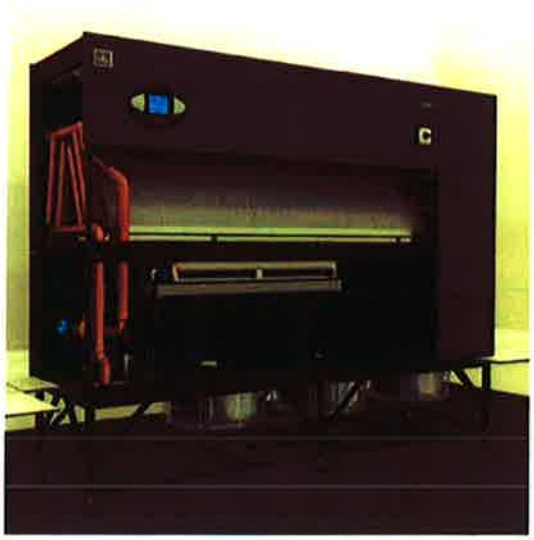
The full line of Liebert chilled water systems use Liebert iCOM microprocessor-based controls to maintain precise temperature and humidity levels, while the cooling hardware is designed and built for continuous, trouble-free operation.

More Cooling Capacities

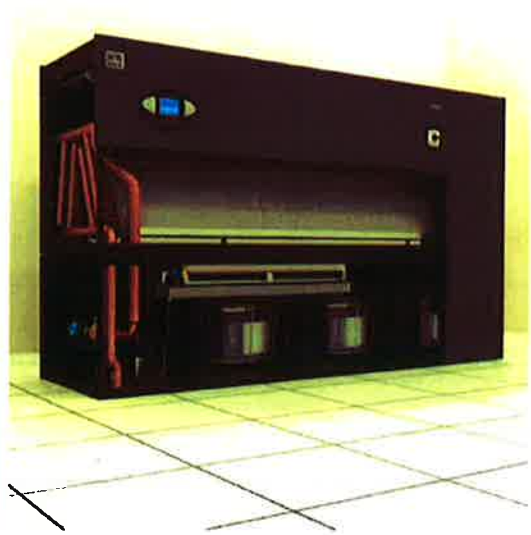
Available in ten cooling capacities, with either upflow or downflow configurations.

Chilled Water Control Valve

The chilled water valve provides proportional control action in response to room temperature and humidity as sensed by the microprocessor control. It includes operating linkage and electronic motor. Unlike other systems of this nature it requires no over-travel linkage or end switches to be adjusted. The control uses "intelligent logic" to eliminate valve hunting, thus greatly increasing the life of the valve. The valve can be a 3-way or 2-way to meet the appropriate requirements of the installed system.



EC Plug Fans in underfloor configuration
(available on downflow models)



EC Plug Fans in-unit configuration
(available on downflow models)

Every Feature Contributes To Absolute Reliability

When the demand is for around the clock operation, you simply can't take shortcuts. Liebert CW is designed with robust components that operate reliably under the most demanding conditions, ensuring uptime for sensitive electronics in critical applications.

Fans And Motors

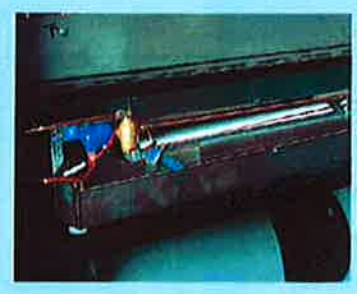
Clean, even air distribution is supplied by large capacity fans, which are balanced to minimize vibration. The fans draw filtered air through the system. An EC Plug Fan option is available for Liebert CW downflow models.

Draw-Through Airflow

The fans draw air evenly and at low velocity through the cooling coil, reheat and humidification systems. The result is fat less turbulence with superior efficiencies in heat transfer. Clean air at the right temperature and humidity is fed positively and evenly into the room.

A-Frame Coil

This Liebert designed and manufactured A-Frame coil features a large face area/low face velocity design for maximum cooling and even air distribution.

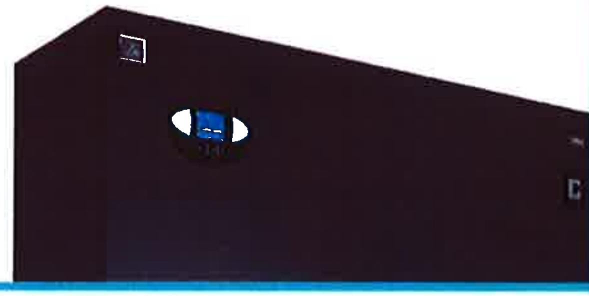


Infrared Humidifier

The infrared humidifier design consists of quartz lamps mounted above a stainless steel water reservoir. The lamps never come in contact with the water. When humidification of room air is required, infrared rays generate water vapor—without impurities or odor, within seconds.

Premium efficiency centrifugal fans, and optional Variable Speed Drive fan motors, are available on all models

Liebert iCOM®



Optimizing Cooling System Performance For Efficiency And Energy Savings

The Liebert iCOM control system offers a variety of advantages:

- Saves energy using predictive humidity control.
- Built-in lead/lag functions for enhanced system reliability.
- Wellness calculation alerts service personnel before problems occur.
- Unit-to-unit communications allows teamwork settings to keep multiple units working together to optimize energy efficiency.

iCOM At A Glance

The Status menu shows setpoints, environmental conditions, operational status, alarm conditions and system health.

- Graphical view
- Simple view
- Display icons
- Access levels—user, service, advanced
- Help menu layout
- Temperature and humidity graphs
- Online help menus

Small Graphic Display Model

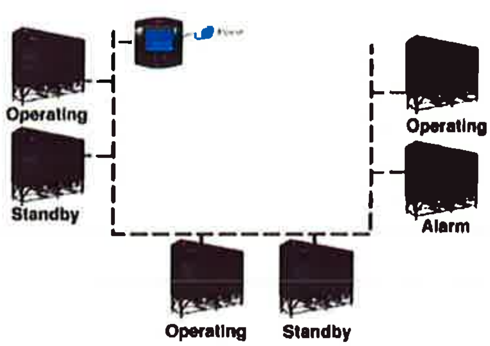
The Liebert iCOM with small display has a 128 x 64 dot matrix screen that simultaneously shows two menu icons, along with descriptive text. This display is capable of controlling only the unit it is directly connected to. Views include:

- Event log
- Temperature and humidity graphs
- Standby/lead/lag
- Unit wellness
- Service contact information

Large Graphic Display Model

The Liebert iCOM with large display has a 320 x 240 dot matrix screen that shows up to 16 menu icons at a time, as well as descriptive text. This display can be used to control a single cooling unit or any cooling unit on a network, regardless of how it is connected—either integrated into a cooling unit or simply connected to the network and mounted remotely. It provides the same information as the small display plus these additional views:

- Spare parts list
- Unit diary
- View status of all cooling units
- Control any cooling unit on network
- View system averages of entire cooling unit network



U2U Configuration 2
Liebert CW units with Small Graphic Display may be centrally monitored and controlled with the Optional Wall Mounted Display.

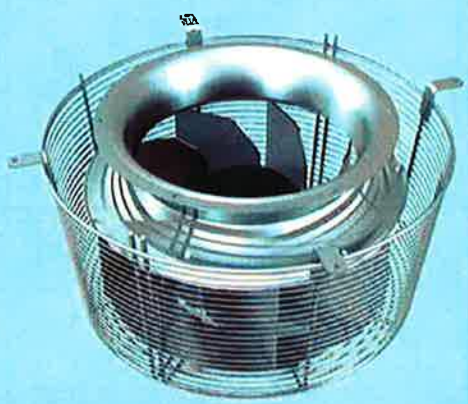
The Optional Wall Mounted Large Graphic Display provides centralized monitoring and control of connected Liebert CW units.

The optional vNSA with iCOM combines a Wall Mounted Large Graphic Display along with a network switch to facilitate U2U wiring in one convenient cabinet.

A Choice Of Fans To Fit Every Application Requirement

Our downflow floormount Liebert CW models are now available with energy efficient EC Plug Fans.

These energy efficient fans add to the superior efficiency already achieved by the use of a traditional variable speed drive system. In fact, many utility companies offer a rebate for using these energy efficient options—check with your local utility for details.



The Liebert CW with EC Plug Fan delivers energy efficiency gains via the fan system. These electrically commutated fans are a backward curved motorized impeller powered by a direct drive DC Motor with integrated AC-DC conversion.

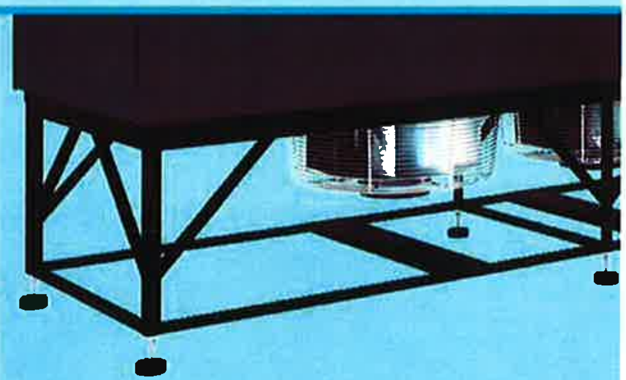
This design uses less energy than standard centrifugal blowers by lowering motor kW. The EC Plug Fan uses 10-30% less energy on average than standard AC motors.

The EC Plug Fan is located in the area beneath the raised floor or within the unit. Superior energy savings can be realized with the fans located beneath the raised floor. Placing the fan in the raised floor space, is 30 percent more energy efficient than centrifugal blowers. The EC Plug Fan also provides greater energy savings than variable speed drives.

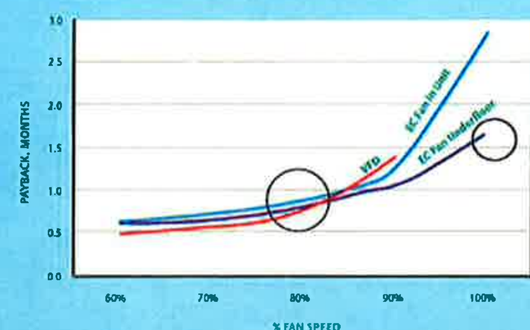
Optional Energy Saving Variable Speed Drive Fan Motor

All Liebert CW models are also available with an optional variable speed drive on the fan motor used to drive centrifugal blowers, matching the motor speed to the room cooling requirements. This feature allows the unit to use far less motor energy to move room air.

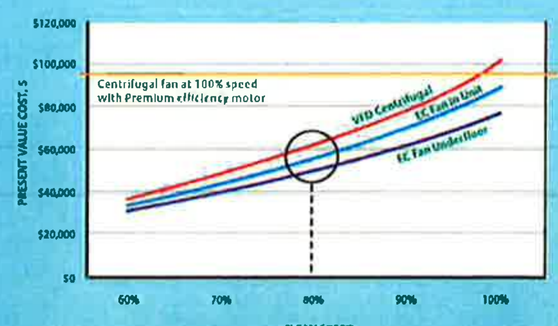
This drive is controlled by the Liebert ICOM control system to match the speed of the blower with the chilled water valve position and consequently the load in the room. This option eliminates excessive energy use due to an oversized design or changing room conditions.



Real World Energy Savings



The energy saving capabilities of the Liebert CW with EC Plug Fans or variable speed drive fans result in a quick payback through lower electricity costs.



Example shows Liebert CW106 @.10/kWH.

Ensuring The High Availability Of Mission-Critical Data And Applications.

Liebert CW Chilled Water System Specifications

Deluxe CW Capacity Data 50 Hz and 60 Hz Chilled Water Systems

CAPACITY DATA kBTU/HR (kW) [BASED ON 45°F (7.2°C) ENTERING WATER. 10°F WATER RISE

		75°F DB, 62.5°F WB (23.9°C DB, 16.9°C WB) 50% RH	75°F DB, 61°F WB (23.9°C DB, 16.9°C WB) 45% RH	72°F DB, 60°F WB (22.2°C DB, 15.5°C WB) 50% RH	72°F DB, 58.6°F WB (22.2°C DB, 14.8°C WB) 45% RH
CW026*	Total	92 (26.8)	87 (25.4)	72 (21.2)	72 (21.2)
	Sensible	86 (25.10)	87 (25.4)	72 (21.20)	72 (21.2)
CW038*	Total	130 (38.1)	121 (35.4)	104 (30.4)	100 (29.3)
	Sensible	114 (33.3)	117 (34.2)	99 (29.1)	100 (29.3)
CW041*	Total	177 (51.7)	158 (46.3)	139 (40.6)	129 (37.9)
	Sensible	137 (40.2)	140 (41.0)	121 (35.5)	125 (36.7)
CW051*	Total	196 (57.5)	184 (53.9)	155 (45.4)	152 (44.6)
	Sensible	174 (51.1)	180 (52.7)	152 (44.4)	152 (44.6)
CW060*	Total	280 (82.0)	251 (73.6)	220 (64.4)	204 (59.8)
	Sensible	216 (63.4)	221 (64.8)	191 (55.9)	198 (57.9)
CW076*	Total	279 (81.8)	256 (75.1)	219 (64.3)	211 (61.7)
	Sensible	238 (69.7)	244 (71.6)	208 (60.9)	211 (61.7)
CW084*	Total	359 (105.1)	320 (93.8)	282 (82.6)	262 (76.7)
	Sensible	278 (81.5)	284 (83.2)	245 (71.9)	253 (74.2)
CW089**	Total	395 (115.6)	353 (103.5)	313 (91.8)	286 (83.9)
	Sensible	296 (86.8)	301 (88.2)	262 (76.8)	270 (79.0)
CW106*	Total	410 (120.2)	373 (109.2)	322 (94.3)	305 (89.3)
	Sensible	339 (99.4)	348 (102.0)	298 (87.3)	305 (89.3)
CW114*	Total	517 (151.5)	463 (135.7)	409 (119.8)	372 (109.0)
	Sensible	392 (114.8)	400 (117.10)	346 (101.4)	356 (104.3)
CW146**	Total	567 (166.1)	515 (150.9)	450 (131.8)	422 (123.5)
	Sensible	456 (133.6)	469 (137.3)	405 (118.5)	418 (122.4)
CW181**	Total	811 (237.7)	725 (212.3)	645 (189.0)	589 (172.5)
	Sensible	600 (175.7)	608 (178.2)	531 (155.4)	546 (159.9)

Capacity data is certified to ASHRAE 127-2007 standard. Fan motor heat has been subtracted, resulting in "net" capacity.

*Available with Centrifugal or downflow EC Plug Fan. Centrifugal Fan capacity shown.
** Only available in downflow configuration with EC Plug Fan.

Emerson Network Power
Liebert Corporation
World Headquarters
1050 Dearborn Drive
P.O. Box 29186
Columbus, Ohio 43229
United States Of America
800 877 9222 Phone (U.S. & Canada Only)
614 888 0246 Phone (Outside U.S.)
614 841 6022 FAX

Emerson Network Power
European Headquarters
Via Leonardo Da Vinci 8
Zona Industriale Tognana
35028 Piove Di Sacco (PD)
Italy
39 049 9719 111 Phone
39 049 5841 257 FAX

Emerson Network Power Asia Pacific
29/F, The Orient Square Building
F. Ortigas Jr. Road, Ortigas Center
Pasig City 1605
Philippines
+63 2 687 6615
+63 2 730 9572 FAX

liebert.com

24 x 7 Tech Support
800 222 5877 Phone
614 841 6755 (outside U.S.)

SL-18055 (R11/10) Printed in USA

Emerson Network Power.

The global leader in enabling *Business-Critical Continuity*™.

EmersonNetworkPower.com

- AC Power
- Connectivity
- DC Power
- Embedded Computing
- Embedded Power
- Infrastructure Management & Monitoring
- Outside Plant
- Power Switching & Controls
- **Precision Cooling**
- Racks & Integrated Cabinets
- Services
- Surge Protection

3.0 Liebert CW Dimensions and Weights

Table 1 Shipping dimensions

Model	Domestic Packed in. (mm)	Export Packed in. (mm)
026, 028, 031	55x40x76 (1400x1020x1930)	58x41x82 (1470x1040x2080)
051, 060	77x40x76 (1960x1020x1930)	80x41x82 (2030x1040x2080)
076, 084	102x40x76 (2590x1020x1930)	105x41x82 (2670x1040x2080)
089, 106, 114	125x40x80 (3180x1020x2030)	128x41x82 (3250x1040x2080)
146, 181	125x53x80 (3180x1350x2030)	128x54x82 (3250x1370x2080)
300, 400*	125x53x80 (3180x1350x2030)	128x54x82 (3250x1370x2080)

1. Models CW300 and CW400 ship in two separate sections, each the size shown.

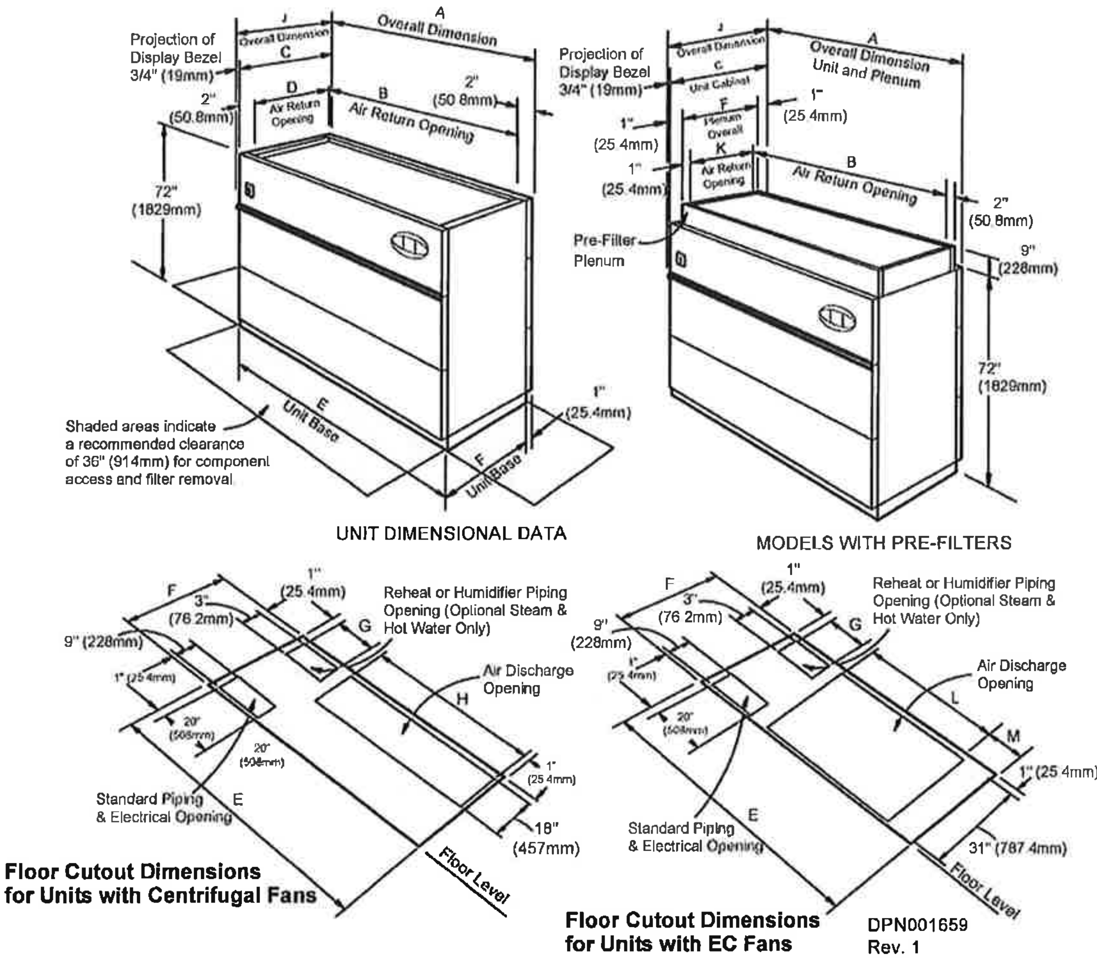
Table 2 Shipping weights

Model	Domestic Packaging lb. (kg)	Export Packaging lb. (kg)
026	805 (365)	1030 (467)
038	840 (381)	1065 (483)
041	890 (404)	1115 (506)
051	1135 (515)	1360 (617)
060	1200 (544)	1425 (646)
076	1380 (625)	1630 (739)
084	1480 (671)	1730 (785)
089	1800 (817)	2075 (942)
106	1950 (885)	2225 (1,009)
114	2090 (949)	2365 (1,073)
146	2900 (1,314)	3200 (1,450)
181	2900 (1,314)	3200 (1,450)
300 *	5800 (2,628)	6400 (2,900)
400 *	5800 (2,628)	6400 (2,900)

* Models CW300 and CW400 ship in two separate sections, each weighing half of the amount shown.

3.1 Dimensions—Downflow Models with EC Fans

Figure 4 Cabinet and floor planning dimensions, downflow models CW026 - CW084 with EC fans



Model	Dimensions, inches (mm)												Net Weight lb (kg)
	A	B	C	D	E	F	G	H (FC Only)	J	K	L (EC Only)	M (EC Only)	
CW026	50 (1270)	46 (1168)	35 (889)	32 (813)	48 (1219)	33 (883)	8 (203)	37 (940)	35-5/8 (905)	31 (787)	28 (711)	2-7/8 (73)	760 (345)
CW038	50 (1270)	46 (1168)	35 (889)	32 (813)	48 (1219)	33 (883)	8 (203)	37 (940)	35-5/8 (905)	31 (787)	28 (711)	2-7/8 (73)	795 (361)
CW041	50 (1270)	46 (1168)	35 (889)	32 (813)	48 (1219)	33 (883)	8 (203)	37 (940)	35-5/8 (905)	31 (787)	28 (711)	2-7/8 (73)	855 (388)
CW051	74 (1880)	70 (1778)	35 (889)	32 (813)	72 (1829)	33 (883)	8 (203)	61 (1549)	35-5/8 (905)	31 (787)	51 (1295)	2-7/8 (73)	1090 (494)
CW060	74 (1880)	70 (1778)	35 (889)	32 (813)	72 (1829)	33 (883)	8 (203)	61 (1549)	35-5/8 (905)	31 (787)	51 (1295)	2-7/8 (73)	1115 (524)
CW076	99 (2515)	95 (2413)	35 (889)	32 (813)	97 (2464)	33 (883)	15-1/4 (387)	78-3/4 (2000)	35-5/8 (905)	31 (787)	60-3/4 (1543)	8-7/8 (225)	1320 (599)
CW084	99 (2515)	95 (2413)	35 (889)	32 (813)	97 (2464)	33 (883)	15-1/4 (387)	78-3/4 (2000)	35-5/8 (905)	31 (787)	60-3/4 (1543)	8-7/8 (225)	1420 (644)

Source: DPN001659, Rev. 1

Figure 5 Cabinet and floor planning dimensions, CW026, CW038 and CW041, downflow with EC fans, front discharge

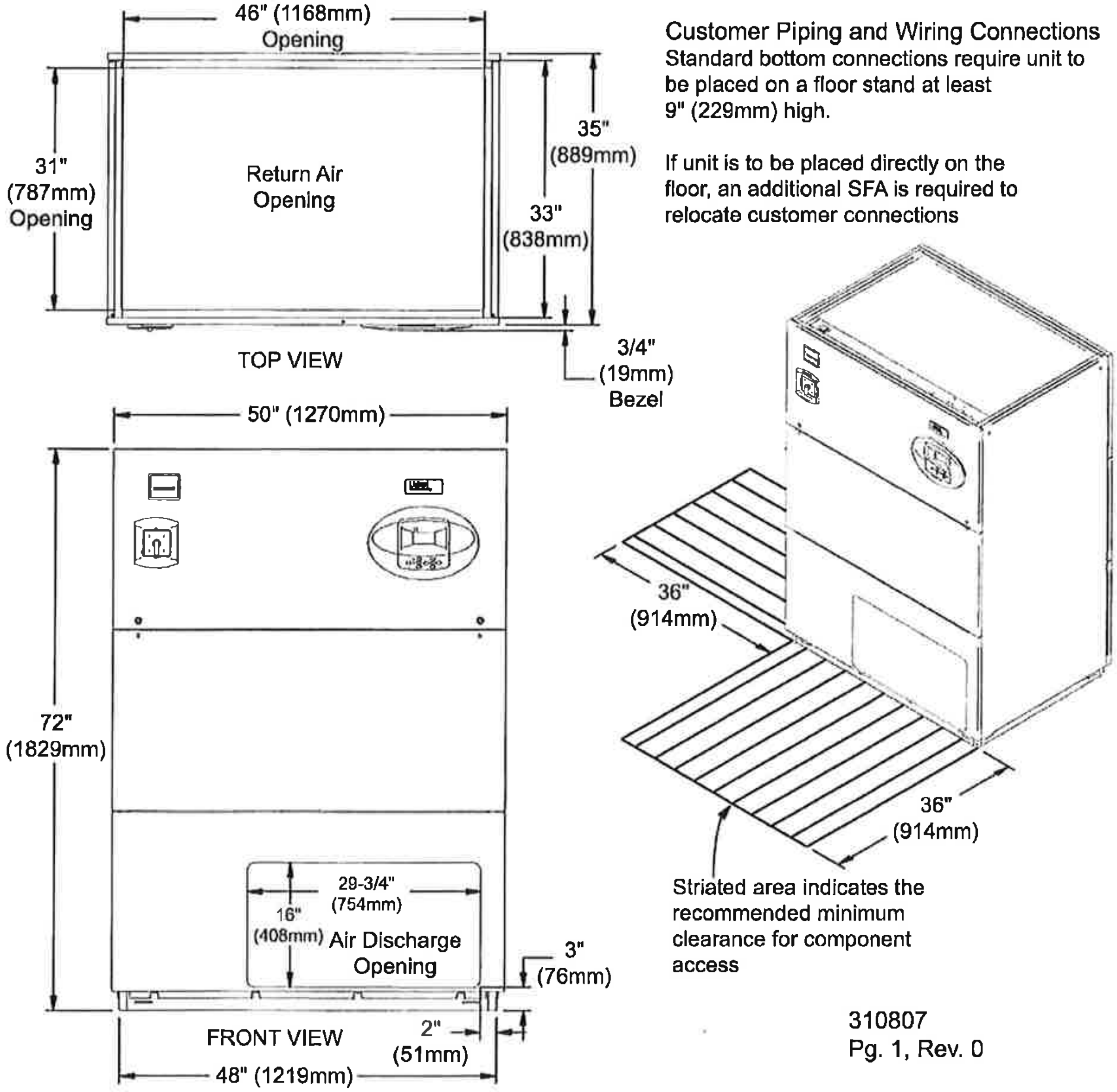
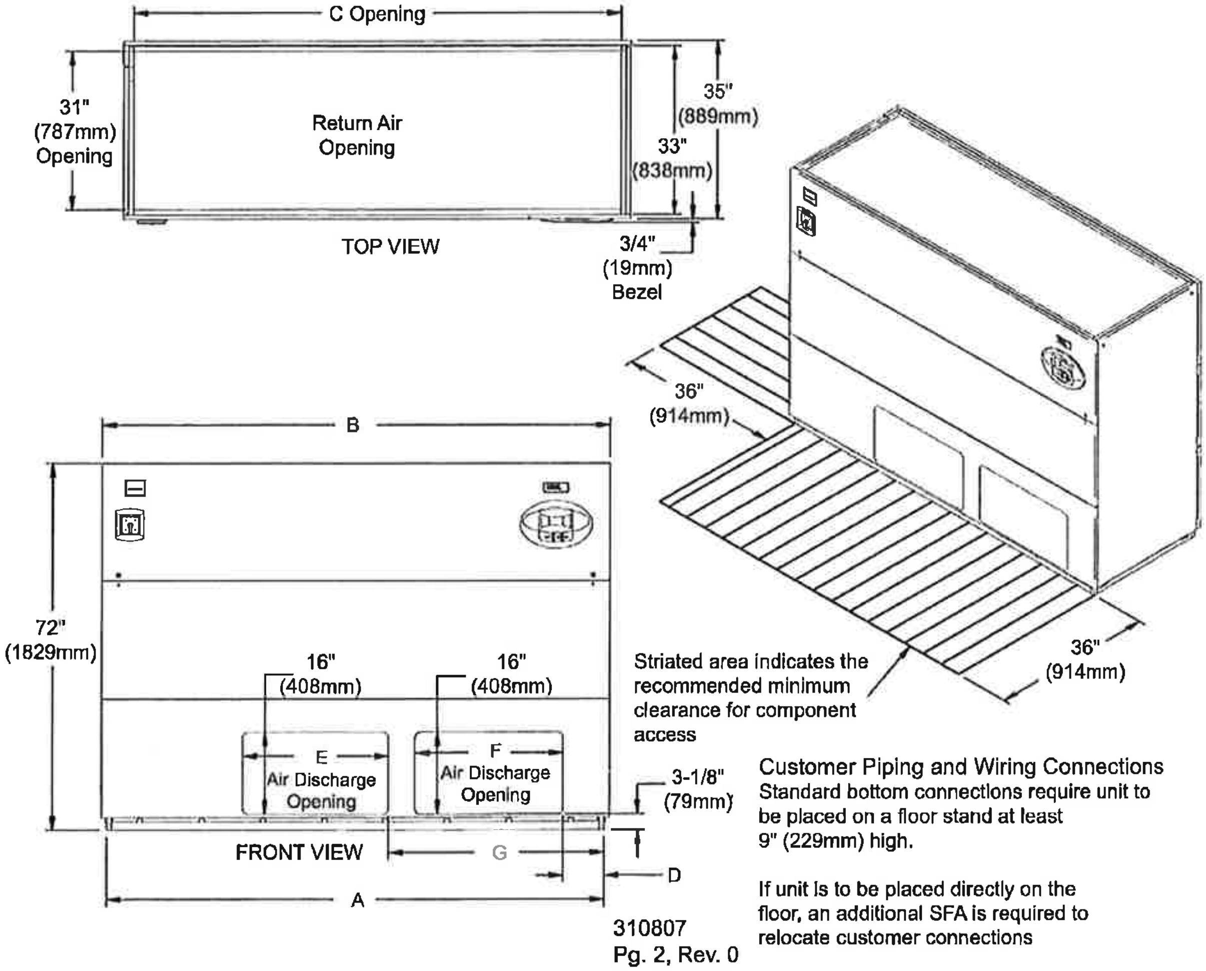


Figure 6 Cabinet and floor planning dimensions, CW051, CW060, CW076 and CW084, downflow with EC fans, front discharge

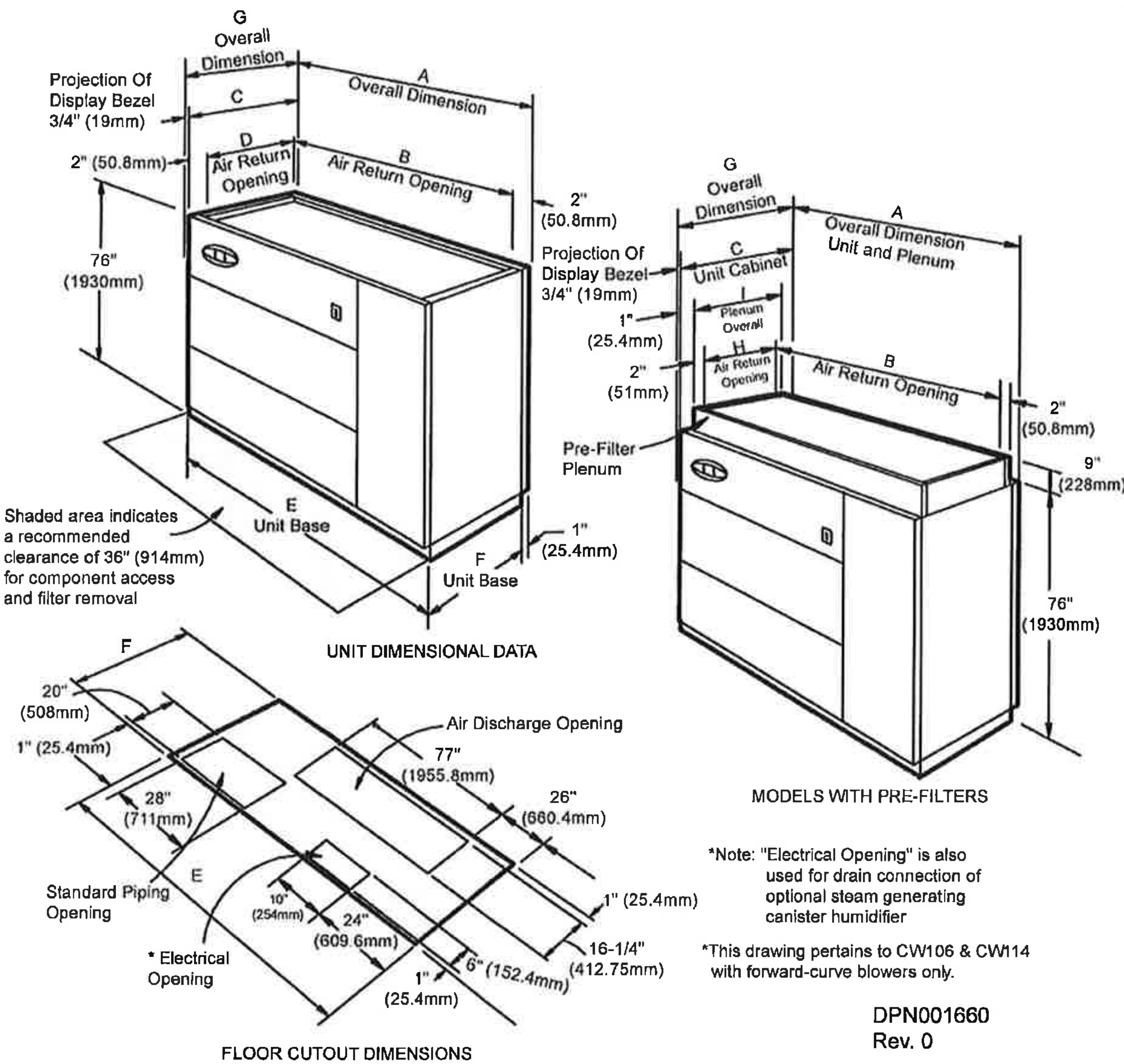


Customer Piping and Wiring Connections
Standard bottom connections require unit to be placed on a floor stand at least 9" (229mm) high.

If unit is to be placed directly on the floor, an additional SFA is required to relocate customer connections

Dimensions inches (mm)							
Model	**A**	**B**	**C**	**D**	**E**	**F**	**G**
CW051	72 (1829)	74 (1880)	70 (1778)	2.0 (51)	25.0 (636)	25.3 (643)	30.1 (764)
CW060	72 (1829)	74 (1880)	70 (1778)	2.0 (51)	25.0 (636)	25.3 (643)	30.1 (764)
CW076	97 (2464)	99 (2515)	95 (2413)	8.0 (203)	28.6 (727)	28.8 (730)	41.9 (1064)
CW084	97 (2464)	99 (2515)	95 (2413)	8.0 (203)	28.6 (727)	28.8 (730)	41.9 (1064)

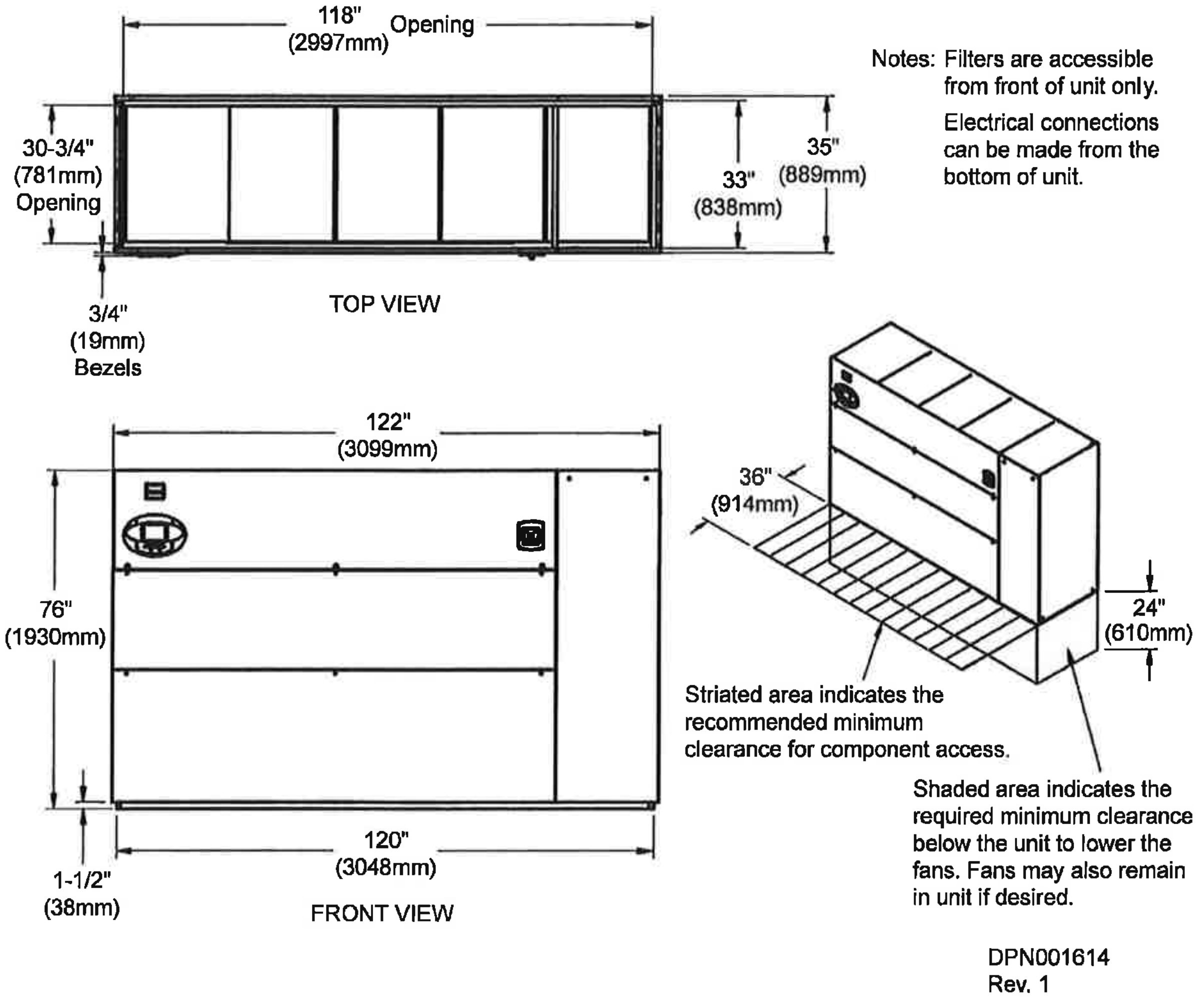
Figure 7 Cabinet and floor planning dimensions, downflow models CW106 and CW114 with EC fans



Model	Dimensions, inches (mm)									Net Weight lb (kg)
	A	B	C	D	E	F	G	H	I	
CW106	122 (3099)	118 (2997)	35 (889)	31 (787)	120 (3048)	33 (838)	35-5/8 (905)	30 (762)	34 (864)	1785 (810)
CW114	122 (3099)	118 (2997)	35 (889)	31 (787)	120 (3048)	33 (838)	35-5/8 (905)	30 (762)	34 (864)	1925 (873)

Source: DPN001660, Rev. 0

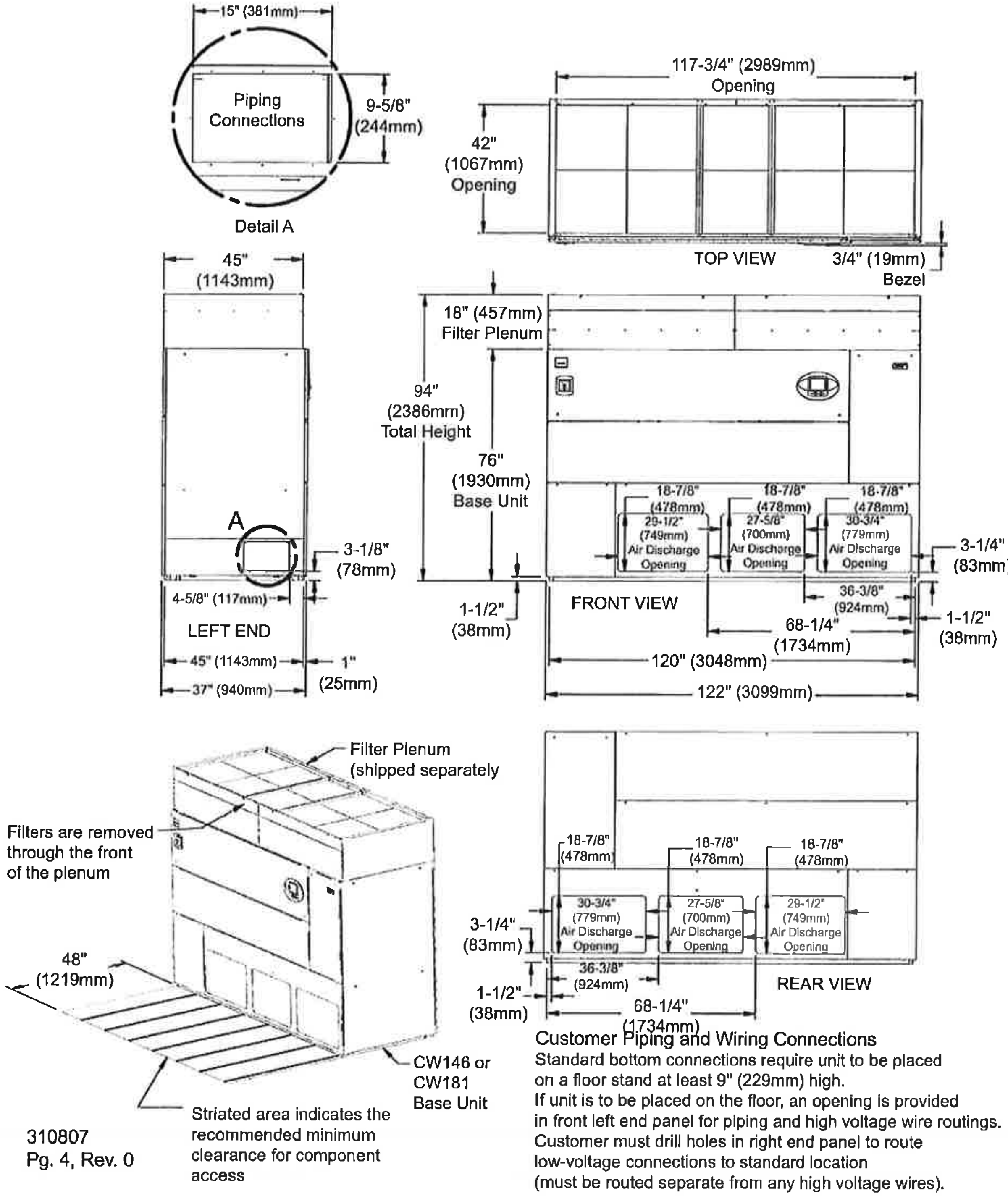
Figure 8 Cabinet and floor planning dimensions for downflow models CW089, CW106 and CW114 with EC fans



Model	Weight lb (kg)
CW089	1925 (873)
CW106	1785 (810)
CW114	1925 (873)

Source: DPN001659, Rev. 1

Figure 9 Cabinet and floor planning dimensions, CW146 - CW181, downflow with EC fans, front discharge



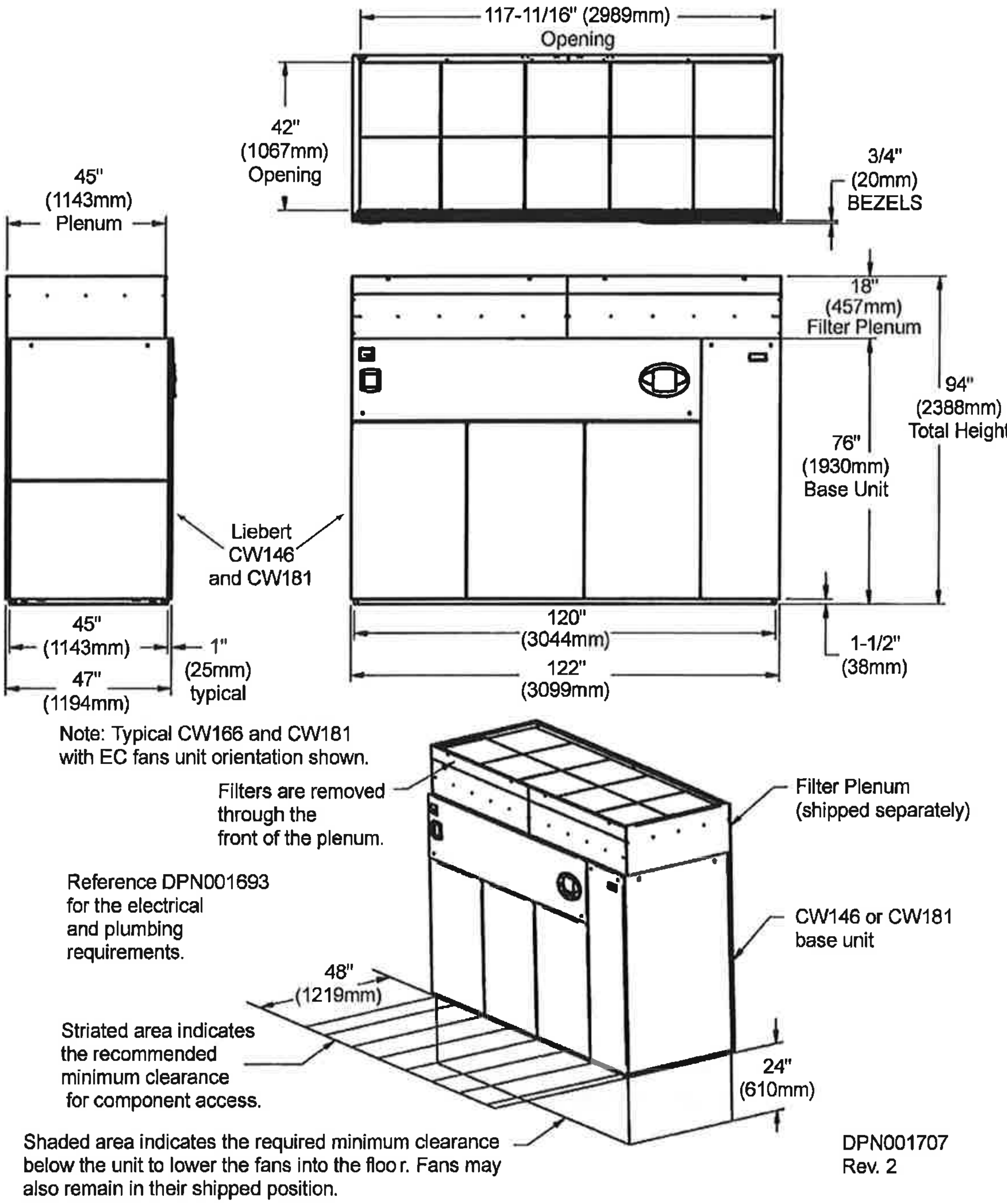
Customer Piping and Wiring Connections

Standard bottom connections require unit to be placed on a floor stand at least 9" (229mm) high.

If unit is to be placed on the floor, an opening is provided in front left end panel for piping and high voltage wire routings.

Customer must drill holes in right end panel to route low-voltage connections to standard location (must be routed separate from any high voltage wires).

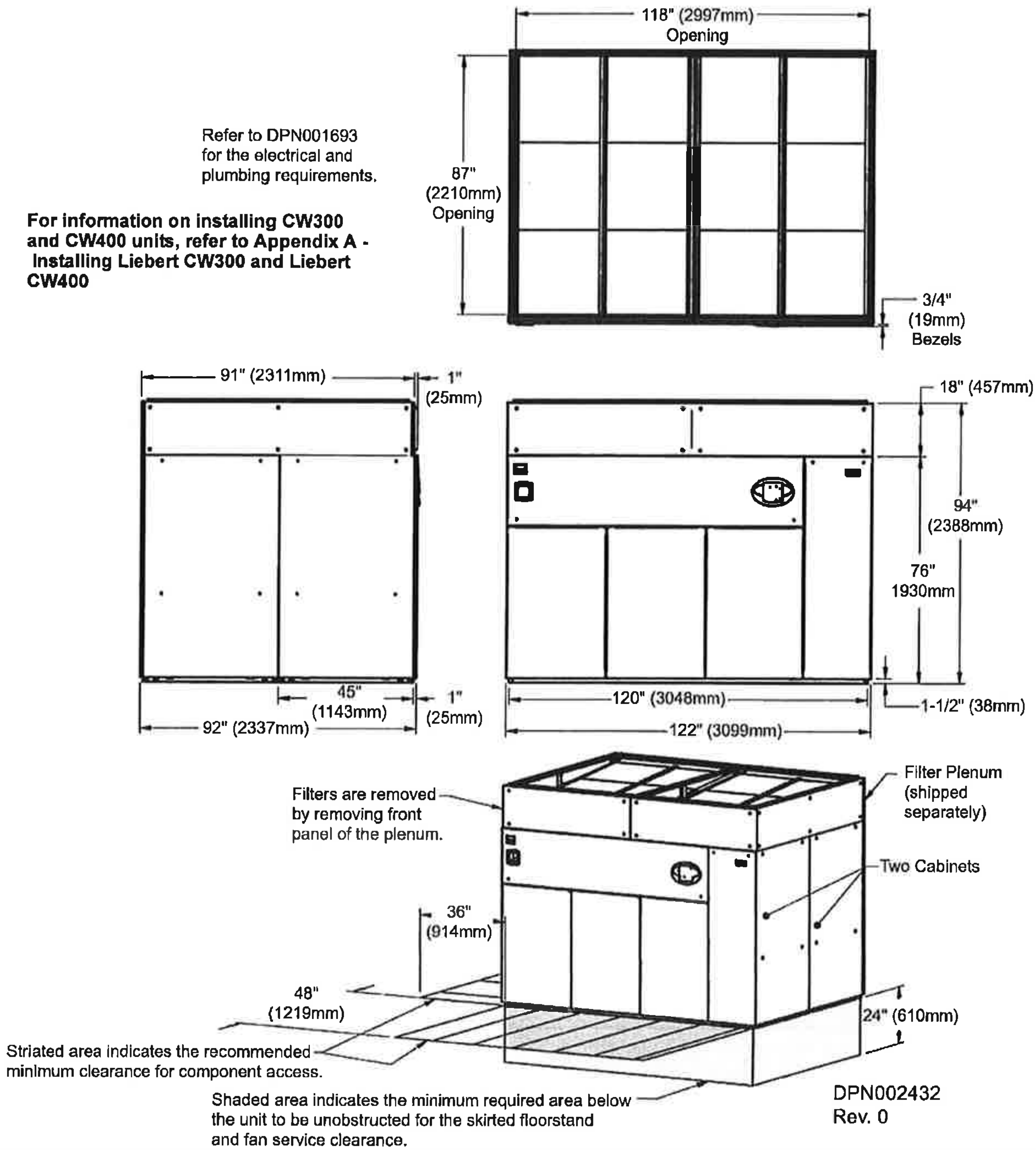
Figure 10 Cabinet and floor planning dimensions for downflow models CW146 and CW181 with EC fans



Model	Weight lb (kg)
CW146	2520 (1143)
CW181	2520 (1143)

Source: DPN001707, Rev. 2

Figure 11 Dimensions and floor planning data downflow models CW300, CW400 with EC fans and filter plenums



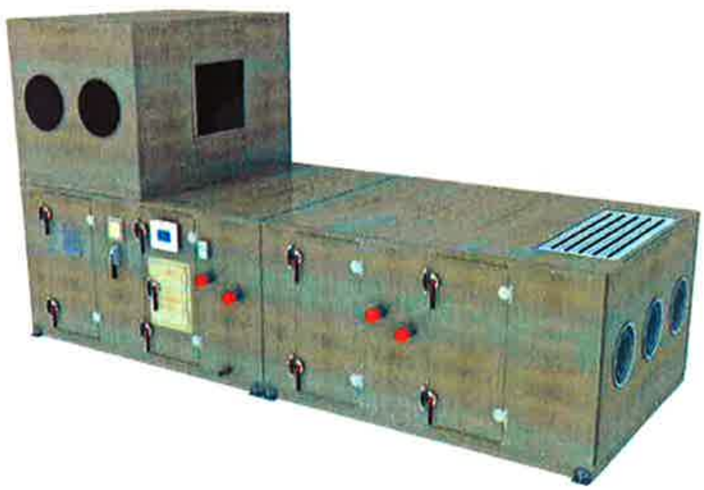
TRANE

Performance Climate Changer™

Next generation air handler from Trane

Ingersoll Rand

Trane Performance Climate Changer™ Air Handler



Trane has a history of combining customer needs, engineering expertise, advanced technology and cutting-edge innovation to provide superior products that deliver exceptional performance. The next generation of Trane air handlers continues this tradition.

Superior performance

The Performance air handler has the tightest casing in the commercial ARI market, meeting an ASHRAE 111 Class 6 leakage level. This leakage rate is better than most custom designs. Superior performance features include:

- Low-leak casing design that achieves less than 1.0 percent leakage rate and can withstand +/- 8 inches w.g. static pressure, with no more than 0.0042 inch deflection.
- Two-inch, R-13 foam-injected panels with mid-span, internal thermal breaks and standard thermal break access doors. The no-through-metal design delivers thermal performance that helps ensure condensation will not form on the casing exterior, even with 55°F supply air temperature and unit external conditions of 81°F dry bulb and 73°F wet bulb.
- Filter technology that exceeds LEED requirements and reduces pressure drops up to 50 percent versus previous designs

Energy efficient

Trane has designed even the most basic features to encourage energy conservation, allowing the system to surpass minimum ASHRAE Standard 90.1 requirements.

The Performance air handler delivers:

- Superior performance
- Industry leading energy efficiency
- System optimization
- Highest quality
- Lowest installed cost

Energy efficient components include:

- Positional service lights with light emitting diode (LED) fixtures, which last up to ten times longer than fluorescent bulbs and one hundred times longer than incandescent bulbs, while using only 2–10 watts of electricity.
- Traq™ dampers, an AMCA 611-certified airflow monitoring solution with standard and low-flow options, which allow direct measurement and control of outdoor and return airflow. The low-flow Traq damper is a key part of a demand control ventilation strategy to help drive down energy costs.
- High-efficiency coil fins deliver superior heat-transfer efficiency while allowing face velocities in excess of 625 fpm without moisture carryover.
- Discharge plenums and plenum fan sections, which are available with variable size, type and location of openings, to reduce static pressure loss and lower energy consumption.

System optimization

The Trane EarthWise™ design philosophy incorporates high-efficiency air handlers and water chillers with low-flow rates and low temperatures on both the waterside and airside. Benefits include:

- Reduced emissions
- Lower first cost
- Lower operating cost
- Improved acoustical performance
- Smaller equipment and components
- Better comfort with lower space humidity

Low-temperature, low-flow systems can be challenging, but the Performance air handler is engineered to capitalize on the benefits of an EarthWise system:

- Low-leak casing design incorporates foam-injected and mid-span internal thermal break panels and standard thermal break access doors to minimize condensation from low-leaving air temperatures.

The Trane EarthWise™ design philosophy incorporates high efficiency air handlers and water chillers with low flow rates and low temperatures on both the waterside and airside.

System Optimization, continued

In addition to the obvious energy savings, moving less air reduces the size of air handlers and ductwork. This can result in a quieter unit and a smaller mechanical room, leaving more space for tenants. In addition, the colder air lowers building dew point, improving building humidity control and indoor air quality.

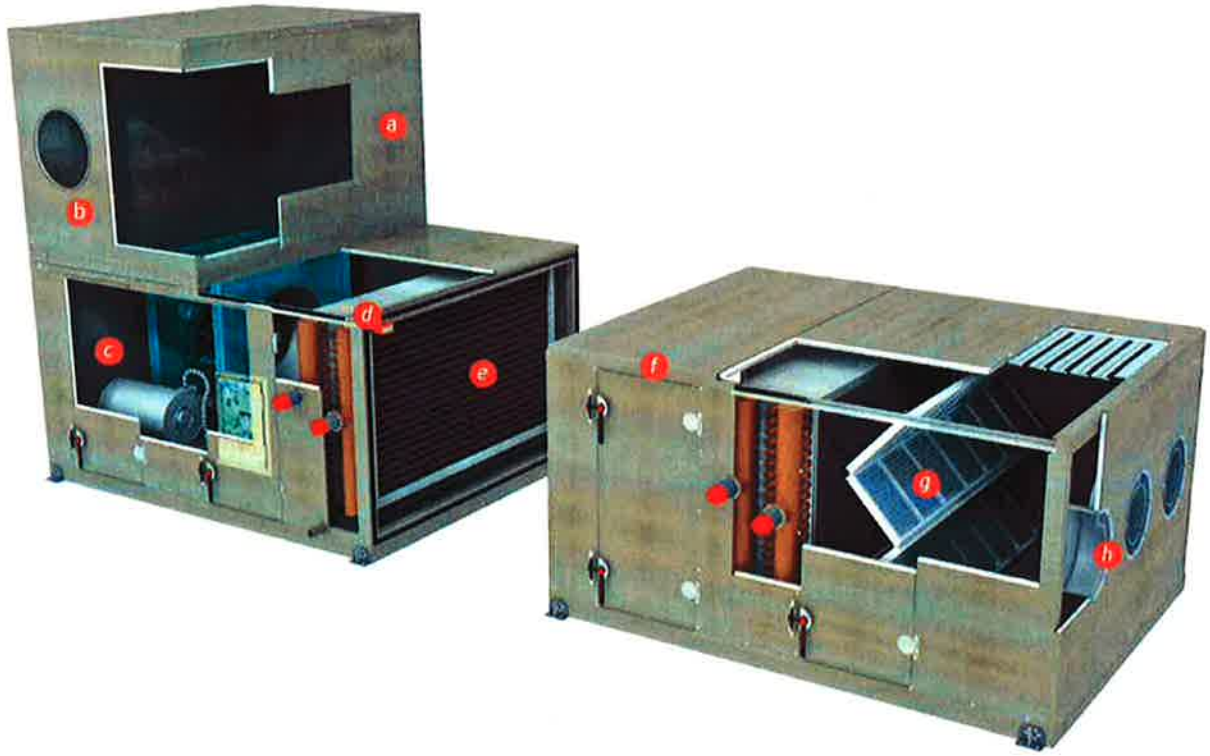
- Factory-engineered, -mounted, and -tested controls ensure that sensors and sequences deliver optimal operating efficiencies and that casing openings have been properly sealed.
- Numerous coil types and high-efficiency coil fin technology enables the latest in airside heat transfer, which improves overall system efficiency by lowering the coil approach temperature and reducing the chance of moisture carryover.
- The ability to choose the exact number of fins per foot of coil surface allows heat transfer and air pressure performance to be tuned to specific application requirements.
- A wide array of fan options provides optimal sound and efficiency choices for the application.
- The latest controls technology easily incorporates fan pressurization and/or demand control ventilation strategies to further enhance the system.

EarthWise design provides many benefits—both for the environment, and for business. Few building design and construction strategies can offer a solution as complete as the EarthWise system.

High quality

Trane has a long-term commitment to quality and manufacturing excellence ensuring our customers receive a reliable unit with proven and tested dependability. The innovative new Performance air handler—ARI Standard 430–certified—will provide optimal, energy-efficient comfort for decades to come.

Exceptional quality is built into every component of the new Performance air handler. Formulated panels and an integral base frame minimize the number of seams that could introduce air leak paths. All Trane coils are ARI Standard 410-certified and tested at one-and-a-half times the maximum operating pressure. In addition, all Trane fans are dynamically balanced in the horizontal and vertical planes. Fans with variable frequency drives also undergo inverter balancing at peak airflow and at all operating points on the system curve. Experienced technicians factory-mount and –wire controls using standard control point locations so that each unit is wired the same way, every time, making check out and servicing quicker and easier.



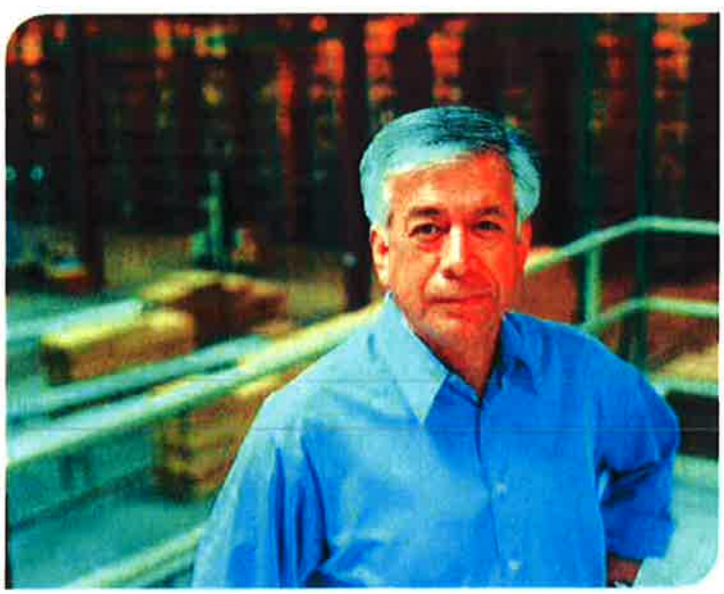
Performance Climate Changer features:

- a *Low casing air leakage:* ASHRAE Standard 111 Class 6 leakage level achieves less than one percent leakage rate
- b *Discharge plenum sections:* Minimize air pressure drop by transforming sections to the most efficient opening sizes, types and locations
- c *Fan sections:* Twice the fan flexibility and an average 3–5 percentage points more efficient than previous Climate Changer™ air handler designs
- d *Single-point power and quick connect wiring:* Factory wiring minimizes installation costs and provides wiring integrity between sections
- e *Coil sections:* More coil options with industry-leading low pressure drop fin designs and infinitely variable fin spacing to exactly match capacity requirements
- f *Thermal-break casing panels and doors:* Two-inch R-13 foam-injected casing panels and doors with thermal breaks minimize heat transfer and withstand +/– 8-inches w.g. pressure with no more than 0.0042 inches deflection
- g *Filter sections:* Filter technology that exceeds LEED requirements and reduces pressure drops up to 50 percent versus previous designs
- h *Mixing sections:* New AMCA 611-certified Traq technology capable of accurately measuring lower flow for demand control ventilation applications

Lowest installed cost

The Performance air handler includes many features designed to reduce installation time and cost:

- Lifting lugs are included on the integral base frame; and all units ship with a skid designed for forklift transport.
- Discharge plenums are available with variable height, size, type and location of openings, which minimizes the need for duct transitions by the installing contractor.
- Factory-installed interoperable controls shorten construction cycles, simplify job site coordination, reduce installation time and expense, and provide single-source responsibility for warranty and service issues.
- Single-point power is available with a high-voltage distribution block and external main unit disconnect with lockout/tagout capabilities.
- LED service lights are factory wired to an external factory-provided Service Module, which includes a switch and GFCI receptacle.
- Quick-connect wiring minimizes installation costs and provides wiring integrity between sections without having to identify or check continuity.
- Factory-installed conduit connectors eliminate penetrations in the wrong location, and all electrical casing penetrations and coil connections are properly sealed at the factory.
- NEMA 4 external motor junction box and motor conduit is available. Motor leads are run through flexible metal conduit to the external junction box, and penetrations are properly sealed.



Trane consistently delivers the best HVAC solution for your buildings.

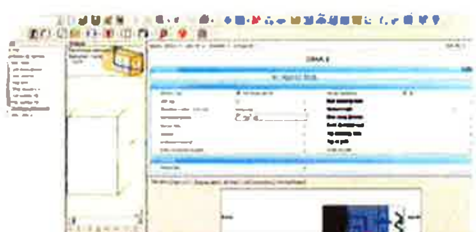
Trane analysis and design tools

Trane has comprehensive analysis and design software tools to provide whole building analysis, acoustical design guidance, equipment performance data, suggested control strategies, and more. Talk with your local Trane sales engineer to learn how these tools will help achieve an energy-efficient system design that provides optimal IAQ, and stays within the project budget.

Trane Climate Changer Configurator (CCC) software evaluates air handler design alternatives such as split dehumidification units, energy wheels, and CDQ™ desiccant dehumidification systems for energy efficiency and humidity control.

Trane Air Conditioning Economics (TRACE™) optimizes and compares the design of virtually any building's HVAC system based on energy utilization and lifecycle cost, factoring in construction, orientation and size.

Trane Controls Pre-Packaged Solutions (PPS) quickly lays out and optimizes control strategies for superior equipment and system performance.



Trane Official Product Selection System (TOPSS™) selects and calculates performance of Trane equipment.

Trane Acoustics Program (TAP™) accurately predicts and compares system sound levels.

Trane Expertise

The innovative Performance air handler was developed by the trusted leader in the industry, Trane. For superior performance, industry leading energy efficiency, system optimization, the highest quality and the lowest installed cost, the right choice is the Trane Performance Climate Changer air handler.

Trane is a pioneer in the HVAC industry and has consistently led the industry in providing solutions for its ever changing needs. With a portfolio of proven equipment and controls, systems-focused solutions, leading industry experts, and highly trained sales engineers, Trane has the experience and expertise to design, manufacture, install and service an HVAC system that will meet your environmental, business and building performance goals.

Ingersoll Rand

Ingersoll Rand (NYSE:IR) is a world leader in creating and sustaining safe, comfortable and efficient environments in commercial, residential and industrial markets. Our people and our family of brands—including Club Car, Hussmann, Ingersoll Rand, Schlage, Thermo King and Trane—work together to enhance the quality and comfort of air in homes and buildings, transport and protect food and perishables, secure homes and commercial properties, and increase industrial productivity and efficiency. We are a $13 billion global business committed to sustainable business practices within our company and for our customers.

TRANE

Introducing Today's VariTrane®

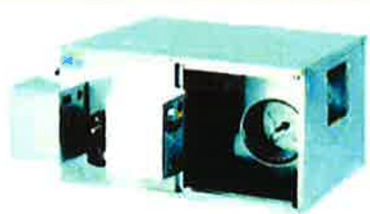
Leadership Redefined

The Trane Company is pleased to introduce a breakthrough in Variable Air Volume (VAV) technology – the new VariTrane VAV terminal unit. VariTrane units are manufactured in the most state-of-the-art VAV facility in the world. Proven components, such as the patented Trane flow ring and the VariTrane DDC controller, are used. Patent-pending manufacturing techniques are implemented to provide the most rugged and reliable VAV unit in the industry. All products are UL listed for safety and provide proven performance via accepted industry standards like ARI-880 and 885.

The Flexibility of VariTrane

Today's VariTrane units are designed for diverse applications and environments. Uses range from the smallest buildings to the most complicated and rigorous applications. The energy-saving merits and reliability of VAV systems and system-level controls has initiated expansion into buildings previously reserved for less efficient systems.

Applications include office spaces, hospitals, movie theaters, hotels, retail stores, malls, extended-care facilities, and educational facilities. VariTrane terminal units provide the most reliable and flexible products available.



All VariTrane units include:

- Trane flow ring for unmatched airflow measurement accuracy
- Heavy gage air valve cylinder
- Interlocking panels which create an extremely rugged unit
- Insulation edges are encapsulated with metal
- UL and CUL listing
- Fusing and disconnects (optional)
- Control power transformers (optional)

Single-Duct and Dual-Duct Terminal Units:

- Single-duct reheat options include water or electric heating coils
- Unit sizes provide 0 to 8000 nominal cfm
- Access for water coil cleaning
- Factory-commissioned Trane controls
- Factory installation of customer supplied controllers
- Slip and Drive connections as standard

Fan-powered Terminal Units:

- Parallel intermittent fan and series continuous fan configurations
- Complete reheat options include water or electric heating coils
- Fan sizes provide 200 to 3000 nominal cfm
- Single-speed motor with SCR is standard for simplified system balancing
- Optional high efficiency ECM motors
- Low-height models for critical plenum requirements

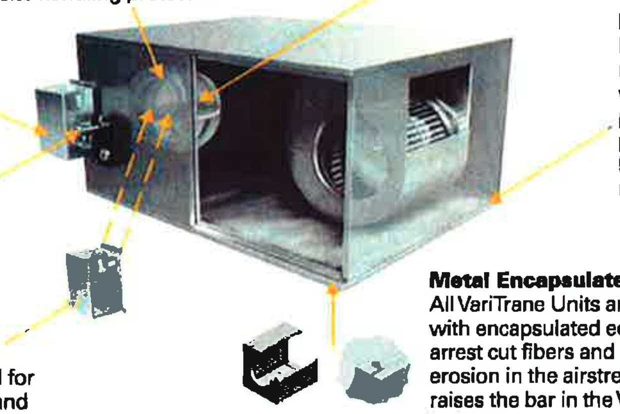
See what makes today's VariTrane Units the best. Ever.

Controls – The Trane factory installs more VAV controllers than any other manufacturer in the industry. For the highest quality and reliability, demand Trane controls.

Flow Ring – The patented Trane flow ring provides unmatched airflow measurement accuracy and unit performance. It is recessed within the 18-gage air valve cylinder for maximized jobsite handling protection.

Air Valve – Designed to limit inlet deformation and provide consistent and repeatable airflow across the flow ring.

Interlocking Panels – Ruggedness and rigidity are assured with Trane's patent-pending interlocking panel construction. It creates unmatched unit rigidity.



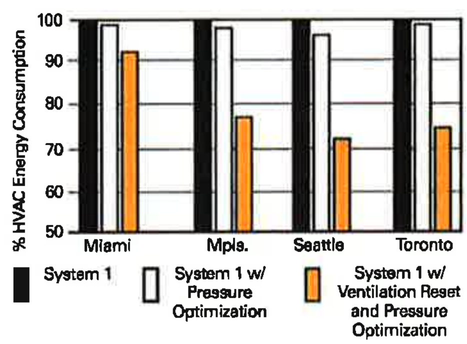
External Shaft – Comes with Air Valve Position Indicator for easier service diagnostics. An external shaft also simplifies mounting of all brands of controllers.

Fan Controls – Now comes with a standard SCR used for fan-speed control and system balancing.

Metal Encapsulated Edges – All VariTrane Units are complete with encapsulated edges to arrest cut fibers and prevent erosion in the airstream. This raises the bar in the VAV industry.

Integrated Comfort Systems (ICS) – VAV systems emerged during the oil embargo of the early 1970s to increase building efficiency. Trane's Integrated Comfort System (ICS) combines VariTrane VAV terminal units, Trane DDC controls and factory-commissioning. Trane ICS enables system-level control strategies like Ventilation Reset and Static Pressure Optimization to improve system performance and efficiency. It's like fuel injection in a car's engine. A gravity fed carburetor will provide gas to your car's engine, but fuel injection does it in the most efficient manner, while boosting horsepower. ICS is just that – a horsepower and efficiency boost for your VAV system!

Energy Efficiency – A significant consumer of energy in commercial buildings is heating and air conditioning. One of the most energy efficient HVAC solutions is the VAV system. This has led to a steady increase in VAV systems over the past several years. VAV systems save significant energy, comply with ventilation requirements, and provide reliable and personalized occupant comfort.



(Analysis performed with Trace® 700 building energy and economic analysis software.)

Energy-saving features of the Trane VAV terminal units include:

- System strategies like Ventilation Reset, and Static Pressure Optimization, etc.
- Night setback
- Occupied/unoccupied control
- Demand controlled ventilation

Summary – An integrated system is essential for complete building environmental comfort and system efficiency. Through the use of factory-commissioned controllers, and the existing capabilities of the DDC system, additional energy-saving strategies can be implemented. At the same time, the system maintains the highest reliability in the industry. Call your local Trane Sales Office for additional details.

Literature Order Number	VAV-SLB005-EN
File Number	SB-TD-VAV-000-SLB005-EN-1201
Supersedes	New
Stocking Location	La Crosse

The Trane Company
An American Standard Company
www.trane.com

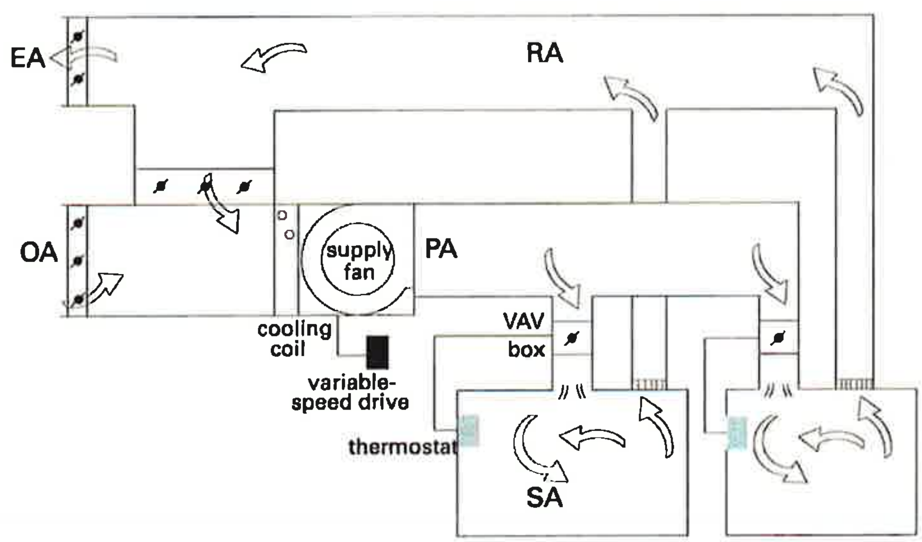
For more information contact your local district office or e-mail us at comfort@trane.com

TRANE

Product Catalog

VariTrane™ Products
Single Duct/Dual Duct Units
VDD, VCC, VCW, VCE

Variable-Air-Volume (VAV) System



July 2013

VAV-PRC011-EN

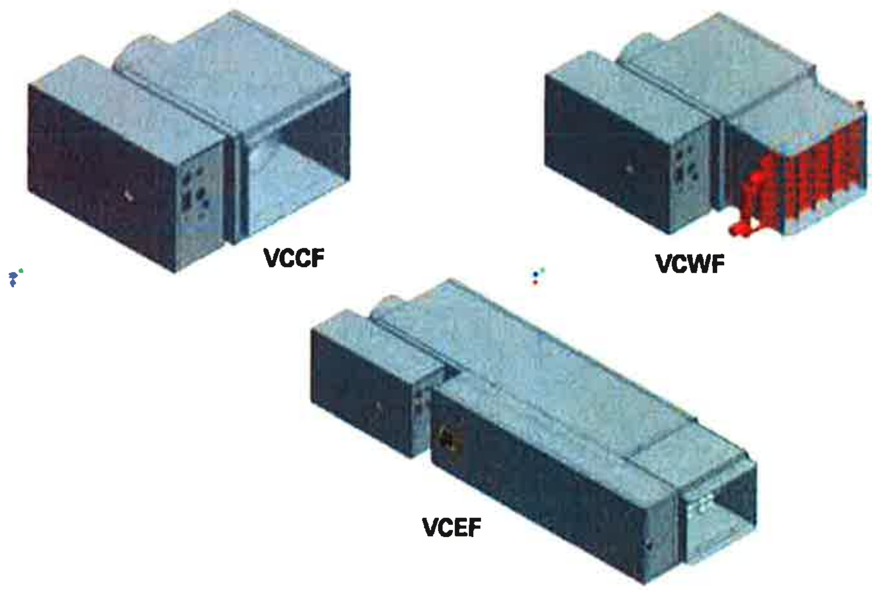
Ingersoll Rand

Introduction

VariTrane™ variable-air-volume (VAV) units lead the industry in quality and reliability and are designed to meet the specific needs of today's applications. This generation of VariTrane units builds upon the history of quality and reliability and expands the products into the most complete VAV offering in the industry.

Single-duct units provide an economical energy-savings system solution. This is the most common type of VAV unit.

Dual-duct units have two air valves. One heating valve and one cooling air valve modulate simultaneously to provide occupant comfort. This option is also used with system concepts which use one valve for maintaining and monitoring 100% ventilation air.



Revision Summary

VAV-PRC011-EN (16 Jul 2013). Updated proportional water valve design

VAV-PRC011-EN (27 Jun 2013). Added wireless and UC210 information. Added bottom access with cam lock configuration. Updated dimensions for units with attenuators.

Trademarks

Tracer, VariTrane, VariTrac, Trane and the Trane logo are trademarks of Trane in the United States and other countries. All trademarks referenced in this document are the trademarks of their respective owners.

BACnet is a registered trademark of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE); LONMARK and LonTalk are registered trademarks of Echelon Corporation.

Single Duct Model Number Descriptions

Digit 1, 2 — Unit Type

VC = VariTrane Single Duct

Digit 3—Reheat

C = Cooling Only
E = Electric Heat
W = Hot Water Heat

Digit 4—Development Sequence

F = Sixth

Digit 5, 6—Primary Air Valve

04 = 4" inlet (225 cfm)
05 = 5" inlet (350 cfm)
06 = 6" inlet (500 cfm)
08 = 8" inlet (900 cfm)
10 = 10" inlet (1400 cfm)
12 = 12" inlet (2000 cfm)
14 = 14" inlet (3000 cfm)
16 = 16" inlet (4000 cfm)
24 = 24" x 16" inlet (8000 cfm)

Digit 7, 8, 9—Not Used

000= N/A

Digit 10, 11—Design Sequence

** = Factory Assigned

Digit 12, 13, 14, 15—Controls

DD00 Trane Actuator Only and Enclosure
DD01= UCM4 Cooling Only Control
DD02= UCM4 N.C. On/Off Hot Water
DD03= UCM4 Prop. Hot Water
DD04= UCM4 Staged On/Off E-Heat
DD05= UCM4 Pulse Width MOD E-Heat
DD07= UCM4 N.O. On/Off Hot Water
DD11= VV550 DDC Controller - Cooling Only
DD12= VV550 DDC Ctrl to operate N.C. On/Off water valve
DD13= VV550 DDC Ctrl to operate Prop water valve
DD14= VV550 DDC Ctrl - On/Off Electric Heat
DD15= VV550 DDC Ctrl w/Pulse Width Modulation
DD16= VV550 DDC Controller - Ventilation Flow
DD17= VV550 DDC Ctrl to operate N.O. On/Off Water Valve
DD19= VV550 DDC Controller with Flow Tracking
DD20= VV550 DDC Vent Flow cntrl to operate N.C. water valve
DD21= VV550 DDC - Vent Flow w/ On/Off Elec Heat
DD22= VV550 DDC Vent Flow cntrl to operate prop water valve
DD23= VV550 DDC- Basic plus- Local (Electric heat- PWM) Remote (Staged EH)
DD24= VV550 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.C. 2 position)
DD25= VV550 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.O. 2 position)
DD26= VV550 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- Modulating)
DD27= VV550 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- Modulating)
DD28= VV550 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.O. 2-position)
DD29= VV550 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- NC 2-position)
DD30= VV550 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.C. 2-position)
DD31= VV550 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.O. 2-position)
DD32= VV550 DDC-Basic plus- Local (Electric heat- Staged) Remote (Staged EH)
DD33= VV550 DDC Vent Flow cntrl to operate N.O. On/Off water valve
DD41= UC400 DDC-Basic (No water or electric heat)
DD42= UC400 DDC-Basic (Water heat- N.C.- 2 position)
DD43= UC400 DDC-Basic (Water heat- Modulating)
DD44= UC400 DDC-Basic (Electric heat- staged)
DD45= UC400 DDC-Basic (Electric heat- PWM)
DD46= UC400 DDC Ventilation flow- cooling only
DD47= UC400 DDC-Basic (Water heat- N.O.- 2 position)
DD49= UC400 DDC-Flow Tracking (Cooling only)
DD50= UC400 DDC-Ventilation Flow (Water heat- N. C.- 2 position)
DD51= UC400 DDC-Ventilation Flow (Electric heat- staged)
DD52= UC400 DDC-Ventilation Flow (Water heat- Modulating)
DD53= UC400 DDC-Basic plus- Local (Electric heat- PWM) Remote (Staged EH)
DD54= UC400 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.C. 2 position)
DD55= UC400 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.O. 2 position)
DD56= UC400 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- Modulating)
DD57= UC400 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- Modulating)
DD58= UC400 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.O. 2-position)
DD59= UC400 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.C. 2-position)
DD60= UC400 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.C. 2-position)
DD61= UC400 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.O. 2-position)
DD62= UC400 DDC-Basic plus- Local (Electric heat- Staged) Remote (Staged EH)
DD63= UC400 DDC-Ventilation Flow (Water heat- N.O. 2-position)
DD65= UC400 Basic (Electric HeatModulating SCR)
DD66= UC400 Basic plus-Local (Electric heat-Modulating SCR) Remote (Staged EH)
DD67= UC400 Ventilation Flow (Electric heat-Modulating SCR)
DD71= UC210 DDC-Basic (No water or electric heat)
DD72= UC210 DDC-Basic (Water heat- N.C.- 2 position)
DD73= UC400 DDC-Basic (Water heat- Modulating)
DD74= UC210 DDC-Basic (Electric heat- staged)
DD75= UC210 DDC-Basic (Electric heat- PWM)
DD76= UC210 DDC Ventilation flow- cooling only
DD77= UC210 DDC-Basic (Water heat- N.O.- 2 position)
DD79= UC210 DDC-Flow Tracking (Cooling only)
DD80= UC210 DDC-Ventilation Flow (Water heat- N. C.- 2 position)
DD81= UC210 DDC-Ventilation Flow (Electric heat- staged)
DD82= UC210 DDC-Ventilation Flow (Water heat- Modulating)
DD83= UC210 DDC-Basic plus- Local (Electric heat- PWM) Remote (Staged EH)
DD84= UC210 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.C. 2 position)
DD85= UC210 DDC-Basic plus- Local (Water heat- Modulating) Remote (Water- N.O. 2 position)
DD86= UC210 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- Modulating)
DD87= UC210 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- Modulating)
DD88= UC210 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.O. 2-position)
DD89= UC210 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.C. 2-position)
DD90= UC210 DDC-Basic plus- Local (Water heat- N.O. 2-position) Remote (Water- N.C. 2-position)
DD91= UC210 DDC-Basic plus- Local (Water heat- N.C. 2-position) Remote (Water- N.O. 2-position)

Single Duct Model Number Descriptions

DD92= UC210 DDC-Basic plus- Local (Electric heat- Staged) Remote (Staged EH)
DD93= UC210 Ventilation Flow (Water heat- N.O. 2-position)
DD95= UC210 Basic (Electric HeatModulating SCR)
DD96= UC210 Basic plus-Local (Electric heat-Modulating SCR) Remote (Staged EH)
DD97= UC210 Ventilation Flow (Electric heat-Modulating SCR)
ENCL= Shaft Only in Enclosure
ENON= Shaft Out Side for Electric Units
FM00= Other Actuator and Control
FM01= Trane Supplied Actuator, Other Ctrl
PC00= N.C. Actuator and Linkage Only
PC04= N.C. with DA Stat, 3000 Series
PC05= N.C. with RA STAT, 3000 Series
PCSS= Normally Closed Special
PN00= N.O. Actuator and Linkage Only
PN04= N.O. 3000 Series, DA STAT
PN05= N.O. 3000 Series, RA STAT
PN11= Auto Dual Min.
PN32= N.O. PNEU Constant Vol.
PN34= N.O. 3000 Series Constant Vol.,RA STAT
PNON= Shaft Out Side for Pneumatic Units
PNSS= Normally Open Special
N.C .= Normally-closed
N.O. = Normally-opened
DA Stat = Direct-acting pneumatic t-stat (by others)
RA Stat = Reverse-acting pneumatic t-stat (by others)
PN = Pneumatic
FM = Factory installation of customer-supplied controller
PVR = Pneumatic Volume Regulator

Digit 16—Insulation

A = 1/2" Matte-faced
B = 1" Matte-faced
D = 1" Foil-faced
F = 1" Double-wall
G = 3/8" Closed-cell

Digit 17 & 18—Not Used

00 = N/A

Digit 19—Outlet Plenum (Connection is Slip & Drive)

0 = None
A = 1 Outlet RH
B = 1 Outlet END
C = 1 Outlet LH
D = 2 Outlets, 1 RH, 1 END
E = 2 Outlets, 1 LH, 1 END
F = 2 Outlets, 1 RH, 1 LH
H = 3 Outlets, 1 LH, 1 RH, 1 END
J = 4 Outlets, 1 LH, 1 RH, 2 END

Note: *See unit drawings for outlet sizes/ damper information.*

Digit 20—Not Used

0 = N/A

Digit 21—Water Coil

0 = None
1 = 1-Row
2 = 2-Row
3 = 3-Row
4 = 4-Row
A = 1-Row Premium
B = 2-Row Premium
C = 3-Row Premium
D = 4-Row Premium

Digit 22—Electrical Connections

L = Left (Airflow hitting you in the face)
R = Right (Airflow hitting you in the face)
0 = Opposite side connection – coil and control

Note: *VCCF, VCWF can be flipped in field for opposite-hand connection*

Digit 23—Transformer

0 = None
1 = 120/24 volt (50 VA)
2 = 208/24 volt (50 VA)
3 = 240/24 volt (50 VA)
4 = 277/24 volt (50 VA)
5 = 480/24 volt (50 VA)
6 = 347/24 Volt (50 VA)
7 = 380/24 Volt (50 VA)
8 = 575/24 Volt (50 VA)

Note: *For VCEF units with transformers the VA depends on the staging, control, and contactor type (ranges are 50 VA to 75 VA, for 1 and 3 phase)*

Digit 24—Disconnect Switch

0 = None
W = With

Note: *VCCF, VCWF - Toggle Disconnect; VCEF - Door Interlocking Power Disconnect*

Digit 25—Power Fuse

0 = None
W = With

Digit 26—Electric Heat Voltage

0 = None
A = 208/60/1
B = 208/60/3
C = 240/60/1
D = 277/60/1
E = 480/60/1
F = 480/60/3
G = 347/60/1
H = 575/60/3
J = 380/50/3
K = 120/60/1

Digit 27 - 29—Electric Heat kW

000= None
010 = 1.0 kW
015 = 1.5 kW
460 = 46.0 kW

Note: *0.5 to 8.0 kW – ½ kW increments 8.0 to 18.0 kW – 1 kW increments 18.0 to 46.0 kW – 2 kW increments*

Digit 30—Electric Heat Stages

0 = None
1 = 1 Stage
2 = 2 Stages Equal
3 = 3 Stages Equal

Digit 31—Electrical Heat Contactors

0 = None
1 = 24-volt magnetic
2 = 24-volt mercury
3 = PE with magnetic
4 = PE with mercury
5 = SCR heat UC400
6 = SCR heat FMTD/ENCL/DD00

Digit 32 & 33—Not Used

00 = N/A

Digit 34—Actuator

0 = Standard
A = Spring Return (Normally Open)
B = Spring Return (Normally Closed)
C = Belimo Actuator

Digit 35—Sensor Options

0 = Standard (Wired)
1 = Factory Mounted Wireless Receiver (Sensor Accessory)
2 = Wireless Comm Interface Modular FM

Digit 36—Pre-Wired Factory Solutions

0 = None
1 = Factory Mounted DTS
2 = HW Valve Harness
3 = Both DTS & HW Valve Harness

Digit 37—Bottom Access with Cam Locks

0 = None
1 = Access Left Side Terminal Unit
2 = Access Right Side Terminal Unit
3 = Access Left Side Terminal Unit with Water Connection on Right
4 = Access Right Side Terminal Unit with Water Coil Connection on Left

Single-Duct VAV Terminal Units

The features of the single-duct VAV terminal units are described by the product categories shown in bold. Within each category the available options are listed.

Selection Procedure

This section describes the catalog selection of single-duct VAV terminal units with specific examples. A computer selection program is also available to aid in selection of VAV terminal units. Selection of single-duct VAV terminal units can involve three elements:

- Air valve selection
- Heating coil selection (if required)
- Acoustics controls

Air Valve Selection

The wide-open static pressure and airflows are found in the performance data section of the catalog. To select an air valve, locate the required design cooling airflow for your terminal unit type and find the smallest air valve size that has a pressure drop equal to or lower than the maximum wide-open static pressure requirement.

Selection Example: Cooling Only VCCF Terminal Unit

Design cooling airflow: 1700 cfm

Maximum wide open Air pressure drop: 0.25 in. wg

Minimum cooling airflow: 850 cfm

From the performance data charts, select a valve size 12, which has a wide-open static pressure drop of 0.01 in. wg

Check the minimum and maximum cfm desired with the minimum and maximum cfm allowed in the table in the general data section. The maximum setting of 1700 cfm is within the acceptable range. The desired minimum setting of 850 cfm is acceptable for the cooling only box desired. Note that if an electric reheat box was selected, the minimum cfm would be dependent upon the kW of the electric heater. (See Electric Heat Unit Selection.)

Heating Coil Selection (If required)

First, determine the amount of heat required to meet space and downstream duct heat losses from a load calculation.

Hot Water Heat

Select a hot water coil sufficient to meet the design heat loss.

Example:

VCWF, Hot Water Unit Heat, Size 12 (See air Valve Selection)

Heating airflow: 850 cfm

Hot water flow: 1.0 gpm

Design Heat Loss: Q =25 MBh

Select hot water coil from the coil performance table in the Performance Data section of the catalog.

Selection:

A one-row coil is sufficient to meet design conditions. From the Hot Water Coil Capacity Data of the Performance Data Section, a one-row coil for a size 12 air valve will operate at the above conditions as follows:

Coil Capacity: 25.17 MBh

Water pressure drop: 0.72 ft WPD

Air pressure drop (APD) of the hot water coil is included in the chart preceding the hot water coil performance data section.

APD = 0.35 in. wg

Electric Heat

Determine the kW required to meet zone design heat loss.

kW=MBh / 3.414

MBh=Design Heat Loss

Select the nearest available kW with voltage and steps desired from the electric heater kW guideline table in the Performance Data section of the catalog.

Example:

VCEF, Electric Unit Heat, Size 12 (See Air Valve Selection)

Heating airflow: 850 cfm

Voltage: 277/60/1 VAC

Design Heat Loss: Q=25 MBh

kW=Q/3.414
kW=25/3.414
kW=7.3

Selection:

Select 7.5 kW from the electric heat table in the voltage and stages required. The table shows the minimum cfm allowable for the kW selected. The static pressure requirement is shown as 0.06 in. wg for this example with a design cooling flow of 1700 cfm.

Check Leaving Air Temperature:

$$LAT = \frac{Q}{1.085 \times CFM} + T$$

T is the primary entering air temperature 55°F for this example.

$$LAT = \frac{3414 \times 7.5}{1.085 \times 850} + 55 = 82.8$$

Decide if leaving air temperature of 82.8°F is satisfactory for your application.

Acoustics

The acoustical data found in the "Performance Data" section of the VAV catalog is used to make a determination of the amount of noise the terminal unit will generate. Locate the table for the VAV terminal unit of interest. Sound power data and an equivalent NC level for an AHRI 885-2008 transfer function is listed.

Example:

VCCF, Cooling-Only Terminal Unit, Size 10 (See air Valve Selection)

Cooling Airflow: 1100 cfm

Maximum inlet static pressure: 1.5 in. wg

Interpolation gives sound power data of:

Octave Band	2	3	4	5	6	7	NC
Disch Sound Power	68	68	65	65	60	57	28
Rad Sound Power	63	58	54	47	39	32	29

The NC level above is determined by using either the catalog's AHRI 885-2008 **mineral fiber for radiated sound** transfer function for the conditions shown in the acoustics table. A different transfer function could be applied as conditions dictate.

The maximum NC level is NC-29. If the maximum NC level was exceeded, it would have been necessary to reselect the next larger unit size.

Computer Selection

The advent of personal computers has served to automate many processes that were previously repetitive and time-consuming. One of those tasks is the proper scheduling, sizing, and selection of VAV terminal units. Trane has developed a computer program to perform these tasks. The software is called the Trane Official Product Selection System (TOPSS).

The TOPSS program will take the input specifications and output the properly sized VariTrane VAV terminal unit along with the specific performance for that size unit.

The program has several required fields, denoted by red shading in the TOPSS screen, and many other optional fields to meet the criteria you have. Required values include maximum and minimum airflows, control type, and model. If selecting models with reheat, you will be required to enter information to make that selection also. The user is given the option to look at all the information for one selection on one screen or as a schedule with the other VAV units on the job.

The user can select single-duct, dual-duct, and fan-powered VAV boxes with the program, as well as most other Trane products, allowing you to select all your Trane equipment with one software program.

The program will also calculate sound power data for the selected terminal unit. The user can enter a maximum individual sound level for each octave band or a maximum NC value. The program will calculate acoustical data subject to default or user supplied sound attenuation data.

Schedule View

The program has many time-saving features such as: 1) Copy/Paste from spreadsheets like Microsoft® Excel; 2) Easily arranged fields to match your schedule; and 3) Time-saving templates to store default settings.

The user can also export the Schedule View to Excel to modify and put into a CAD drawing as a schedule. Specific details regarding the program, its operation, and how to obtain a copy of it are available from your local Trane sales office.

General Data

Table 2. Primary airflow control factory settings - I-P

Control Type	Air Valve Size (in.)	Maximum Valve Cfm	Maximum Controller Cfm	Minimum Controller Cfm	Constant Volume Cfm
Direct Digital Control/ UCM	4	225	25-225	0,25-225	25-225
	5	350	40-350	0,40-350	40-350
	6	500	60-500	0,60-500	60-500
	8	900	105-900	0,105-900	105-900
	10	1400	165-1400	0,165-1400	165-1400
	12	2000	240-2000	0,240-2000	240-2000
	14	3000	320-3000	0,320-3000	320-3000
	16	4000	420-4000	0,420-4000	420-4000
	24 x 16	8000	800-8000	0,800-8000	800-8000
Pneumatic with Volume Regulator	4	225	38-225	0,38-225	38-225
	5	350	63-350	0,63-350	63-350
	6	500	73-500	0,73-500	73-500
	8	900	134-900	0,134-900	134-900
	10	1400	215-1400	0,215-1400	215-1400
	12	2000	300-2000	0,300-2000	300-2000
	14	2887	408-2887	0,408-2887	408-2887
	16	3789	536-3789	0,536-3789	536-3789
	24 x 16	7745	1096-7745	0,1096-7745	1096-7745

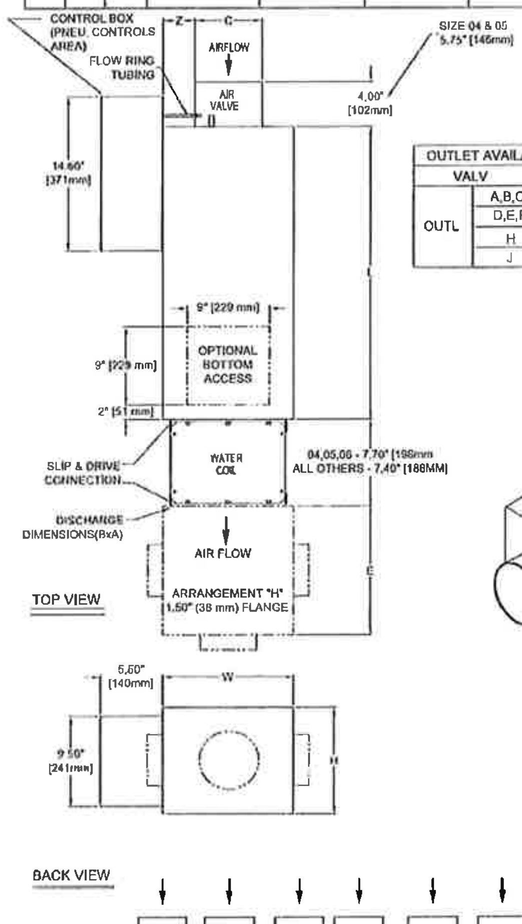
Table 3. Primary airflow control factory settings - SI

Control Type	Air Valve Size (in.)	Maximum Valve L/s	Maximum Controller L/s	Minimum Controller L/s	Constant Volume L/s
Direct Digital Control/ UCM	4	106	12-106	0,12-106	12-106
	5	165	19-165	0,19-165	19-165
	6	236	28-236	0,28-236	28-236
	8	425	50-425	0,50-425	50-425
	10	661	77-661	0,77-661	77-661
	12	944	111-944	0,111-944	111-944
	14	1416	151-1416	0,151-1416	151-1416
	16	1888	198-1888	0,198-1888	198-1888
	24 x 16	3776	378-3776	0,378-3776	378-3776
Pneumatic with Volume Regulator	4	106	18-106	0,18-106	18-106
	5	165	30-165	0,30-165	30-165
	6	236	35-236	0,35-236	35-236
	8	425	63-425	0,63-425	63-425
	10	661	102-661	0,102-661	102-661
	12	944	141-944	0,141-944	141-944
	14	1363	193-1363	0,193-1363	193-1363
	16	1788	253-1788	0,253-1788	253-1788
	24 x 16	3656	517-3656	0,517-3656	517-3656

Note: Maximum airflow must be greater than or equal to minimum airflow.

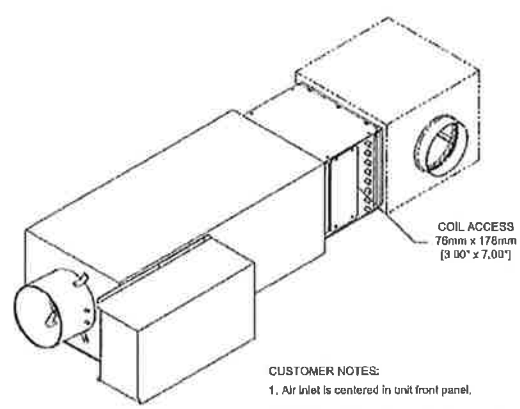
SINGLE DUCT HOT WATER W/ OPTIONAL PLENUM & BOTTOM ACCESS (VCWF)

VALV	CFM	L/s	INLET SIZE (NOMINAL Ø) C	L	H	W	Z	DISCHARGE DIM W/O OUTLET PLENUM A (h)	DISCHARGE DIM W/O OUTLET PLENUM B (w)	E	WT LBS [KGS]
04	225	106	4" [104mm]	36.00" [914mm]	9.50" [241mm]	11.50" [292mm]	2.75" [70mm]	8.00" [203mm]	10.00" [254mm]	11.50" [292mm]	27 [12]
05	350	165	5" [127mm]								
06	500	236	6" [152mm]								
08	900	425	8" [203mm]		11.50" [292mm]	12.50" [318mm]	2.25" [57mm]	10.00" [254mm]	11.00" [279mm]		30 [14]
10	1400	661	10" [254mm]		13.50" [343mm]	15.50" [394mm]	2.75" [70mm]	12.00" [305mm]	14.00" [356mm]	14.00" [356mm]	40 [18]
12	2000	994	12" [305mm]		15.50" [394mm]	18.50" [470mm]	3.25" [83mm]	14.00" [356mm]	17.00" [432mm]	14.00" [356mm]	51 [23]
14	3000	1416	14" [356mm]		19.50" [495mm]	20.50" [521mm]		18.00" [457mm]	19.00" [483mm]	NA	62 [28]
16	4000	1888	16" [406mm]			24.50" [622mm]	4.25" [108mm]		23.00" [584mm]	NA	71 [32]
24RT	8000	3776	18X24"			28.50" [724mm]	2.25" [57mm]		27.00" [686mm]	NA	95 [43]



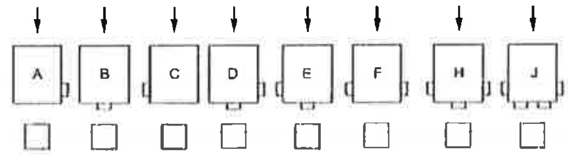
OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" [127mm]
II	6" [152mm]
III	8" [203mm]
IV	10" [254mm]

OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ							
VALV		4	5	6	8	10	12
OUTL	A,B,C	I, II	I, II	I, II	III	III, IV	IV
	D,E,F	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	H	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	J	N/A	N/A	N/A	N/A	I	I, II



CUSTOMER NOTES:

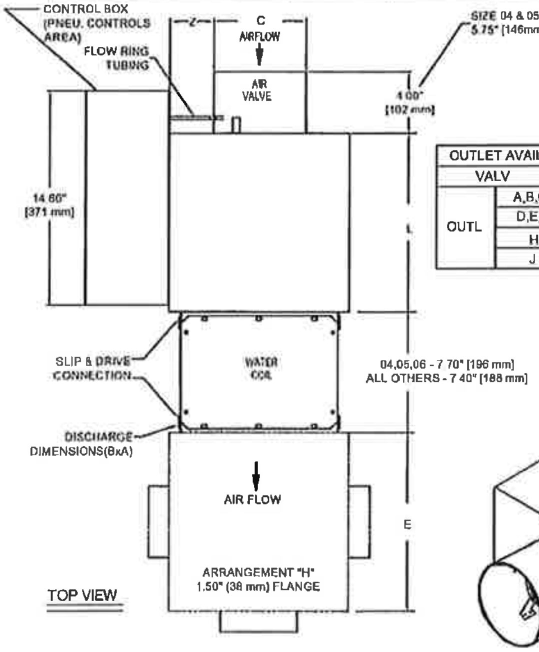
1. Air inlet is centered in unit front panel.
2. Outlet combinations to remote diffusers have optional integral balancing dampers (See specification sheet.)
3. Outlet connections are centered in plenum panel.
4. Plenum not available w/sizes 14 & 16 units.
5. Minimum of 1.5 duct diameters of straight duct required for proper flow reading
6. Allow 36" [914mm] on control side for servicing.
7. Weights are an estimation and will vary based on selected options, insulation type, etc
8. Coil furnished with stub sweat connections. handedness of coil connection is determined by facing air stream.
9. Coils are provided without internal insulation. If the unit is to be installed in a location with high humidity, external insulation around the heating coil should be installed as required.
10. Add 1.75" for 3 or 4 row coils. 1 or 2 row shown.
11. Optional bottom access requires an extended casing.



OUTLET PLENUM
ARRANGEMENTS
(TOP VIEW)

SINGLE DUCT HOT WATER W/PLENUM (VCWF)

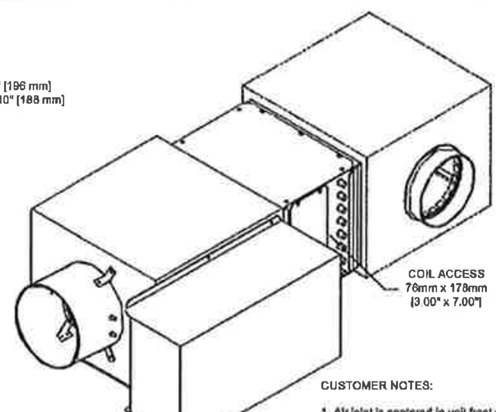
VALV	CFM	L/s	INLET SIZE (NOMINAL Ø) C	L	H	W	Z	DISCHARGE DIM W/O OUTLET PLENUM A (h)	DISCHARGE DIM W/O OUTLET PLENUM B (w)	E	WT LBS [KGS]
04	225	106	4" [104mm]	11 50" [292mm]	9 50" [241mm]	11.50" [292mm]	2 75" [70mm]	8 00" [203mm]	10 00" [254mm	11 50" [292mm]	27 [12]
05	350	165	5" [127mm]								
06	500	236	6" [152mm]								
08	900	425	8" [203mm]	11 00" [279mm]	11 50" [292mm]	12 50" [318mm]	2 25" [57mm]	10 00" [254mm]	11 00" [279mm]		30 [14]
10	1400	661	10" [254mm]	12.00" [305mm]	13 50" [343mm]	15 50" [394mm]	2 75" [70mm]	12.00" [305mm]	14 00" [356mm]	14 00" [356mm]	40 [18]
12	2000	994	12" [305mm]	13 00" [330mm]	15.50" [394mm]	18 50" [470mm]	3 25" [83mm]	14 00" [356mm]	17.00" [432mm]	14.00" [350mm]	51 [23]
14	3000	1416	14" [356mm]	14.00" [356mm]	19.50" [495mm]	20 60" [521mm]		18 00" [457mm]	19 00" [483mm]	NA	62 [28]
16	4000	1888	16" [406mm]	15 00" [381mm]		24 50" [622mm]	4 25" [108mm]		23 00" [584mm]	NA	71 [32]
24RT	8000	3776	16X24"	18 00" [457mm]		28 50" [724mm]	2 25" [57mm]		27 00" [686mm]	NA	95 [43]

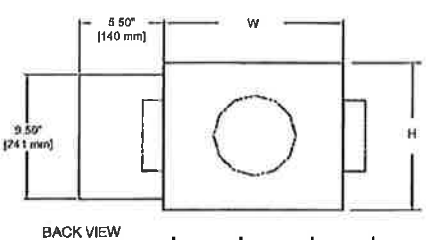


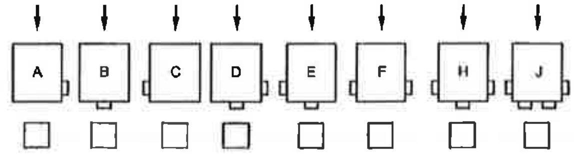
OUTL CONVERSION CHART	
SYMBOL	NOMINALØ
I	5" [127mm]
II	6" [152mm]
III	8" [203mm]
IV	10" [254mm]

OUTLET AVAILABILITY CHART - SEE OUTL CONVERSION FOR NOMINALØ

	VALV	4	5	6	8	10	12
OUTL	A,B,C	I, II	I, II	I, II	III	III, IV	IV
	D,E,F	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	H	I, II	I, II	I, II	I, II, III	II, III, IV	III, IV
	J	N/A	N/A	N/A	N/A	I	I, II







OUTLET PLENUM
ARRANGEMENTS
(TOP VIEW)

CUSTOMER NOTES:

1. Air inlet is centered in unit front panel
2. Outlet combinations to remote diffusers have optional integral balancing dampers (See specification sheet)
3. Outlet connections are centered in plenum panel
4. Plenum not available w/sizes 14 & 16 units.
5. Minimum of 1 5 duct diameters of straight duct required for proper flow reading.
6. Allow 36" [914mm] on control side for servicing.
7. Weights are an estimation and will vary based on selected options, insulation type, etc
8. Coil furnished with stub sweat connections handedness of coil connection is determined by facing air stream
9. Coils are provided without internal insulation. If the unit is to be installed in a location with high humidity, external insulation around the heating coil should be installed as required.
10. Unit is field convertible from a left-hand connection (shown) to right-hand by rotating unit.
11. Add 1.75" for 3 or 4 row coils. 1 or 2 row shown

A New Angle on Cool

In-floor Cooling Solutions Deliver the Right Amount of Cooling in the Right Place

The continued adoption of high density equipment, virtualization and cloud computing strategies require that the cooling infrastructure of a data center be able to accommodate high and often variable heat loads while offering superior energy efficiency. Recognizing the challenges of cooling a high density, variable load data center environment Tate has developed a range of cost-effective and energy-efficient solutions that provide data center owners with compelling returns on investment and lower operating costs in both new build and retrofit applications.

In-Floor Cooling Solutions

Tate's **DirectAire®** directional airflow panel angles airflow to nearly eliminate by-pass air and save significant energy. The **Opposed Blade Damper** offers granular manual airflow volume control. **SmartAire®** automated variable-air-volume damper directly matches cooling with the heat load at the rack level by monitoring and reacting almost instantly to any variations in utilization. And, the **PowerAire®** fan assist module provides retrofit applications with a solution to implementing high density equipment in their current raised floor facilities without significant capital investment.

These products directly address many of the challenges brought by the introduction of these new technologies. While the technology and infrastructure in the data centers continue to evolve so has the raised floor design. These new products have enabled a raised floor environment to accommodate these changes by offering the ability to handle extremely high density racks, adjust cooling to match variable heat loads, and do so efficiently. Best of all, the In-floor Cooling solutions can easily be used in retrofit applications or new construction. So take a new efficient angle on how you approach cooling your data center.

DirectAire® & DirectAire® X2

High Density Directional Airflow Solutions for Data Centers

Unlike other airflow panels the DirectAire and DirectAire X2 angle the airflow toward the server rack to significantly reduce bypass air. DirectAire is designed for a one-to-one pairing with a standard 42U rack while DirectAire X2 is intended to provide even airflow delivery to racks on either side of the cold aisle in a legacy data center that has only one accessible airflow panel. Both offer the same directional airflow, strong durable design and improved energy performance.

Easily Cool High Density Racks

Both DirectAire's features **68% open area**, capable of delivering **2,600 CFM at .1" H_2O static pressure.** More importantly each vane has a deflection angle at the top to direct the airflow towards the rack to achieve a **93% TAC** rate. This means 93% of the airflow delivered through the panel is entering the face of the server rack, providing the highest cooling capacity and energy efficiency. Compared to typical airflow panels which only deliver 30-50% directly to the rack. This improvement enables DirectAire to efficiently cool over **25kW per rack (X2 over 12.5kW per rack).**

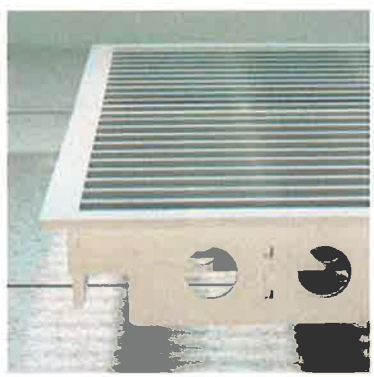
Strong & Durable

Both DirectAire's feature all steel construction making them the strongest airflow panels on the market. With a **2000 lb Rolling Load, 2500lb Design Load and a Minimum Safety Factor of 2.0** equipment can be moved over the airflow panels without worry.

Improve Data Center Financial Performance

DirectAire maximizes the financial performance of any new or existing data center. The precise delivery of air reduces bypass airflow allowing new facilities to reduce the number of CRAH units. Retrofits can set CRAH units with fixed speed fans to standby mode or adjust variable fan drives to operate at a lower static pressure, saving energy. Likewise the 93% TAC rate eliminates the need for a full containment system. The facilities overall cooling capacity will also be improved allowing for the addition of IT equipment without the capital investments on infrastructure.

Directional airflow vanes provide 93% TAC



Designed for superior load performance

68% open area delivers 2600 CFM @ .1" H_2O

DirectAire Key Performance Characteristics

- Directional Air Flow Achieves a 93% Total Air Capture
- Pressure Equalizing Diffusion Blades
- Cools over 25kW per Rack
- Reduces Capital Expenditures on Cooling Infrastructure by 40%
- 68% Open Area delivers 2,600 CFM @ .1" H2O
- Over 40% Annual Fan Energy Savings
- 2,500 lbs Design Load boosted to 3,000 lbs with HD stringer

DirectAire X2 Key Performance Characteristics

- Allows for directional airflow delivery to two racks when the existing cold aisle can only accommodate one airflow panel.
- Capable of cooling >12.5kW per rack due to evenly split nature of directional airflow paths

Tate®

Total Air Capture (TAC) Rate

Total Air Capture (TAC) rate refers to the amount of air delivered through the airflow panel that is then captured by the server rack. The server rack profile below represents a standard 24" x 76" server rack. Lines have been added to show the three zones of the server rack. Zone 1 represents the bottom of the rack closest to the floor and Zone 3 represents the top of the rack farthest from the air supply. You will notice that the DirectAire panel delivers 93% of it's 2,600 CFM at .1" H_2O to the face of the server.

The data reported on the smoke test images below show the distribution of airflow through both panels for each zone in a 42U rack. You will notice the airflow through the DirectAire panel is spread evenly across the three zones of the rack. When racks are placed 6" from the edge of a DirectAire X2 panel as shown the airflow is divided evenly between the two adjacent racks.

DirectAire
2600 CFM Delivered @ .1" H2O
2420 CFM Captured
93% TAC

The DirectAire smoke test above shows directional airflow path and air capture rate per zone at the face of a standard 42U server rack.

DirectAire X2
2600 CFM Delivered @ .1" H2O
2420 CFM Captured
93% TAC

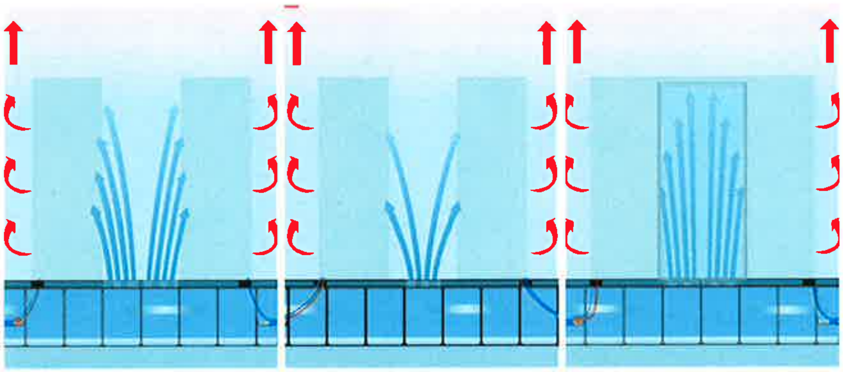
The DirectAire X2 smoke test above shows directional airflow path and air capture rate per zone at the face of a standard 42U server rack.

Delivering Air in the Right Place

DirectAire Reduces Bypass Air to Improve Capacity and Energy Efficiency

Eliminate the Burden of Airflow Containment

Containment systems in a data center come with many challenges including fire code requirements, service distribution restraints and limited flexibility. Unlike other panels which throw air straight up in a vertical plume the DirectAire's angular throw evenly distributes the majority of the air it delivers directly to the face of the rack providing effective containment when used in conjunction with best practices.



DirectAire's 93%TAC rate enables you to gain near peak airflow without containment.

DirectAire X2 enables you to maximize airflow in aisles with a single row of airflow panels without containment.

Typical airflow panels require containment systems to ensure maximum airflow to the racks.

High Density Cooling Capacity

DirectAire's ability to deliver high volumes of air directly and evenly across the face of the server rack gives it the unique ability to handle very high density equipment. The table below lists cooling capacities per rack based on a mathematical calculation for systems without containment.

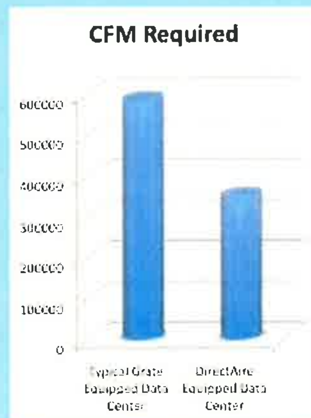
DirectAire & DirectAire X2 CFM & Cooling Capacity			
Pressure (in. H2O)	CFM	**DirectAire** kW/rack w/o Containment*	**DirectAire X2** kW/rack w/o Containment*
.02	1151	8.5	4.2
.04	1626	12.0	6.0
.05	1844	13.6	6.8
.06	2007	14.8	7.4
.08	2318	17.1	8.6
.10	2594	19.1	9.6
.12	2823	20.8	10.4
.14	3027	22.3	11.2
.16	3217	23.7	11.9
.18	3378	24.9	12.5
.20	3433	25.3	12.7

*Cooling capacities were calculated using the following formula:

(CFM x Total Air Capture %) / 126*(CFM needed to cool 1kW @ 25°F △)* = kW per rack.

TAC Reduces Energy Usage

The total airflow required for cooling the same size data center is significantly reduced through the increased TAC rate provided by DirectAire. This reduction in total airflow has a dramatic effect on the fan energy required to move air throughout the data center.



The chart shows over a 40% reduction in the Total CFM required to cool a typical data center with a 2MW IT load using a typical grate compared to DirectAire.

For more info on DirectAire's airflow and heat load capacity and learn how these tests were conducted download the white paper at: www.tateinc.com/infloor

Tate®

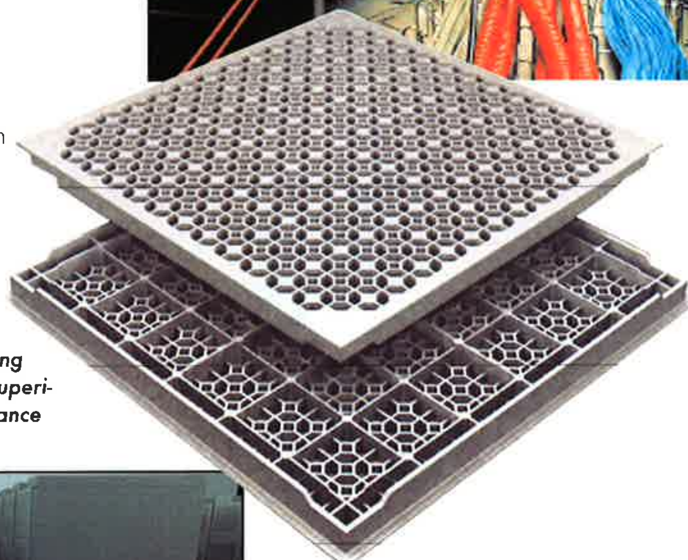
GrateAire®
56% Open Airflow Panel

Tate®

Heat Management Solution for Data Centers

System Highlights

- Unmatched ability to handle heat density needs of the most demanding mission critical facilities
- Achieve densification never before possible with perforated panels
- Unique design provides seamless compatibility with All Steel and ConCore® Panels
- Effortless reconfiguration and retrofit of any existing stringered access floor, without modification
- One GrateAire® can cool over 12kw of heat and up to 25kw in a contained system at .2 inches H_2O



The GrateAire® aluminum grate is designed for new and existing access floor installations, providing superior airflow and rolling load performance

GrateAire® allows unprecedented densification of server equipment. Blue arrows indicate cool air from grate entering server, which is the cold aisle. Red arrows indicate hot air exhausted from server, forming the hot aisle.

Benefits

COMPATIBILITY

- GrateAire® is compatible with All Steel and ConCore® panels utilizing bolted stringer systems

AIRFLOW

- One GrateAire® can perform the cooling of three perforated panels, without the comparable cost

ROLLING LOAD

- Nearly seven times more rolling load capacity than perforated panels. Can be used in aisles and high traffic areas

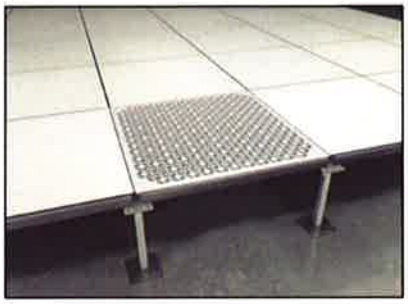
STRENGTH

- High strength, low weight, all aluminum die-cast construction

7510 Montevideo Rd. Jessup, MD 20794 • 800-231-7788 • tateinfo@tateaccessfloors.com • www.tateaccessfloor.com

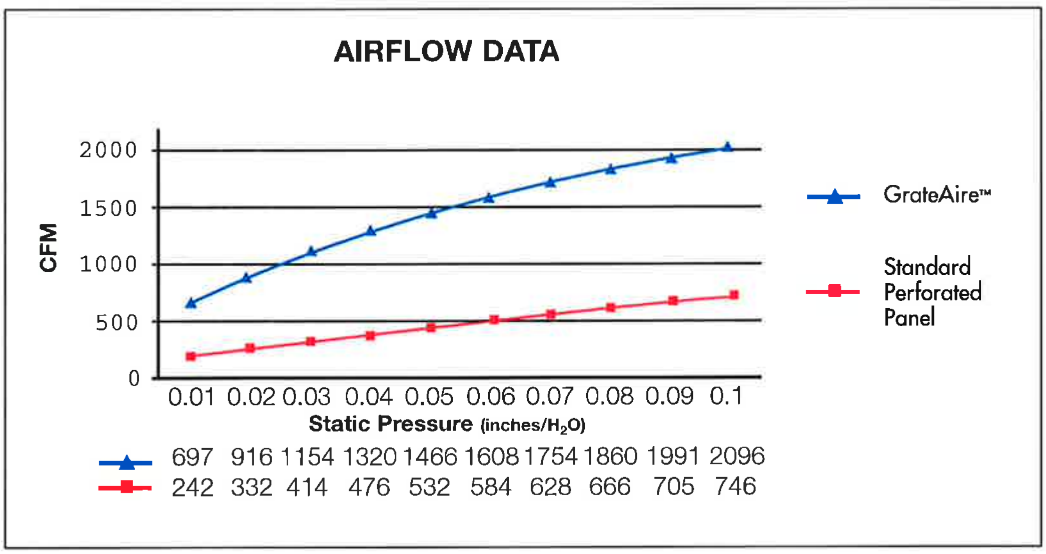
GrateAire® Specification

Tate®



GENERAL INFORMATION

- Compatible with All Steel and ConCore® panels
- 24 inches square
- Panel weight: 4.7 lbs/ft² bare
- Panel height: 1¹/4 ″
- Flange width: approximately ¹/2″ inch to accommodate standard ³/4″ wide x 1¹/4″ deep stringers
- Die cast aluminum construction
- Class A flame spread rating
- Non-combustible material
- 56% open area
- Available with coatings
- Top surface adjustable damper available
- Removable with portable lifting device
- Load performance – see table below
- Airflow data – see chart below



GrateAire® PERFORMANCE CHART

SYSTEM TYPE		STATIC LOADS			ROLLING LOADS		IMPACT LOAD
Panel	Understructure	Design Load	Safety Factor	Ultimate Load	10 Passes	10,000 Passes	
GrateAire®	Bolted Stringer	1,000 lbs.	Min. >2	2500 lbs.	1000 lbs.	800 lbs.	100 lbs.

Notes:

**All tests are performed using CISCA's Recommended Test Procedures for Access Floors with the exception of Design Load*

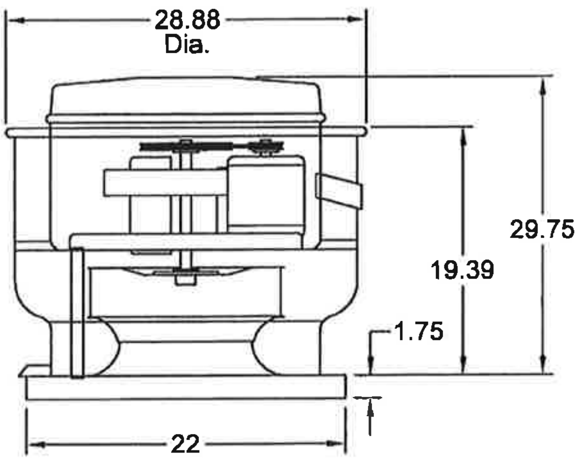
1. Design Load is tested using CISCA's Concentrated Load test method on actual understructure instead of steel blocks. Design Load is determined by taking the lesser value of ultimate load divided by two or the point at which permanent damage begins to occur (yield point).

2. Safety factor is the multiple of Design load to the Ultimate Load. International standards and Tate recommend a minimum of 2.

3. For further information and product specifications, call the Tate Hotline at 800-231-7788.

4. Based on typical computer room conditions running at 0.2" static pressure, whereby each 140cfm of cold air will dissipate approximately 1kW of heat.

7510 Montevideo Rd. Jessup, MD 20794 • 800-231-7788 • tateinfo@tateaccessfloors.com • www.tateaccessfloor.com



Reference assembly view drawings for actual dimensions with mounted accessories

Model: CUBE-161-10

Belt Drive Upblast Centrifugal Roof Exhaust Fan

Standard Construction Features:

- Aluminum housing - Curb cap with prepunched mounting holes - Motor and drives isolated on shock mounts - Drain trough - Ball bearing motors - Adjustable motor pulley - Adjustable motor plate - Fan shaft mounted in ball bearing pillow blocks - Bearings meet or exceed temperature rating of fan - Static resistant belts - Corrosion resistant fasteners - Internal lifting lugs

Options & Accessories:

NEMA Premium Efficient Motor - meets NEMA Table 12-12
Dual Drives
UL Listed - Power Vents for Smoke Control Systems (500F/4hrs + 1000F/15 mins)
Switch, NEMA-3R, Fused, Heavy Duty, Ship Separate, Field Mounted
High Wind Rated to 150.0 MPH
Florida Product Approval #FL13225.1 & Miami-Dade NOA #09-0624.09
Roof Curb, GPF-22-16-G12, Under Sized 1 in Total, Tray
Stainless Steel Fasteners - 300 Series
Stainless Steel Shaft - 300 Series
Birdscreen: Galvanized
Heat Baffle (Attached)
Bearings with Grease Fittings, L10 life of 100,000 hrs (L50 avg. life 500,000 hrs)
Steel Wheel Material

Dimensional

Qty	Weight w/o Accessories (lb)	Weight with Accessories (lb)	Roof Opening (in)
1	84	127	18.5 x 18.5

Performance

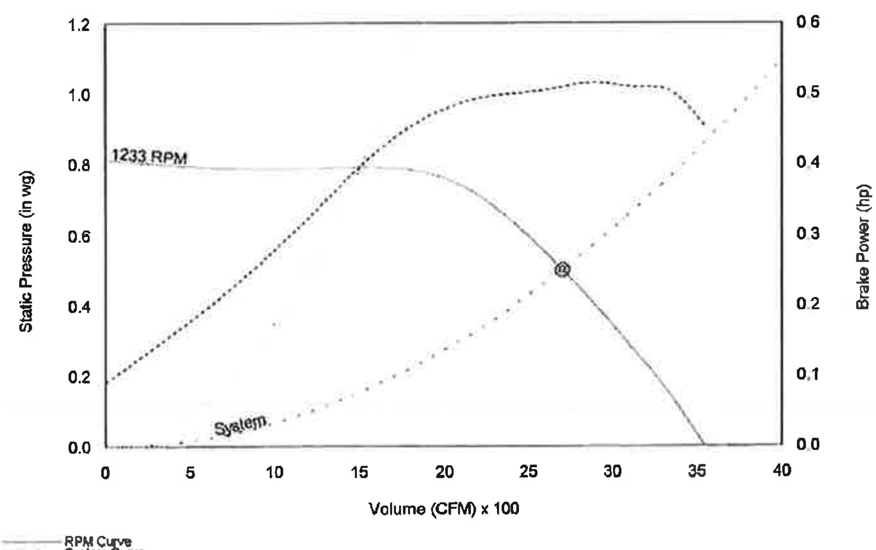
Requested Volume (CFM)	Actual Volume (CFM)	Requested SP (in wg)	Actual SP (in wg)	Fan RPM	Operating Power (hp)	Elevation (ft)	Airstream Temperature (F)	Drive Loss (%)	Tip Speed (ft/min)	SE (%)
2,700	2,700	0.5	0.5	1,233	0.51	0	400	12.1	5366	47.5

Motor

Motor Mounted	Size (hp)	V/C/P	Encl.	Motor RPM	Windings	NEC FLA* (Amps)
Yes	1	460/60/3	ODP	1725	1	2.1

Sound Power by Octave Band

Sound Data	62.5	125	250	500	1000	2000	4000	8000	LwA	dBA	Sones
Inlet	74	81	80	78	71	69	65	62	79	67	15.4



Notes:

All dimensions shown are in units of in
*FLA - based on tables 150 or 148 of National Electrical Code 2002. Actual motor FLA may vary, for sizing thermal overload, consult factory
LwA - A weighted sound power level, based on ANSI S1.4
dBA - A weighed sound pressure level, based on 11.5 dB attenuation per Octave band at 5.0 ft - dBA levels are not licensed by AMCA International
Sones - calculated using AMCA 301 at 5.0 ft

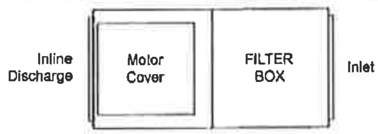
AMCA

amca
CERTIFIED
RATINGS
SOUND
AND
AIR
PERFORMANCE
®
AIR
MOVEMENT
AND CONTROL
ASSOCIATION
INTERNATIONAL, INC.

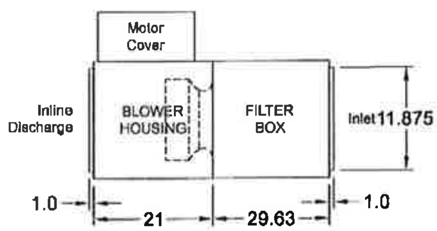
AMCA Licensed for Sound and Air Performance. Power rating (BHP/kW) does not include transmission losses.

Greenheck Fan Corporation certifies that the model shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program. Performance certified is for installation type A: Free inlet, Free outlet. Power rating (BHP/kW) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories). The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type A: free inlet hemispherical sone levels. dBA levels are not licensed by AMCA International. The AMCA Certified Ratings Seal applies to sone ratings only.

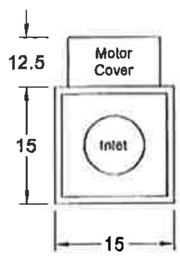
Printed Date: 7/2/2012
Job: Kirtland Data Center
Product Type: Fan
Mark: SF-1



PLAN VIEW



ELEVATION VIEW



END VIEW

Model: BSQ-80-7

Belt Drive Centrifugal Inline Fan

Standard Construction Features:

- Galvanized steel housing - Backward Inclined aluminum wheel - Two bolted access panels - Integral duct connection flanges - Ball bearing motors - Adjustable motor pulley - Adjustable motor plate - Fan shaft mounted in ball bearing pillow blocks - Static free belts - Corrosion resistant fasteners

Options & Accessories:

High Efficient Motor - meets Greenheck High Efficiency Table
Motor VFD Rated
Motor with Thermal Overload
Automatic Belt Tensioner
Grip Notch Belt(s)
Spare Belt(s) - 2 Sets (Attached)
UL/cUL 705 Listed - "Power Ventilators"
Switch, NEMA-1, Toggle, Junction Box Mounted & Wired
Stainless Steel Fasteners - 300 Series
Stainless Steel Shaft - 300 Series
Insulated Housing - 1 in Thick: Fan Housing, Filter Box, Motor Cover
Motor Cover
Sloped Filter Box, 2 in Pleated Filters, MERV 8
Isolators & Brackets (Qty:8), Spring Hanging (PN 850344)(Shipped Loose)

Dimensional

Qty	Weight w/o Accessories (lb)	Weight with Accessories (lb)
1	93	171

Performance

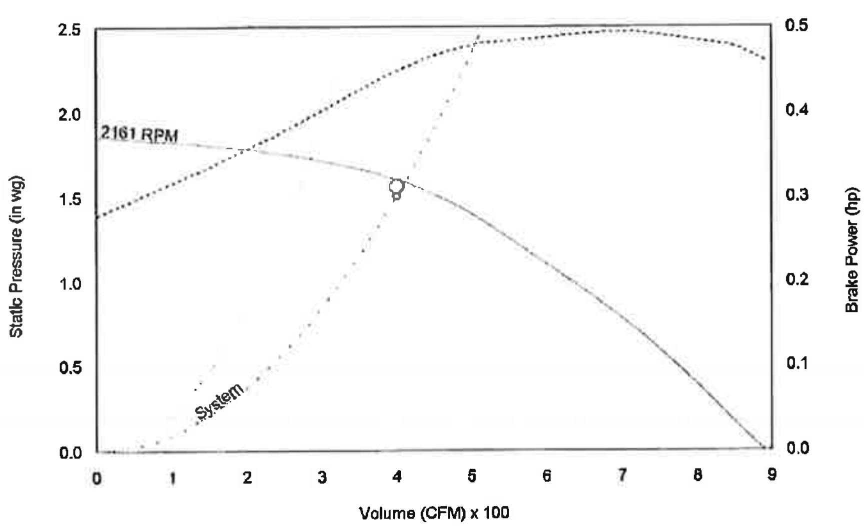
Requested Volume (CFM)	Actual Volume (CFM)	Requested SP (in wg)	Actual SP (in wg)	Fan RPM	Operating Power (hp)	Elevation (ft)	Airstream Temperature (F)	Drive Loss (%)	Tip Speed (ft/min)	SE (%)
400	400	1.5	1.557	2,161	0.44	0	70	12.9	6330	25.5

Motor

Motor Mounted	Size (hp)	V/C/P	Encl.	Motor RPM	Windings	NEC FLA* (Amps)
Yes	3/4	460/60/3	TEFC	1725	1	1.6

Sound Power by Octave Band

Sound Data	62.5	125	250	500	1000	2000	4000	8000	LwA	dBA	Sones
Inlet	82	85	81	81	70	66	64	61	80	69	17.1
Radiated	81	80	71	71	59	47	45	48	71	59	9.6



Notes:

All dimensions shown are in units of in
*FLA - based on tables 150 or 148 of National Electrical Code 2002. Actual motor FLA may vary, for sizing thermal overload, consult factory
LwA - A weighted sound power level, based on ANSI S1.4
dBA - A weighed sound pressure level, based on 11.5 dB attenuation per Octave band at 5.0 ft - dBA levels are not licensed by AMCA International
Sones - calculated using AMCA 301 at 5.0 ft

Building Value in Air.
GREENHECK

CAPS 4.3.979

H:\proj\14029303\HVAC\Kirtland Data Center.gcj

AMCA

AMCA Licensed for Sound and Air Performance Without Appurtenances (Accessories). Power rating (BHP/kW) does not include transmission losses.

Greenheck Fan Corporation certifies that the model shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program. Performance certified is for installation type B: Free inlet, Ducted outlet. Power rating (BHP/kW) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories). The inlet sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type B: free inlet hemispherical sone levels. dBA levels are not licensed by AMCA International. The AMCA Certified Ratings Seal applies to inlet sone ratings only. Radiated (casing) sound data is the sound generated through the fan housing when the fan is ducted on both the inlet and outlet.

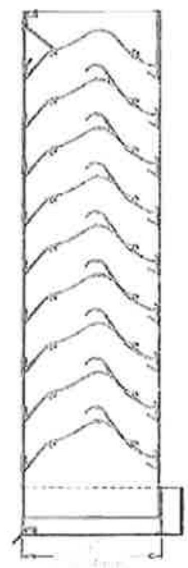
The AMCA licensed air and/or sound performance data has been modified for installation, appurtenances or accessories, etc. not included in the certified data. The modified performance is not AMCA licensed but is provided to aid in selection and applications of the product.

GREENHECK EHH-601

Wind-Driven Rain Louver
Horizontal Blade

Application and Design

EHH-601 is a Wind-Driven Rain louver designed to protect air intake and exhaust openings in building exterior walls that are sensitive to direct water penetration. Design incorporates a drainable head member and horizontal rain resistant blades to provide maximum resistance to wind driven rain in even the most extreme weather conditions. The EHH-601 is an **AMCA CERTIFIED LOUVER** enabling designers to select and apply with confidence.



Standard Construction

Frame . . . . Heavy gauge extruded 6063-T5 aluminum, 6 in. x 0.081 in. nominal wall thickness

Blades . . . . Horizontal rain resistant style, heavy gauge extruded 6063-T5 aluminum, 0.081 in. nominal wall thickness, positioned on approximately 2 in. blade spacing

Construction . . . . Mechanically fastened

Birdscreen . . . . . . 3/4 in. x 0.051 in. flattened expanded aluminum in removable frame, inside mount (rear)

Finish . . , ... Mill

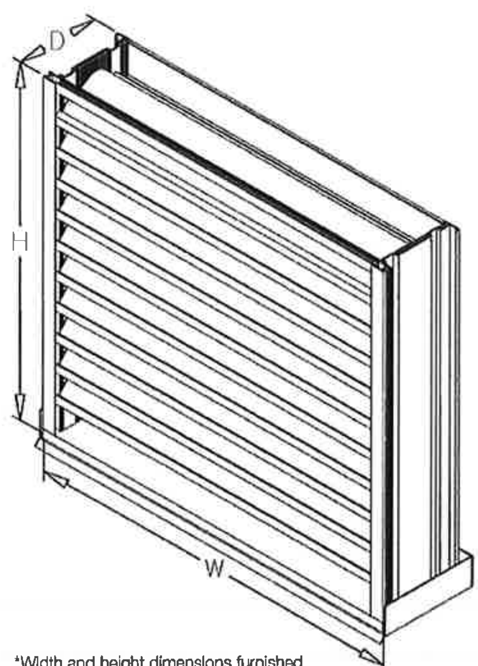
Sill Pan . . . . 0.063 formed aluminum

Minimum Size . . . 12 in. W x 7 in. H

Maximum Single Section Size . . . . 120 in. W or 120 in. H (limited to 70 ft. sq.)

Options *(at additional cost)*

- A variety of bird and insect screens
- Blank-off panel
- Clip angles
- Filter rack
- Flanged frame *(head and jamb only)*
- Security bars
- A variety of architectural finishes including:
  - Clear anodize
  - Integral color anodize
  - Baked enamel
  - Kynar



*Width and height dimensions furnished approximately ¼ inch under size.

PERFORMANCE DATA

EHH-601

Wind-Driven Rain Louver
Extruded Aluminum

Wind-Driven Rain Performance

75 mm/h (3 in./hr) Rainfall & 13 m/s (29 mph) Wind Velocity						202 mm/h (8 in./hr) Rainfall & 22 m/s (50 mph) Wind Velocity					
Free Area Velocity		Ventilation Air Core Velocity		Water Penetration		Free Area Velocity		Ventilation Air Core Velocity		Water Penetration	
(fpm)	(m/s)	(fpm)	(m/s)	Class	Effective	(fpm)	(m/s)	(fpm)	(m/s)	Class	Effective
0	0	0	0			0	0	0	0		
179	0.9	98	0.5			179	0.9	98	1.0		
359	1.8	197	1.0			359	1.8	197	1.5		
538	2.7	295	1.5			538	2.7	295	2.0		
718	3.6	394	2.0			718	3.6	394	2.5		
897	4.6	492	2.5			864	4.4	474	2.4	99.5	A
1077	5.5	591	3.0			1033	5.2	567	2.9	99.6	A
1217	6.2	668	3.4	A	100.0	1232	6.3	676	3.4	99.2	A
1391	7.1	763	3.9	A	99.8	1394	7.1	765	3.9	98.5	B
1527	7.8	838	4.3	B	98.1	1567	8.0	860	4.4	95.6	B
1801	9.1	988	5.0	B	95.4	1744	8.9	957	4.9	88.7	C

Discharge Loss Coefficient Classifications	
Class	Discharge Loss Coefficient
1	0.4 and Above
2	0.3 to 0.399
3	0.2 to 0.299
4	0.199 and Below

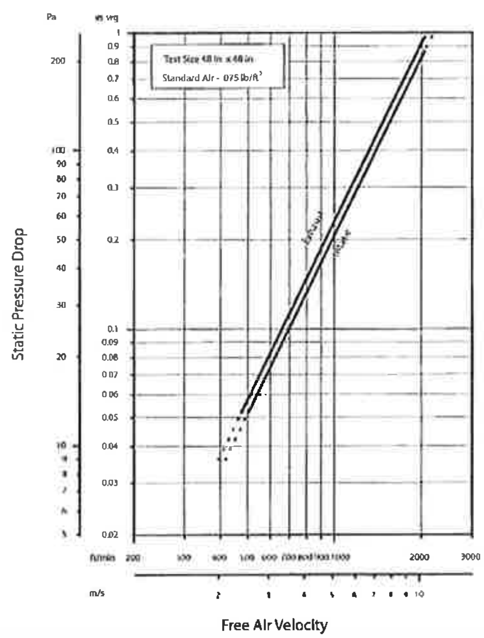
Wind-driven Rain Penetration Classes	
Class	Effectiveness
A	1 to 0.99
B	0.989 to 0.95
C	0.949 to 0.80
D	Below 0.80

Greenheck Fan Corporation certifies that the EHH-601 louvers shown herein are licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to air performance, water penetration, and wind-driven rain ratings.

Discharge Loss Coefficient Class (Intake) = 2

Weather louvers shall be classified by their ability to reject simulated rain. The table shows different classifications based on the maximum simulated rain penetration per square meter (square feet) of louver. Water penetration rating at a given louver face velocity is determined by the water penetration while the louver is subjected to a selected simulated rainfall rate and wind velocity.

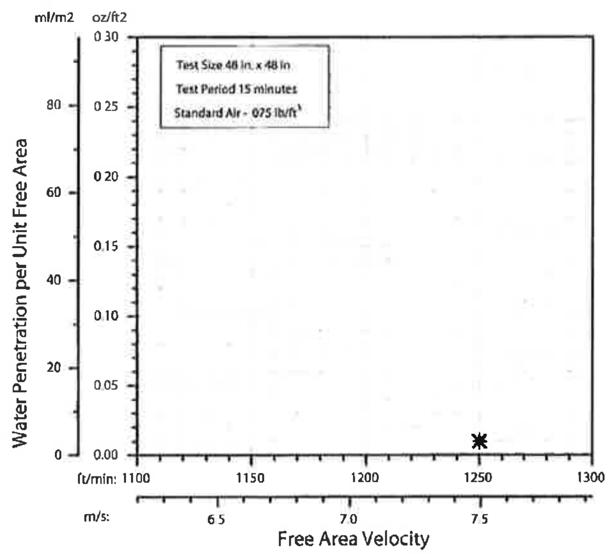
Airflow Resistance (Standard Air - .075 lb/ft³)



Model EHH-601 resistance to airflow (pressure drop) varies depending on louver application (air intake or air exhaust). Free area velocities (shown) are higher than average velocity through the overall louver size. See louver selection information.

Water Penetration

Test Size 48 in. x 48 in. Test Duration of 15 min



The AMCA Water Penetration Test provides a method for comparing various louver models and designs as to their efficiency in resisting the penetration of rainfall under specific laboratory test conditions. The beginning point of water penetration is defined as that velocity where the water penetration curve projects through 0.01 oz. of water (penetration) per sq. ft. of louver free area. ***The beginning point of water penetration for Model EHH-601 is above 1250 fpm free area velocity.** These performance ratings do not guarantee a louver to be weather-proof or stormproof and should be used in combination with other factors including good engineering judgement in selecting louvers.

PERFORMANCE DATA

EHH-601

Wind-Driven Rain Louver
Extruded Aluminum

Free Area Chart (sq. ft.)

Louver Height Inches	Louver Width in Inches																		
	12	18	24	30	36	42	**48**	54	60	66	72	78	84	90	96	102	108	114	120
7	0.07	0.12	0.17	0.21	0.26	0.31	0.36	0.39	0.44	0.48	0.53	0.58	0.63	0.67	0.72	0.75	0.80	0.85	0.89
12	0.23	0.38	0.53	0.67	0.82	0.97	1.12	1.23	1.37	1.52	1.67	1.82	1.96	2.11	2.26	2.37	2.51	2.66	2.81
18	0.47	0.77	1.07	1.36	1.66	1.96	2.26	2.48	2.78	3.08	3.37	3.67	3.97	4.27	4.56	4.79	5.09	5.38	5.68
24	0.71	1.16	1.61	2.05	2.50	2.95	3.40	3.74	4.18	4.63	5.08	5.53	5.98	6.42	6.87	7.21	7.66	8.11	8.55
30	0.95	1.55	2.15	2.74	3.34	3.94	4.54	4.99	5.59	6.19	6.79	7.38	7.98	8.58	9.18	9.63	10.23	10.83	11.43
36	1.11	1.81	2.50	3.20	3.90	4.60	5.30	5.83	6.52	7.22	7.92	8.62	9.32	10.02	10.72	11.24	11.94	12.64	13.34
42	1.35	2.19	3.04	3.89	4.74	5.59	6.44	7.08	7.93	8.78	9.63	10.48	11.33	12.18	13.03	13.66	14.51	15.36	16.21
48	1.58	2.58	3.58	4.58	5.58	6.58	**7.58**	8.33	9.33	10.33	11.33	12.33	13.33	14.33	15.33	16.08	17.08	18.08	19.08
54	1.82	2.97	4.12	5.27	6.42	7.57	8.72	9.59	10.74	11.89	13.04	14.19	15.34	16.49	17.64	18.50	19.66	20.81	21.96
60	2.06	3.36	4.66	5.96	7.26	8.57	9.87	10.84	12.14	13.44	14.75	16.05	17.35	18.65	19.95	20.93	22.23	23.53	24.83
66	2.30	3.75	5.20	6.65	8.10	9.56	11.01	12.10	13.55	15.00	16.45	17.90	19.35	20.81	22.26	23.35	24.80	26.25	27.70
72	2.46	4.01	5.56	7.11	8.66	10.22	11.77	12.93	14.48	16.04	17.59	19.14	20.69	22.24	23.80	24.96	26.51	28.06	29.61
78	2.70	4.40	6.10	7.80	9.50	11.21	12.91	14.19	15.89	17.59	19.29	21.00	22.70	24.40	26.10	27.38	29.08	30.78	32.49
84	2.93	4.79	6.64	8.49	10.35	12.20	14.05	15.44	17.29	19.15	21.00	22.85	24.71	26.56	28.41	29.80	31.65	33.51	35.36
90	3.17	5.18	7.18	9.18	11.19	13.19	15.19	16.69	18.70	20.70	22.70	24.71	26.71	28.72	30.72	32.22	34.22	36.23	38.23
96	3.41	5.56	7.72	9.87	12.03	14.18	16.33	17.95	20.10	22.26	24.41	26.56	28.72	30.87	33.03	34.64	36.80	38.95	41.10
102	3.65	5.95	8.26	10.56	12.87	15.17	17.47	19.20	21.51	23.81	26.12	28.42	30.73	33.03	35.33	37.06	39.37	41.67	43.98
108	3.81	6.21	8.62	11.02	13.43	15.83	18.24	20.04	22.44	24.85	27.25	29.66	32.06	34.47	36.87	38.68	41.08	43.49	45.89
114	4.05	6.60	9.16	11.71	14.27	16.82	19.38	21.29	23.85	26.40	28.96	31.51	34.07	36.62	39.18	41.10	43.65	46.21	48.76
120	4.28	6.99	9.70	12.40	15.11	17.81	20.52	22.55	25.25	27.96	30.66	33.37	36.08	38.78	41.49	43.52	46.22	48.93	51.63

Core Area Chart (sq. ft.)

Louver Height Inches	Louver Width In Inches																		
	12	18	24	30	36	42	**48**	54	60	66	72	78	84	90	96	102	108	114	120
7	0.20	0.32	0.45	0.57	0.70	0.82	0.95	1.07	1.20	1.32	1.45	1.57	1.70	1.82	1.95	2.07	2.20	2.32	2.45
12	0.53	0.86	1.19	1.53	1.86	2.19	2.53	2.86	3.19	3.53	3.86	4.19	4.53	4.86	5.19	5.53	5.86	6.19	6.53
18	0.92	1.51	2.09	2.67	3.26	3.84	4.42	5.01	5.59	6.17	6.76	7.34	7.92	8.51	9.09	9.67	10.26	10.84	11.42
24	1.32	2.15	2.99	3.82	4.65	5.49	6.32	7.15	7.99	8.82	9.65	10.49	11.32	12.15	12.99	13.82	14.65	15.49	16.32
30	1.72	2.80	3.88	4.97	6.05	7.13	8.22	9.30	10.38	11.47	12.55	13.63	14.72	15.80	16.88	17.97	19.05	20.13	21.22
36	2.11	3.44	4.78	6.11	7.44	8.78	10.11	11.44	12.78	14.11	15.44	16.78	18.11	19.44	20.78	22.11	23.44	24.78	26.11
42	2.51	4.09	5.67	7.26	8.84	10.42	12.01	13.59	15.17	16.76	18.34	19.92	21.51	23.09	24.67	26.26	27.84	29.42	31.01
48	2.90	4.74	6.57	8.40	10.24	12.07	**13.90**	15.74	17.57	19.40	21.24	23.07	24.90	26.74	28.57	30.40	32.24	34.07	35.90
54	3.30	5.38	7.47	9.55	11.63	13.72	15.80	17.88	19.97	22.05	24.13	26.22	28.30	30.38	32.47	34.55	36.63	38.72	40.80
60	3.69	6.03	8.36	10.69	13.03	15.36	17.69	20.03	22.36	24.69	27.03	29.36	31.69	34.03	36.36	38.69	41.03	43.36	45.69
66	4.09	6.67	9.26	11.84	14.42	17.01	19.59	22.17	24.76	27.34	29.92	32.51	35.09	37.67	40.26	42.84	45.42	48.01	50.59
72	4.49	7.32	10.15	12.99	15.82	18.65	21.49	24.32	27.15	29.99	32.82	35.65	38.49	41.32	44.15	46.99	49.82	52.65	55.49
78	4.88	7.97	11.05	14.13	17.22	20.30	23.38	26.47	29.55	32.63	35.72	38.80	41.88	44.97	48.05	51.13	54.22	57.30	60.38
84	5.28	8.61	11.94	15.28	18.61	21.94	25.28	28.61	31.94	35.28	38.61	41.94	45.28	48.61	51.94	55.28	58.61	61.94	65.28
90	5.67	9.26	12.84	16.42	20.01	23.59	27.17	30.76	34.34	37.92	41.51	45.09	48.67	52.26	55.84	59.42	63.01	66.59	70.17
96	6.07	9.90	13.74	17.57	21.40	25.24	29.07	32.90	36.74	40.57	44.40	48.24	52.07	55.90	59.74	63.57	67.40	71.24	75.07
102	6.47	10.55	14.63	18.72	22.80	26.88	30.97	35.05	39.13	43.22	47.30	51.38	55.47	59.55	63.63	67.72	71.80	75.88	79.97
108	6.86	11.19	15.53	19.86	24.19	28.53	32.86	37.19	41.53	45.86	50.19	54.53	58.86	63.19	67.53	71.86	76.19	80.53	84.86
114	7.26	11.84	16.42	21.01	25.59	30.17	34.76	39.34	43.92	48.51	53.09	57.67	62.26	66.84	71.42	76.01	80.59	85.17	89.76
120	7.65	12.49	17.32	22.15	26.99	31.82	36.65	41.49	46.32	51.15	55.99	60.82	65.65	70.49	75.32	80.15	84.99	89.82	94.65

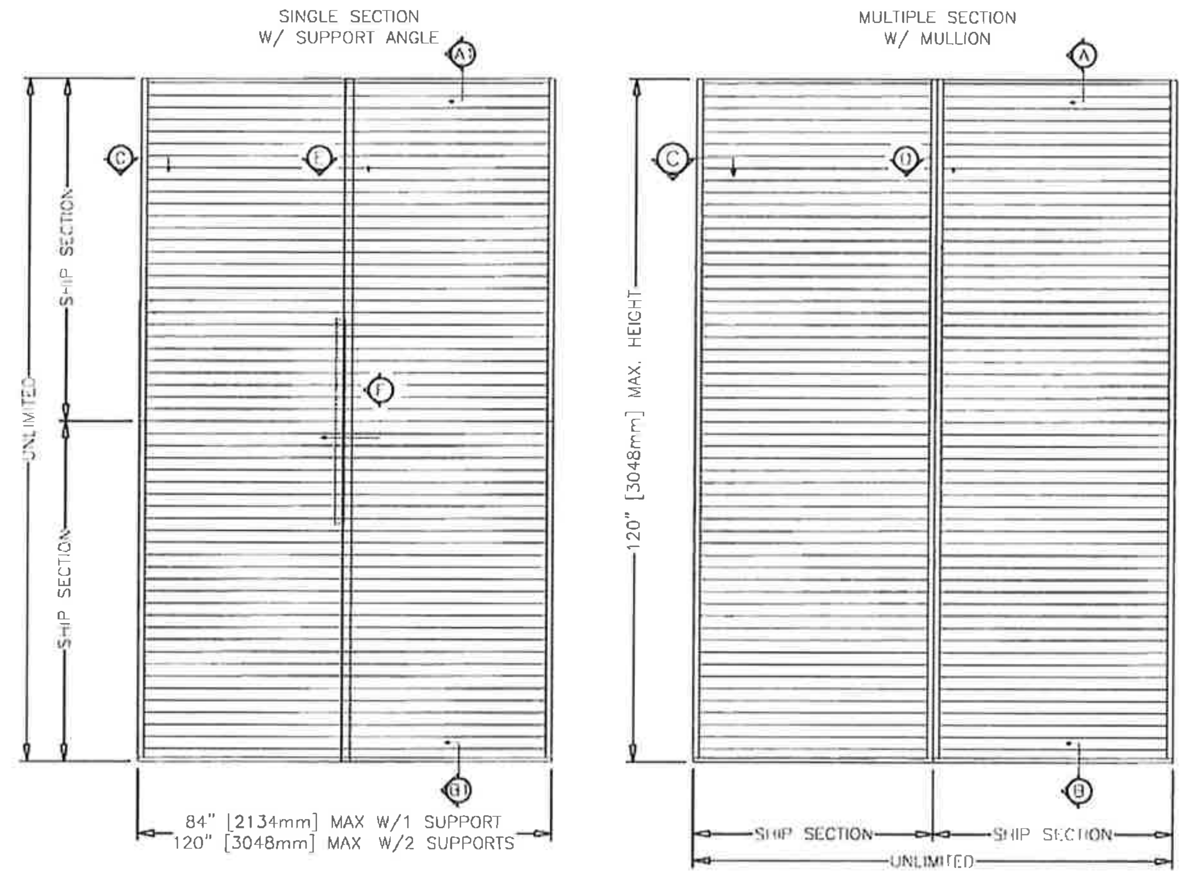
INSTALLATION DETAILS

EHH-601

Wind-Driven Rain Louver
Extruded Aluminum

Maximum Size and Installation Information

Maximum single section size for model EHH-601 is 120 in. W x 84 in. H or 84 in. W x 120 in. H (70 sq. ft). Larger openings require field assembly of multiple louver panels to make up the overall opening size. Individual louver panels are designed to withstand a 25 PSF wind-load (please consult Greenheck if the louvers must withstand higher wind-loads). Structural reinforcing members may be required to adequately support and install multiple louver panels within a large opening. Structural reinforcing members along with any associated installation hardware is not provided by Greenheck unless indicated otherwise by Greenheck. Additional information on louver installation may be found in AMCA Publication #501, Louver Application Manual.

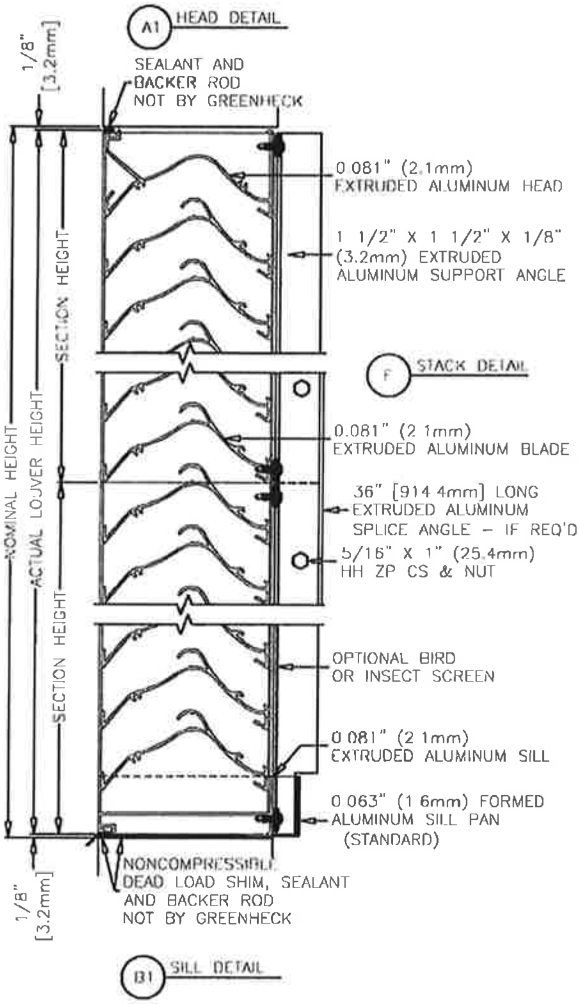


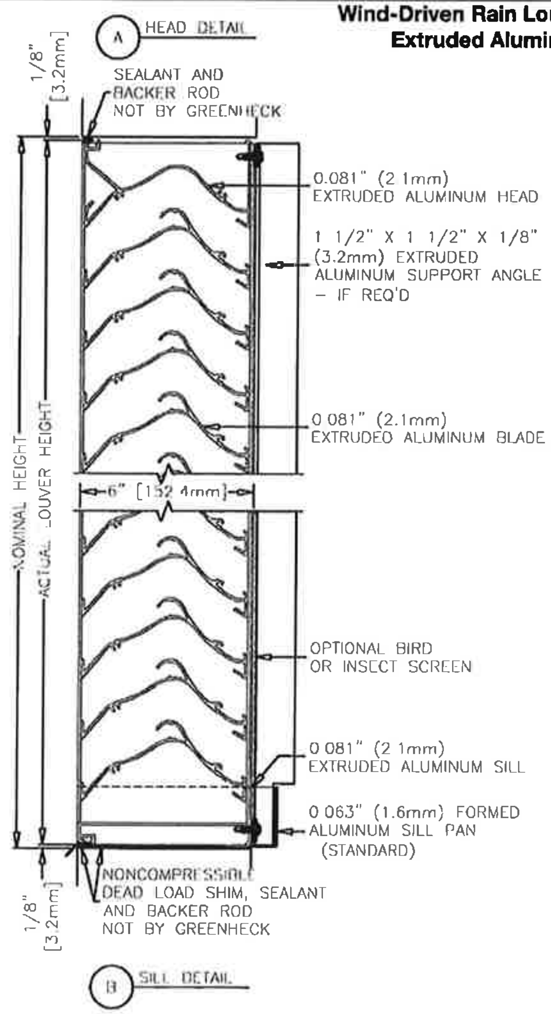
Minimum Single Section Size	Maximum Single Section Size
12 in. W x 7 in. H	70 ft. sq.

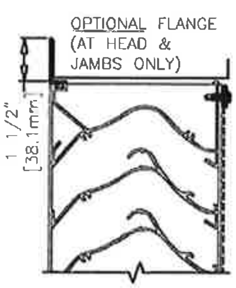
PRODUCT DETAILS

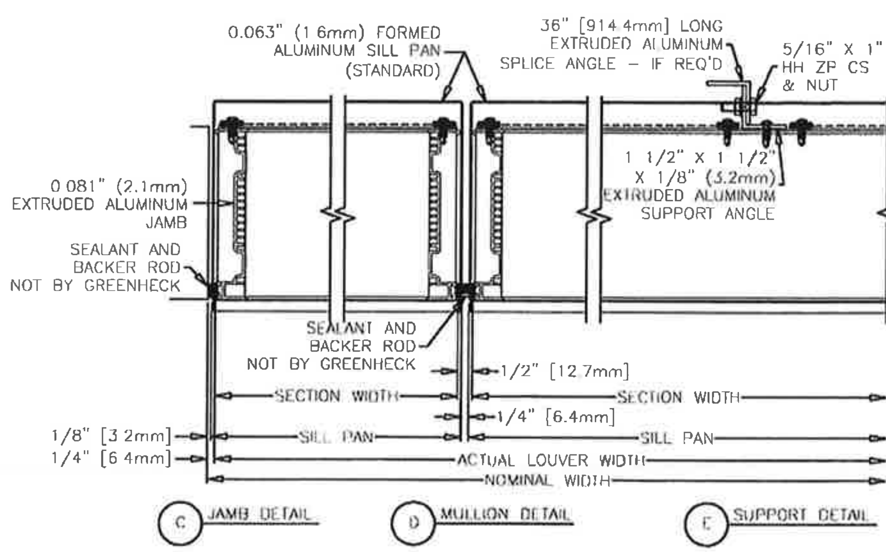
EHH-601

Wind-Driven Rain Louver
Extruded Aluminum







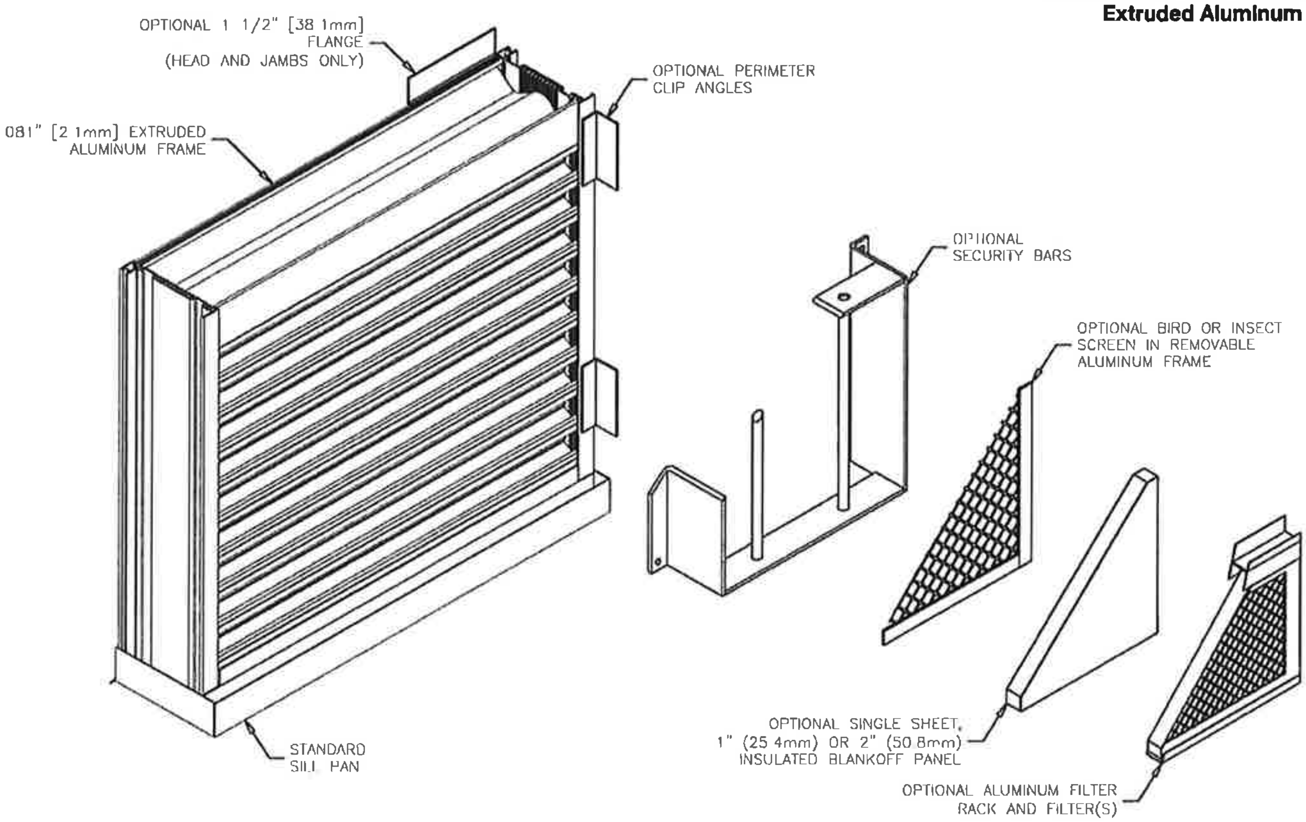


GREENHECK

OPTION DRAWINGS

EHH-601

Wind-Driven Rain Louver
Extruded Aluminum



FINISHES

Finish Type	Description/Application	Color Selection	Standard Warranty (Aluminum)
2-coat 70% KYNAR 500®/HYLAR 5000® AAMA 2605 – Dry film thickness 1.2 mil. (AKA: Duranar®, Fluoropon®, Trinar®, Flouropolymer, Polyvinylidene Fluoride, PVDF2)	***"Best."*** **The premier finish for extruded aluminum. Tough, long-lasting coating has superior color retention and abrasive properties. Resists chalking, fading, chemical abrasion and weathering.**	**Standard Colors:** Any of the 24 standard colors shown can be furnished in 70% or 50% KYNAR 500®/HYLAR 5000® or Baked Enamel.	10 Years (Consult Greenheck for availability of extended warranty)
2-coat 50% KYNAR 500®/HYLAR 5000® AAMA 2604 – Dry film thickness 1.2 mil. (AKA: Acroflur®, Acrynar®)	***"Better."*** Tough, long-lasting coating has excellent color retention and abrasive properties. Resists chalking, fading, chemical abrasion and weathering.	**2-Coat Mica:** Greenheck offers 9 standard 2-coat Mica colors. Other colors are available. Consult Greenheck for possible extra cost when selecting non-standard colors or special finishes.	5 Years
Baked Enamel AAMA 2603 – Dry film thickness 0.8 mil. (AKA: Acrabond Plus®, Duracron®)	***"Good."*** Provides good adhesion and resistance to weathering, corrosion and chemical stain.		1 Year
Integral Color Anodize AA-M10C22A42 (>0.7 mil)	"Two-step" anodizing is produced by following the normal anodizing step with a second, colorfast process.	Light, Medium or Dark Bronze; Champagne; Black	5 years
Clear Anodize 215 R-1 AA-M10C22A41 (>0.7 mil)	Clear, colorless and hard oxide aluminum coating that resists weathering and chemical attack.	Clear	5 years
Clear Anodize 204 R-1 AA-M10C22A31 (0.4-0.7 mil)	Clear, colorless and hard oxide aluminum coating that resists weathering and chemical attack.	Clear	1 Year
Industrial coatings	Greenheck offers a number of industrial coatings such as Hi-Pro Polyester, Epoxy, and Permatector®. Consult a Greenheck Product Specialist for complete color and application information.		Consult Greenheck
Mill	Materials may be supplied in natural aluminum or galvanized steel finish when normal weathering is acceptable and there is no concern for color or color change.		n/a

Finishes meet or exceed AAMA 2605, AAMA 2604, and AAMA 2603 requirements. Please consult www.greenheck.com for complete information on standard and extended paint warranties. Paint finish warranties are not applicable to steel products.

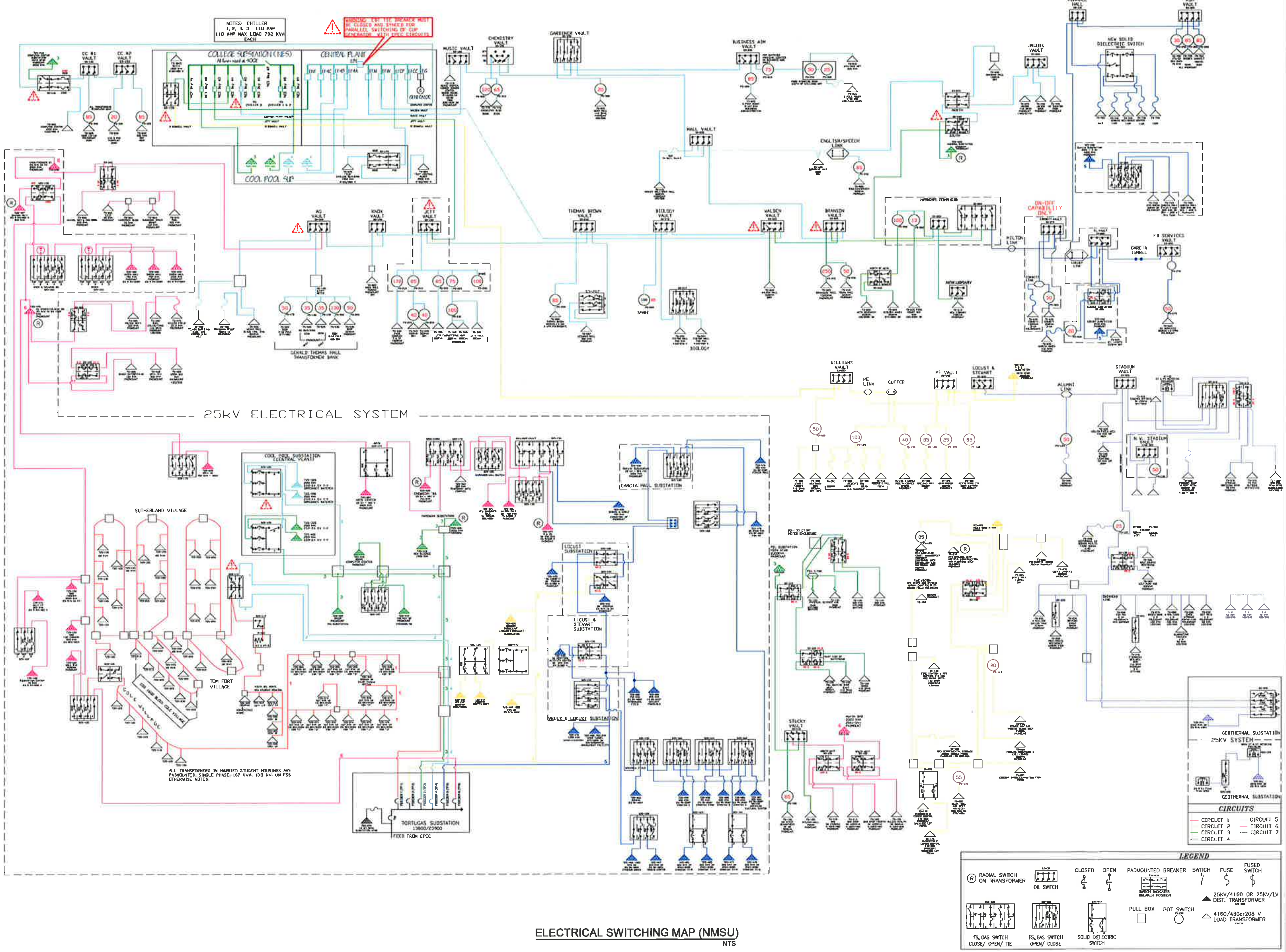
GREENHECK

P.O. Box 410 • Schofield, WI 54476-0410 • 715.359.6171 • greenheck.com

APPENDIX D

EXISTING POWER ONE LINE DIAGRAMS

- SWITCHING DIAGRAM
- 80 K VA ONE LINE DIAGRAM
- DATA CENTER ONE LINE DIAGRAM



ELECTRICAL SWITCHING MAP (NMSU)

NTS

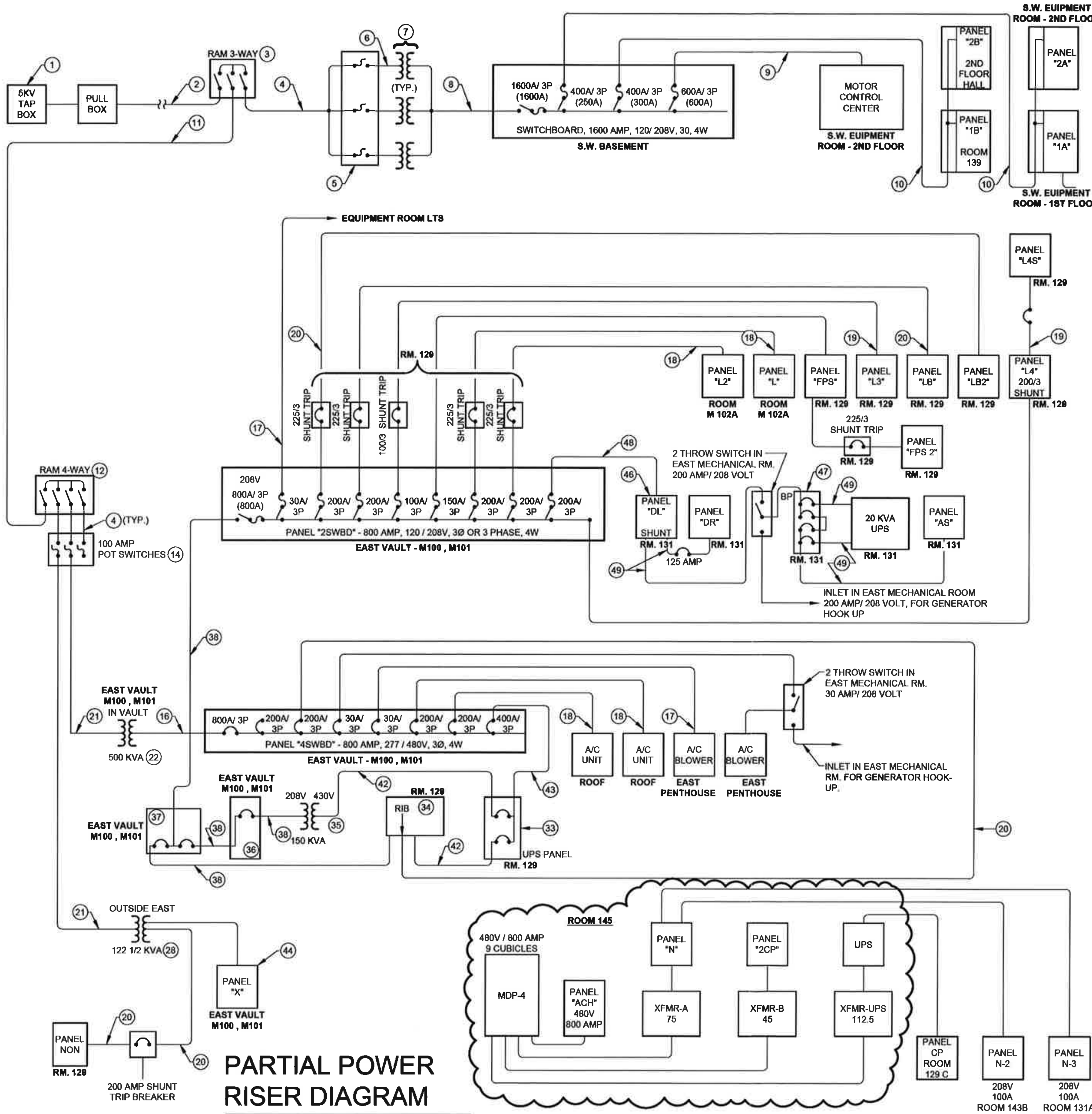
NM STATE UNIVERSITY

PROJECTS / ENGINEERING
FACILITIES & SERVICES
MSC 3545
P.O.Box 30001
Las Cruces, NM 88003-8001

NEW MEXICO STATE UNIVERSITY
LAS CRUCES, NEW MEXICO

SHEET TITLE
ELECTRIC SWITCHING MAP

SHEET
E-1.0



PARTIAL POWER RISER DIAGRAM

NTS

KEYED NOTES

1. 4-WAY LINK BOX-5KV-500A IN UTILITY.
2. THREE #3/ 0 5KV SHIELDED AND ON #3/0 ????? NEUTRAL IN 3" C.
3. 400A, 3-WAY OIL SELECTOR SWITCH.
4. #2 5KV SHIELDED CONDUCTOR.
5. 100A, 5KV OIL FUSED CUTOUTS.
6. THREE #2 5KV UNSHIELDED.
7. THREE, 167 KVA, 2400/ 4160-120/ 240V. ???? TRANSFORMERS.
8. FOUR #600 MCM-THW PER PHASE AND NEUTRAL.
9. PARALLEL RUN OF TWO 3" C EACH WITH ???? MCM AND ONE #2.
10. FOUR #300 MCM AND ONE #2 IN 3" C.
11. THREE #1/0 5KV SHIELDED 3" CONDUIT.
12. 400A, 4-WAY OIL SELECTOR SWITCH.
13. NOT USED
14. 100A, 5KV, OIL FUSED CUTOUTS.
15. NOT USED
16. PARALLEL RUN OF TWO 3-1/2" C EACH WITH ??? MCM.
17. FOUR #10 IN 3/4" C.
18. FOUR #1/0 AND ONE #6 IN 2# C.
19. FOUR #2 AND ONE #8 IN 1-1/2" C.
20. FOUR #3/0 AND ONE #6 IN 2-1/2" C.
21. THREE #2 5KV AND ONE #2 TW IN 3" CONDUIT.
22. 500 KVA, 2400/ 4160-277/ 480V DRY TYPE TRANSFORMER.
23. NOT USED
24. NOT USED
25. NOT USED
26. NOT USED
27. NOT USED
28. 112.5 KVA 2400/ 4160-120/ 208V, THREE PHASE TRANSFORMER.
29. NOT USED
30. NOT USED
31. 225/3 - SHUNT TRIP BREAKER.
32. NOT USED
33. NEW 400A MLO. 480V PANEL FEEDING UPS & TRANSFORMER W/ 2-225A BREAKERS.
34. 160 KVA UPS NEW.
35. 150 KVA 480-120/ 208 3Ø DRY TYPE TRANSFORMER.
36. 250VNI 600A/ 500A TRIP MBP CIRCUIT BREAKER W/ ENCLOSURE.
37. MBP MLO ONLY W/ 2-600A FRAME/ 500A-TRIP C.B.
38. 2 RUNS - 4 #250 MCM THHN COPPER.
39. NOT USED
40. NOT USED
41. NOT USED
42. 4 - #3/0 THHN COPPER.
43. 4 - #500 MCM THHN.
44. 100A - 120/208 3Ø 4W - MCB PANEL.
45. NOT USED
46. 225 AMP SHUNT TRIP MAIN PANEL.
47. UPS BYPASS PANEL.
48. 3 - #4/0 THHN #2 GROUND.
49. 4 - #1/0 THHN #6 GROUND.

NM STATE UNIVERSITY

PROJECTS/ENGEERING
FACILITIES & SERVICES

MSC 3545
P.O.Box 30001
Las Cruces, NM 88003-8001

MARK	DATE	DESCRIPTION
D.F.	2-20-13	REDLINE - REVISIONS

COMPUTER CENTER (126) - PARTIAL POWER RISER DIAGRAM

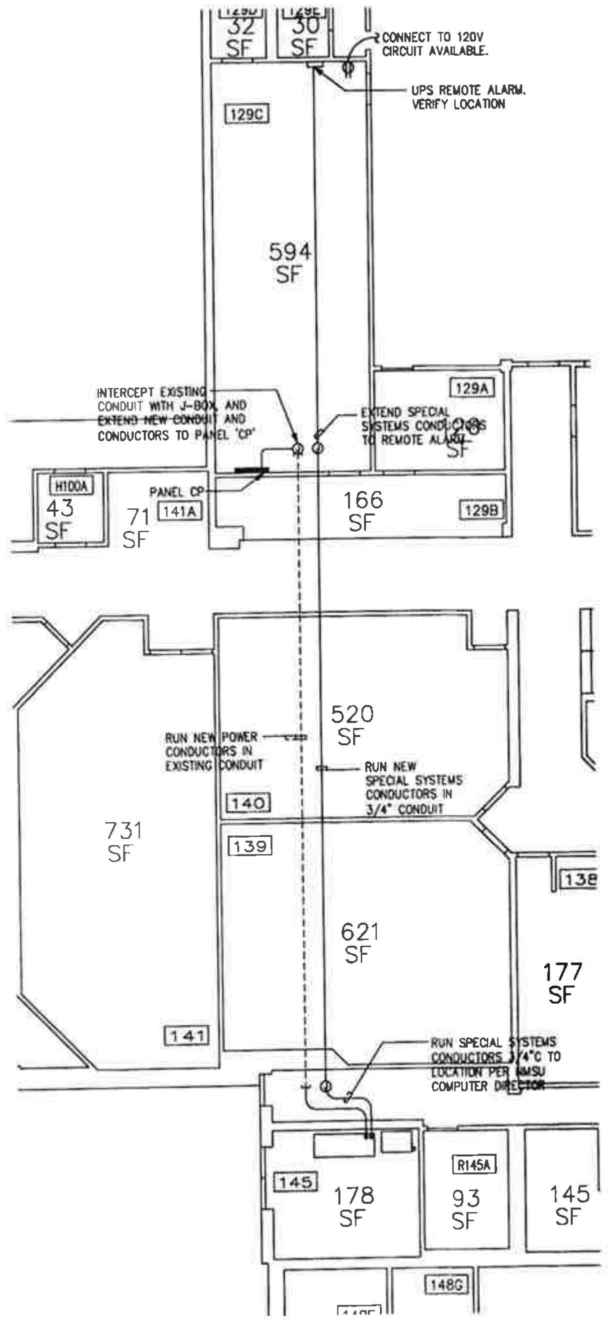
NEW MEXICO STATE UNIVERSITY
LAS CRUCES, NEW MEXICO

DATE:	2/20/2013 12:40:20 PM
PROJECT NO:	12-034677
PLOT TYPE:	18x24
FILE TYPE:	DWG
DRAWN BY:	D. Fernandez
CHK'D BY:	D. Coon

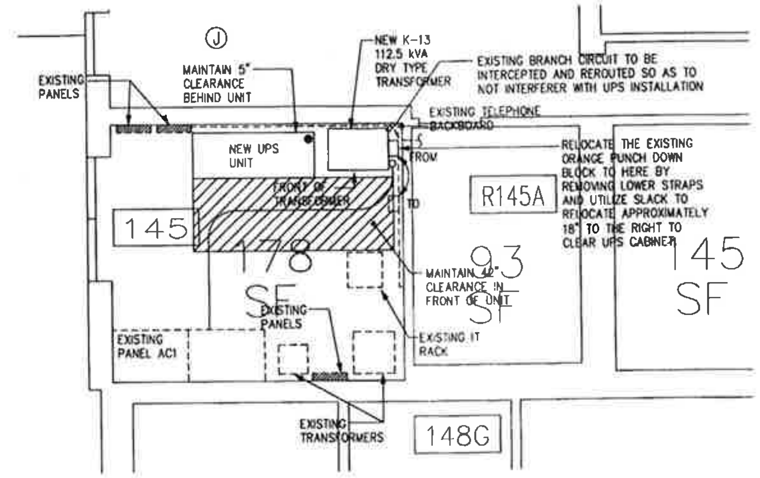
SHEET TITLE
PARTIAL POWER RISER DIAGRAM

SHEET
E-1.0
1 OF 1

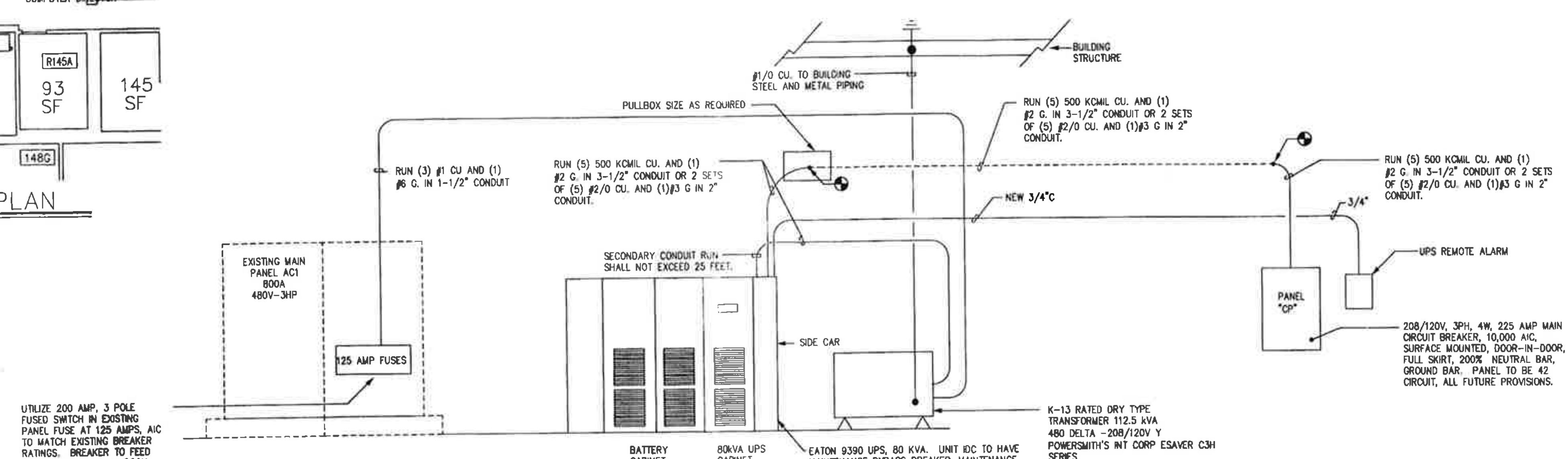
G:\Data Management\CADD\cad projects\Drawing and File Mgt\FS SHOPS\Electric shop\David Coon\Computer Center\Computer Center - Partial Riser Diagram - V1.2 - 2-20-13.dwg



1
E1-0
UPS ELECTRICAL PLAN
SCALE: 1/8"=1'-0"



2
E1-0
ENLARGED ELECTRICAL ROOM
SCALE: 1/4"=1'-0"



3
E1-0
ELECTRICAL RISER
SCALE: 1/4"=1'-0"

NEW MEXICO STATE UNIVERSITY
PROJECT MANAGEMENT OFFICE
OFFICE OF FACILITIES AND SERVICES
P.O. BOX 30001, DEPT. 3545
LAS CRUCES, NEW MEXICO 88003

COMPUTER CENTER
NEW MEXICO STATE UNIVERSITY

DESIGNER:	RBM
DRAWN BY:	CAD
PROJECT NO.	
DATE:	June 17 2008
CHECKED BY:	RBM

REVISIONS

	DATE:
Tom Z.	9-15-08

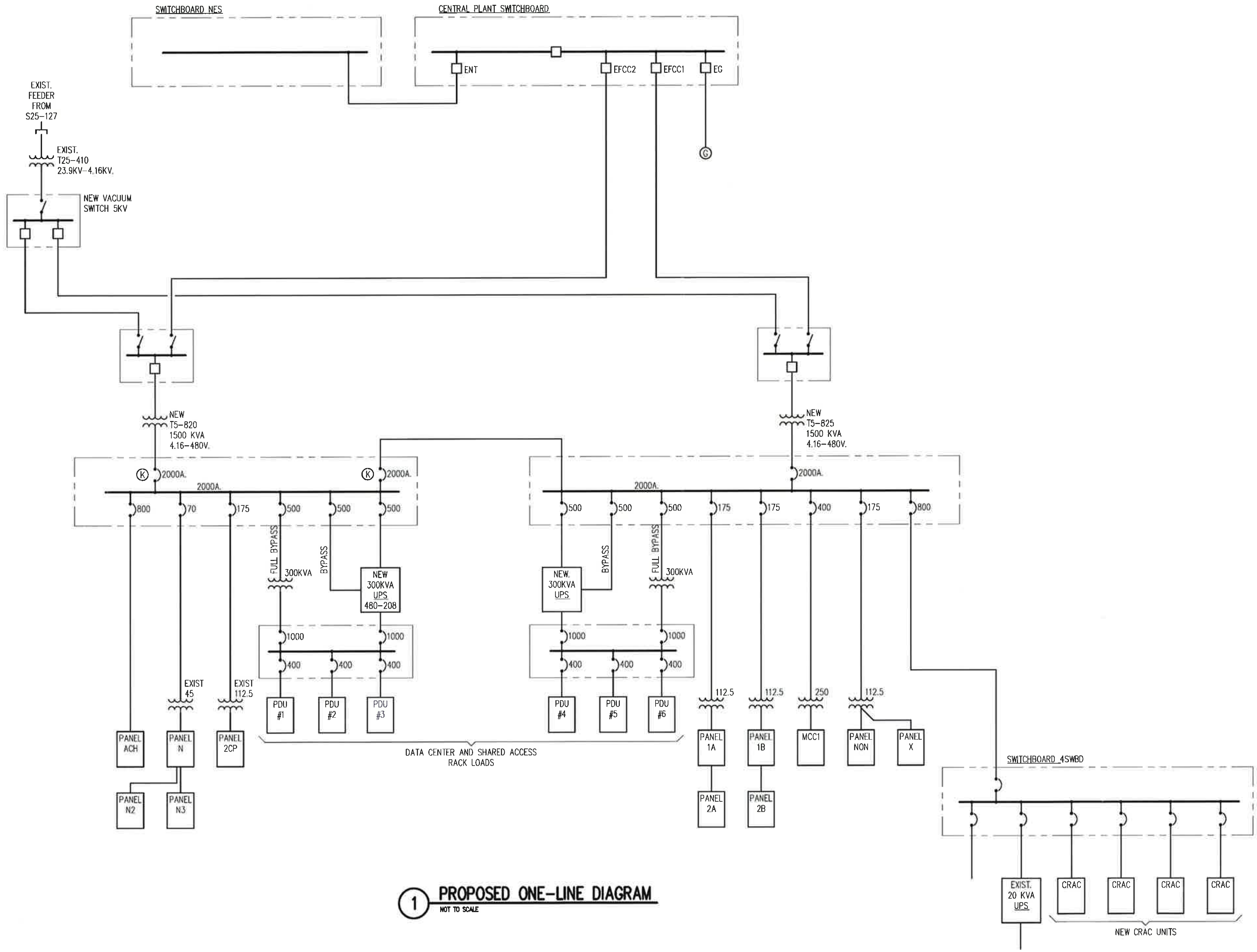
DIR/NAME

RBM ENGINEERING INC.
1014 SOUTH MAIN STE. C
LAS CRUCES, NM 88005
(505) 647-1554
FAX (915) 584-8723
rbm@rbm.cc

SHEET NO.
E1-0

APPENDIX E

PROPOSED POWER ONE LINE DIAGRAMS



1 PROPOSED ONE-LINE DIAGRAM

NOT TO SCALE

HUITT-ZOLLARS
ARCHITECTS - PLANNERS - ENGINEERS
6501 Americas Parkway NE, Suite 550
Albuquerque, New Mexico 87110-5372
Phone (505) 883-8114 Fax (505) 883-5022

NM STATE UNIVERSITY

PROPOSED ONE LINE RISER DIAGRAM

Computer Data Center Renovation & HVAC Upgrades
NEW MEXICO STATE UNIVERSITY

DATE: 12/16/2013
DRAWN: JC
DESIGNED: RLD
CHECKED: RLD
PROJ. NO. 14029405

SHEET: ESK-1

FILE NAME: I:\proj\14029405\Dwgs\14029405_E603.dwg LAYOUT NAME: Riser PLOTTED: Monday, December 16, 2013 - 3:05pm

APPENDIX F

OWNER PROVIDED INFORMATION

All Locations

LOCATION	MODEL	HEAT	POWER
Bladecenter 20	HS20 (8843)	11942	3500
Bladecenter 40	HS20 (8843)	11942	3500
Bladecenter 40	HS20 (8843)	11942	3500
ICT Room 129 Table	Proliant ML570	2400	690
ICT Room 129 Table	Proliant ML350	1794	526
ICT Room 129 Table	Proliant ML330	3530	1200
ICT Room 129 Table	PowerEdge T100	1040	305
Library Table	PowerEdge 2900	2697	930
Library Table	SunFire V890	16531	4843
Network rack 1	CM4148	68.2	20
Rack 1A	PowerEdge R910	2557	750
Rack 1A	PowerEdge R910	2557	750
Rack 1A	PowerEdge R910	2557	750
Rack 1A	PowerEdge R910	2557	750
Rack 1A	PowerEdge R410	1705	500
Rack 1A	PowerEdge R410	1705	500
Rack 1B	PowerEdge 1950	2697	670
Rack 1B	Proliant DL360 G5	2910	252
Rack 1B	PowerEdge 2950	2697	930
Rack 1B	Modular Smart Array 1000	1876	549
Rack 1B	Proliant DL360	2910	852
Rack 1B	Proliant DL380	3990	1170
Rack 1B	PowerEdge R510	2557	750
Rack 1B	PowerEdge 1950	2697	670
Rack 1B	Proliant DL360 G6	1794	526
Rack 1B	PowerEdge 2650	1705	500
Rack 1B	PowerEdge 2950	2697	930
Rack 1B	VNXe3100	1570	475
Rack 1B	Modular Smart Array 1000 Exp	1876	549
Rack 1B	Proliant DL380 GS	3990	1170
Rack 1B	PowerEdge 750	483	141
Rack 1B	Proliant DL360 G7	2916	854
Rack 1E	Bladecenter H (8852-4XU)	32757	9600
Rack 1E	Bladecenter H (8852-HC1)	32757	9600
Rack 1E	Bladecenter H (8852-4XU)	32757	9600
Rack 1F	Proliant ML350	1794	526
Rack 1F	PowerEdge R510	2557	750
Rack 1F	Proliant DL360 G5	2910	252
Rack 1F	PowerEdge R200	1176	345
Rack 1F	Proliant DL360	2910	852
Rack 1G	PowerEdge R510	2557	750
Rack 1G	PowerEdge 2950	2697	930
Rack 1G	PowerEdge 2970	2697	750
Rack 1G	PowerEdge R200	1176	345
Rack 1G	PowerEdge R710	1944	570
Rack 1G	PowerEdge R200	1176	345
Rack 1G	PowerEdge 2970	2697	750
Rack 1G	PowerEdge R200	1176	345
Rack 1G	Xserve2.1	990	290
Rack 1G	PowerEdge 2950	2697	930

Rack 1G	PowerEdge R710	1944	570
Rack 1G	PowerEdge 2950	2697	930
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2A	1815-82A	804	540
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2A	1812-81a	1570	449
Rack 2B	1812-81a	1570	449
Rack 2B	2499-192	4914	1440
Rack 2B	1812-81a	1570	449
Rack 2B	2499-192	4914	1440
Rack 2C	SunFire v120	550	98
Rack 2C	SunFire v120	550	98
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-53A	4884	1450
Rack 2E	x3650 M3	2260	780
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2E	1818-D1A	4884	1450
Rack 2F	1818-D1A	4884	1450
Rack 2F	1812-81a	1570	449
Rack 2F	1818-D1A	4884	1450
Rack 2F	1818-D1A	4884	1450
Rack 2F	1812-81a	1570	449
Rack 2F	x3650 M3	2260	780
Rack 2F	1818-D1A	4884	1450
Rack 2G	C370	1801.6	870
Rack 2G	PowerEdge 1650	1033	275
Rack 2G	M660	2557	750
Rack 2G	PowerEdge 2850	2388	700
Rack 2G	PowerEdge 2850	2388	700
Rack 2G	PowerEdge 1950	2697	670
Rack 2H	SunFire v440	3157	925
Rack 2H	M4000	8018	2350
Rack 2H	SunFire V240	1861.86	546
Rack 2H	SunFire V240	1861.86	0
Rack 2H	T5240	3443.3	1009

Rack 2H	SunFire v440		3157	925
Rack 2H	M4000		8018	2350
Rack S-R1	PowerEdge R210		852	250
Rack S-R2	Proliant DL 320 G3		1710	350
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2A	Altus 1000E		2046	600
Rack-Client 2B	Altus 3400		1705	500
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B		1	1194	350
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2B	Altus 1000E		2046	600
Rack-Client 2C	Altus 1000E		2046	600
Rack-Client 2C	Altus 1000E		2046	600
Rack-Client 2C	Altus 1000E		2046	600
Rack-Client 2C	Altus 1000E		2046	600
Rack-Client 2C	Altus 1000E		2046	600

Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-Client 2C	Altus 1000E	2046	600
Rack-M1	S2100-ES2	23529	6900
Rack-M2	1818-D1A	4884	1450
Rack-M2	1812-81a	1570	449
Rack-M2	1818-D1A	4884	1450
Rack-M2	1818-D1A	4884	1450
Rack-M2	1818-53A	4884	1450
Rack-M2	1818-D1A	4884	1450
Rack-M2	1812-81a	1570	449
Rack-M4	M4000	8018	2350
Rack-M4	SunFire V240	1861.86	546
Rack-M4	SunFire V240	1861.86	0
Rack-M4	T2000	1365	450
Rack-M4	M4000	8018	2350
Rack-M4	SunFire v120	550	98
Rack-M4	SunFire V240	1861.86	546
Rack-M4	SunFire V240	1861.86	0
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M5	1815-82A	804	540
Rack-M5	1812-81a	1570	449
Rack-M5	1812-81a	1570	449
Rack-M6	1812-81a	1570	449
Rack-M6	2498-B80	1313	260
Rack-M6	1812-81a	1570	449
Rack-M6	2498-B80	1313	260
Rack-M6	CM4148	68.2	20

Rack-M7	x3650 M3	2260	780
Rack-M7	PowerEdge R910	2557	750
Rack-M7	Xserve Quad 800	860	252
Rack-M7	PowerEdge R410	1705	500
Rack-M7	PowerEdge R910	2557	750
Rack-M7	PowerEdge R200	1176	345
Rack-M7	PowerEdge 1950	2697	670
Rack-M7	PowerEdge R410	1705	500
Rack-M7	C370	1801.6	870
Rack-M7	x3650 M3	2260	780
Rack-M7	PowerEdge R910	2557	750
Rack-M9	PowerEdge R210	852	250

All Locations

LOCATION	HEAT	POWER
Rack 1A	13638	4000
Rack 1B	39365	10988
Rack 1E	134097	39300
Rack 1F	11347	2725
Rack 1G	24448	7505
Rack 2A	16504	5030
Rack 2B	12968	3778
Rack 2C	1100	196
Rack 2E	65752	19630
Rack 2F	24936	7478
Rack 2G	12864.6	3965
Rack 2H	29517.02	8105
Rack S-R1	852	250
Rack S-R2	1710	350
Rack Client 2A	49104	14400
Rack Client-2B	35635	10450
Rack Client -2C	49104	14400
Rack M1	23529	6900
Rack M2	27560	8148
Rack M4	23536.58	6340
Rack M5	16504	5030
Rack M6	5834.2	1438
Rack M7	22135.6	6947
Rack M9	852	250
CC Table	8764	2721
Library Table	19228	5773
GRAND TOTAL	670885	196097
MILTON HALL	119951.38	35053
COMPUTER CENTER	550933.62	161044

NMSU DATA CENTER
PROGRAMMING / DESIGN INFORMATION

1. Please provide review comments and/or recommendations of the "ICT Building HVAC and Electrical Systems Assessment Report" as prepared by Huitt-Zollars, Inc..
   Document page header has Las Cruces misspelled on every page. Building description on page 1 stating ICT building is primarily a single story structure is incorrect. It is primarily a two story structure with two single story structures to the East and West. Statements on page 2 could use some clarification. On page 4, typical data center occupancy is 14-16 not 12. Page 6, fifth chapter I would like clarifications on chiller source of chilled water. Page 8 chapter 9 characterizes the DX units as backup cooling, though they are really supplemental in nature and each unit is 15 tons one 30. Item 27 under HVAC recommendations on page 13, backup power for AHU-1 and AHU 2 will be yes for both. Providing a loop between the two existing chilled water systems should be a separate item number. Page 15 of Electrical System Section on the networking area UPS should be modified to reflect the replacement of the 20 kVA unit with a 30 kVA unit. Also the wiring from the generator distribution panel has been upgraded in an effort to restore the ability to power the network room and panels in the network room have been replaced or reworked. Under recommended system upgrades page 19 second bullet, ICT is currently installing cable trays to allow for fiber cable relocation and management. As far as obstructions go the biggest under floor obstruction is the chilled water piping.

   Discussion, explanation and review of each recommendation at the meeting is needed.

2. Currently the IT equipment is spread between three separate rooms assigned to several University Departments, including:
   - Room 129 is housing IT equipment providing general support for NMSU website;
   - Room 129C is housing IT equipment providing support to NMSU research department;
   - Room 131 is housing IT equipment providing support to NMSU networking department (this room does not seem to be suitable for IT equipment installation).

   Are there any plans for consolidation of all that IT equipment in a single IT room? *(Note: This will allow for a consolidation of the dedicated HVAC equipment, clean agent fire suppression system, etc. That will also make the implementation of all the recommendations presented in the "HVAC and Electrical Systems Assessment Report" less costly and more efficient.)*

All of our fiber feeds enter the building from the tunnel at the South end of the building and it would not be feasible to splice and extend them into the other part of the data center. It will be better to make adjustments to the area to accommodate the networking equipment currently there. We do have servers in the room, on the center aisle, that could be relocated to the main machine room to reduce the demand on cooling equipment if air flow and other cooling modifications are not feasible to increase cooling. All networking equipment on the South wall will need to remain in place. Room 129 is the main machine room and access is only granted ICT support personnel. Room 129C, known as the Shared Access Area, was intended for departments to house their servers in a machine room setting and the advantage that brings as opposed to housing them in offices and closets. However the two machine rooms will always require a physical security barrier. Since we are still having cooling issues with equipment in that room, it might be feasible by relocating staff in the cubicles adjacent to that area, to remove the hard wall and glass partition and instead install a security mesh material that would allow for un-obstructed air flow but still meet our security requirements.

3. Will the office space be separated from the IT equipment room in order to provide appropriate environmental conditions independent from the IT room?
   ICT would like to provide separate office space with appropriate environmental controls for staff. Once Jacobs Hall/Hardman Hall renovations are complete ICT will be moving the help desk out of the building. This would allow the part of the networking group currently located in room 130 to move to room 141. Then we could create office space along the main hallway to house staff and consoles. Or we could relocate the Shared access room to 130 and use 129C for office space.

4. Does NMSU have long range plans for the IT equipment ? If so the following information will be required, IT equipment electrical demand, and heat release information, preferable for each individual equipment rack. High-density heat load equipment racks (loads greater than 10 kW per rack) shall also be identified.
   ICT is still developing long range estimates for computing equipment power consumption, heat generation and foot print requirements. I expect to have data for our existing equipment racks by October 1st.

   ICT through the migration to Virtual Server technology over the past 3 years has eliminated 70 physical servers from the machine rooms. These services are now running on three high density CPU/memory servers. There is expectation that this trend will continue for the foreseeable future with respect to the administrative computing services still being offered on physical servers. This type of computing tends to result in high density racks with greater computer electric and cooling requirements per hardware rack. ICT anticipates two additional racks consuming <5 kw per rack and requiring heat dissipation of 5120 BTU/HR

ICT runs a Storage Area Network in the data center that allows for server connectivity to central storage. Central storage is in a growth phase. Over the next 5 years the amount of storage needed will likely double or triple. How this affects power consumption and cooling requirements is likely not linear because of the ever increasing storage density and the current paradigm shift from 5.25 to 2.5 form factor disks which might mean denser heat loads and increased per rack electrical and cooling needs. This growth could translate into four to eight more storage equipment racks consuming < 10 kw in the data center.

Another storage wrinkle is the advent of solid state storage for the enterprise. These systems are basically banks of solid state memory attached to a fiber channel controller. ICT plans to have a rack of this type of storage over the next 5 years probably consuming <10 kW per rack.

The industry trend toward cloud computing should also be factored into this equation. Many software and service vendors will only offer their services via the cloud. This will reduce the number of physical servers by some amount. This technology is not mature yet and there are still data privacy and regulatory hurdles that NMSU is working through. This model also may require an increase in the amount of network switch gear the is required to meet the increase bandwidth needed to support heavily used cloud applications.

ICT also houses several high performance computing clusters. These machines consume large amounts electricity and produce lots of heat. The systems are currently deployed are older. It is anticipated the one system will be decommissioned in the next 5 years. We also anticipate one system to be increased to four times the current capacity which will lead to at least a fourfold increase in power consumption and heat production. This system is currently in room 129C. **See HPC Requirements at the end of this document.**

ICT is also entering a MOU with the State of New Mexico DoIT center to begin housing a standby Mainframe system for them. **See Mainframe Requirements at the end of this document.** They may also stand up similar disaster recovery systems in the next five years which is anticipated to result in five additional racks requiring <10 kW per rack. In return NMSU will be able to house up to 10 racks of equipment in their state of the art data center.

ICT accepts equipment from different departments around campus. Growth in this area will likely be one to two low power racks over the next five years.

5. Currently there is no backup power supply to the Data Center cooling system other that the University's Cogeneration Turbine which has to be taken out of service periodically. Chilled water supply to the air handling units is the primary source for cooling and DX cooling coil with outdoor air-cooled condensing units provides backup cooling, although Data Center building is currently provided with chilled water loop that allows for chilled water supply to air handling units from two opposite sources. Is the backup power supply and backup cooling to be provided to the IT equipment room, i.e., backup generator, backup air chilled water supply or backup DX cooling, backup air handling unit, etc.?

   ICT would like to have the cooling loop that allows chilled water from either chiller unit on campus to be used to provide chilled water to the data center. Addition supplemental DX chilling will be needed for summers unless the current chilled water system is resized or increased data center efficiency measures are able to make up the difference. The assumption is that the chilled water plants are on different circuit and that one should always be functioning in the event that the CoGen plant is under maintenance and there is an EPCC power outage.

6. The computer center is currently fed by only one medium voltage circuit from Central Plant which creates a single point of failure and reduces power system reliability. Are there plans to bring a separate medium voltage circuit to this building to allow for additional system reliability?
   ICT would like to see a more redundant electrical system in place that meets best practices for a 24/7 data center. This should at least include a redundant EPCC circuit and live switch gear. Depending on cost, estimated implementation time and best practices recommendations an alternative would be would be a pad mounted generator of sufficient size to power all hardware and cooling equipment as originally proposed.

7. If the collocation area for the research servers is not to be consolidated, has any thought been given to additional security measures to improve the physical security of the other IT areas?
   We welcome any security suggestions to allow the shared access clients unfettered access to their servers while providing better access control and deterrents than glass windows and a residential security screen door.

MAINFRAME REQUIREMENTS

Overview: DoIT is requesting support for a mainframe system that is comprised of a CPU, 2 Storage racks, a Hardware controller and a Storage controller. There is also a need to 2 PCs that act as consoles.

Physical Space: DoIT is requesting space for 5 large racks and 2 consoles. The exact dimensions are indicated on the diagram below. They are depicted in the way they are arranged in Santa Fe. We can put them in any physical configuration as long as we get within max cable lengths.

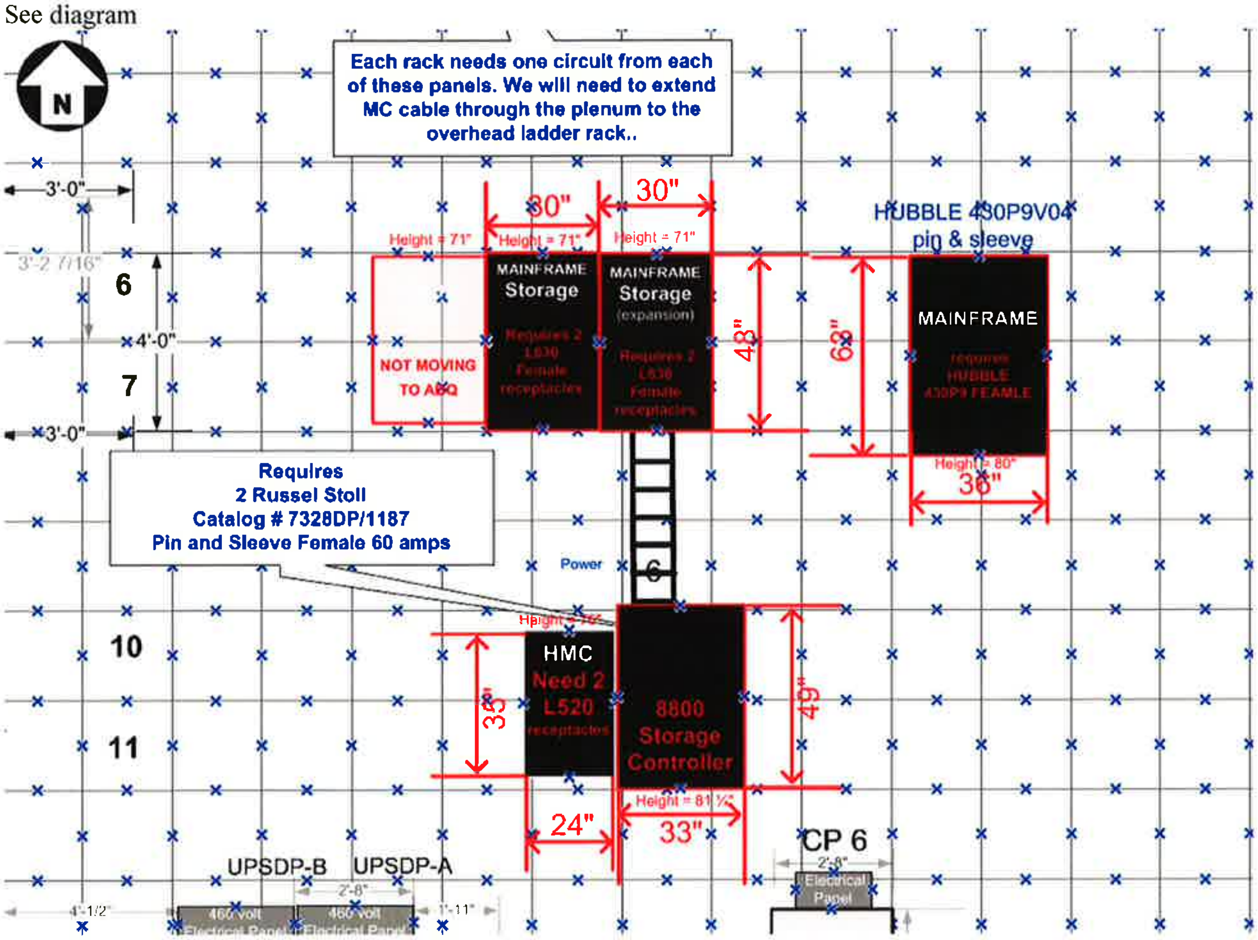
Power: This machine will run in a "warm" mode. Therefore NMSU can plan on a lower electrical usage than will be documented here. Because it will run at full power during a disaster and up to 4 times a year during tests it will need to be engineered at full usage specifications.
The actual usage today on all the primary system is a little less than 8kW for all devices. Many special-order receptacles are needed. The part numbers are indicated on the diagram. DoIT will take responsibility for any custom engineering.

Cooling: The total Mainframe power consumption is 27298 BTUs. This will require 2.27 tons of refrigeration.

HPC Compute Rack Requirements

Each of the three compute racks electrical requirements are 31.5 KW/32.14KVA and A/C requirements 6.52 KBTU/HR/1.91KW/054 tons.

See diagram



Here are the actual power usage figures

Mainframe Power Uagage	Amperage	KW
CPU	6	1.248
CPU	7	1.456
HMC	1.7	0.3536
HMC	1.7	0.3536
Virtual Tape	3.55	0.7384
Virtual Tape	3.125	0.65
8800 Storage controller	6	1.248
8800 Storage controller	5.75	1.196
IBM Library	1.25	0.26
IBM Library	1	0.208
Total	37.075	7.7116

Rack	Model	Name	Heat	Watts
SR-1	DELL Power Edge r210 II		2697	670
	HP Proliant DL385 G7		3990	1170
	D-Link xstack storage		2000	570
	hp proliant ml350		3530	1200
	A1068			
	Catalyst 3750 Series		650	190
	DELL Power Edge 1950		2697	670
	DELL Power Edge 1950		2697	670
	DELL Power Edge 1650		1033	275
	HP Proliant DL385 G7		3990	1170
SR-2	DELL Power Edge 2650		614.3	500
	DELL Power Edge 1750		1026	320
	HP Proliant DL 320 G3		2910	700
	HP Proliant DL 360		2910	700
	HP Storage Works		1063.92	312
	DELL Power Edge 1750		1026	320
	DELL Power Edge 1750		1026	320
SR-3	HP Proliant DL 120 G7		2910	700
	Cisco UCS C220 M3			950
	HP Proliant DL 380 G7		3990	1170
	Verari Systems 2x8 G4			
	Verari Systems 2x8 G4			
	Verari Systems 2x8 G4			
	IBM E Server X Series 335		1195	350
	Cisco IPS 4270 Series		1893	
APC 1	Triplite B020-016-17		102.42	
	Cisco UCS C240 M3			950
	Citrix Netscalar		3753	1100
APC 2	HP Proliant DL 360P Gen8		2916	854
	Triplite B020-016-17	vm-host.chec:	93	
	DELL Power Edge 1950	ns1.checs.net	2697	670
	HP Proliant DL 320 G3	www.checs.ne	1710	350
	HP Proliant DL 320		1794	526
R1	HP Procurve 2910al-24G	rgonnmsu.nmt.edu		
	Cisco AS12 1006			
	ASR1000-SIP10		612	180
	ASR1000-ESP10		612	180
	ASR1000-ESP10		612	180
	ASR1000-RP1		612	180
	ASR1000-RP1		612	180
	Catalyst 3750-X Series		650	190
	Catalyst 3750 Metro Series		650	190
	Enterprise Plus E750RM2Up15			
	Enterprise Plus EBP36XL			
R2	Rentrox 77830			30
	Rentrox 77830			30
	Rad FOM-T1			
	ADC Kentrox 72071			30
	ADC Kentrox 72071			30
	ADTran Mx2800			27
	C3900-SPE100/k9		495	145
R3	Cisco 2911		751	220
	Emmerson Network Power			
	R48-2000			2000

APPENDIX G

MEETING NOTES

MEETING NOTES

PROJECT: **NMSU Data Center Upgrades**

MEETING: **Tour of UNM Data Center Facility**

WHEN: **May 23, 2013**

11:00 AM

HZI PROJECT NO.: R14-0294-05

ATTENDEES:

Randy Erwin	UNM
Moira Gerety	UNM
Scott McLean	NMSU
James Nunez	NMSU
John Roberts	NMSU
Brain ??	UNM
Chuck ??	UNM
John Jarrard	Huitt-Zollars

PURPOSE:
The purpose of the tour has to provide a first hand look at a peer data center facility that closely matches NMSU Data Center to compare and contrast operations.

DISCUSSIONS / COMMENTS:

- Introduction of all present.
- Moira gave a brief overview of the UNM Computer Center. (CC)
    - UNM has two (2) spaces that serve as Data Centers (DC)
    - UNM CC is looking at moving into a new facility, but the time frame has not yet been determined and will depend UNMH acquiring the building for the hospital uses.
    - UNM CC does not provide data services to the hospital
    - There are several small server rooms located throughout the campus that are not under the responsibility of the CC
- Notes from Tour
    - The CC is served by two transformers which provide 208V of main power
    - The CC has a diesel generator. The generator is currently serving the entire building, but will be rewired to serve only the critical needs. The generator is tested once a week.
    - UNM has not had any major power outages in the past 8 years
    - The data centers are located on the main floor and upper floor of the CC
    - A separate Command Center is located adjacent to the main floor DC
    - Each DC is served with a UPS system located adjacent to the main floor DC
    - The main floor DC is the larger of the two centers. There are virtualized servers in this room that have greatly reduced the number of required servers.

- Both DCs are cooled with CRAC units that keep the rooms at or about 70 deg F and 36RH.
- UNM would like to have the CRAC units tied to the UPS
- Alarms are tied into the UNM police station

END OF MEETING NOTES

Attachments

Photos

Generator
Transformers
Command Center
Main Floor Data Center
Upper Floor Data Center
T Stats

PROJECT: **Data Center Upgrades / Master Plan**

MEETING: **Review / Coordination Meeting**

Date: September 20, 2013

Time: 11:00 AM

Location: NMSU Data Center Conference Room

Attendance

Name	Representing	Email
Sergey Aleksanyan	Huitt-Zollars	sga@huitt-zollars.com
James C. Nunez	NMSU - Projects	JCNUNEZ@nmsu.edu
Richard Dickerson	Huitt-Zollars.	rdickerson@huitt-zollars.com
John C. Roberts	NMSU	sysjcr@nmsu.edu
Glen Hauburn	NMSU	GHAUBORD@NMSU.EDU
Boyd Prairie	NMSU	BPRAIRIE@NMSU.EDU
Enrique Genera	NMSU	egenera@nmsu.edu
Dale Harrell	NMSU	dharrell@nmsu.edu
David Coon	NMSU	davidc@nmsu.edu
JOHN JARRARD	HZ	jjarrard@huitt-zollars.com

MEETING NOTES

PROJECT: **NMSU Data Center Upgrades**

MEETING: **Coordination Meeting at NMSU**

WHEN: **September 20, 2013**

11:00 AM

HZI PROJECT NO.: R14-0294-05

ATTENDEES:

See attached sign in sheet.

PURPOSE:

The purpose of the meeting was to discuss the status of the project and solicit input from the University on goals and needs of the project.

DISCUSSIONS / COMMENTS:

- Introduction of all present.
- Glen Haubold gave a brief overview of the his expectations of the project
    - The master plan should assess the risks of losing the data center during a power outage, including the frequency of these outages and the consequences the University could expect from losing the Data Center (DC) during these events.
    - Virtualization has relieved some the power requirements of the data center and Cloud Computing has mitigated some of the risk of a power outage.
    - Richard Dickerson, PE stated that failure analysis would show what vulnerabilities exist in the electrical power system and could determine the overall system reliability. Any risk or possible loss or system damage associated with power failure will have to be determined by the University IT department.
    - The University is looking at upgrades to the power and cogeneration systems on campus. Glen provided the team a copy of the study of these systems prepared by GLHN in 2009.
    - A new cogeneration facility is in the planning that could supplement the existing facility
- John Roberts provided comments on the previously submitted Facility Assessment. This also includes responses to the Programming questionnaire prepared by Huitt-Zollars. (attached)
- JR also provided a overview of current equipment needs, including the State of NM's stand by mainframe system soon to be installed in the data center.
- Dale Harrell and David Coon provided an overview of how the DC is feed both electrically and by chilled water.
    - The current switch is old and requires a manual operation to switch from Cogeneration power to El Paso Electric Company (EPEC). This typically tales 15 to 30 minutes. If this was replace with an automatic type switch the down time could be reduced to seconds.
    - The existing UPS has battery backup that can provide power for approximately 30 minutes if only the critical servers are on line. If all servers are up and running, the batteries would provide about 15 minutes of power.
    - Replacement of the primary switch is only one consideration. While the DC has the capability of being fed from the Central Plant or the Electric utility in three possible ways, the three- and four-way

oil filled selector switches, building transformer, switchgear and UPS systems are all single points of failure that can leave the data center without power.

- Data is currently being backed up at another campus on a daily basis.
- There are a number of dual plug loads (servers and other items that have dual corded power supplies). Since they are served from the same source of power they are as vulnerable to power failure as any other item of equipment.
- Richard Dickerson asked if DCIM (Data Center Information Management) was something the DC would like to implement. The answer was in the affirmative.
- It was determined that the chilled water loop pumps would operate during an outage by EPEC. The chillers however would not be operational. There are only a few building with separate pumps tied directly to the loop and therefore the temperature of the chilled water may remain sufficient for an extended time during this outage.
- Chilled water supply to the Data Center is currently provided from two sources and chilled water piping is looped inside building. The primary chilled water pumps at Central Plant are on emergency power (One from El Paso Electric and one from gas turbine at the Central Plant) and provide chilled water distribution during El Paso Electric shutdowns. No additional source of cooling, such as DX-type equipment, is required. New design shall ensure that emergency power is provided to the secondary chilled water pumps in the building.
- University's desire is to keep telephone servers in room 131 in order to avoid splicing and extension of existing cables further to the new proposed location of the consolidated IT room. This room is currently having difficulties with returning air back to the air handling unit. HZ shall verify if that limited room height will present any problems with return air path to the floor-mounted CRAC units and with providing the most efficient design and with implementation of the hot isle and cold isle air distribution concept.
- Rooms 129 and 129C may be consolidated into one common space. IT equipment racks supporting research systems shall be securely separated from other servers.
- The State of NM DoIT IT equipment will be installed in the DC in the future. This equipment may generate heat gains that may exceed current planned equipment. NMSU to verify if there any racks with high density heat and with built-in chilled water cooling system. HZ shall investigate if built-in chilled water cooling is a viable option. It is recommended that more racks to be provided in lieu of high density racks. CRAC units with chilled water cooling are the preferred option. Other systems may also be considered.
- Office shall be also consolidated and a separate air conditioning system shall be provided with proper temperature controls.
- Data Center Information Management (DCIM) system shall be provided.
- HZ shall investigate if current clean agent fire protection system shall be reused with required modifications or that the new wet pipe fire protection system is desired. Coordinate with NMSU.

- Meeting adjourned at 1:00 PM

END OF MEETING NOTES

Attachments

GLHN Reports
    NMSU Electrical System Overview
    Cogeneration System Assessment
John Roberts Responses
Sign In Sheet

MEETING NOTES

PROJECT: **NMSU Data Center Upgrades**

MEETING: **Coordination Meeting at NMSU**

WHEN: **October 15, 2013**

3:30 PM

HZI PROJECT NO.: R14-0294-05

ATTENDEES:

James Nunez	NMSU	
John Roberts	NMSU	
John Jarrard	HZ	
Richard Dickerson	HZ	(Via Phone)
Sergey Aleksanyan	HZ	(Via Phone)

PURPOSE:

The purpose of the meeting was to discuss the layout floor plans provided by HZ and equipment needs

DISCUSSIONS / COMMENTS:

- Floor plan presented is a first pass at alternative layouts for the machine room and office.
  - Help Desk will not be required
  - Computer Lab may not be required if help desk is omitted
  - Equipment in the Network room (131) can not be easily relocated
  - Open office spaces maybe provide more flexibility
- NMSU will provide projected maximum load and heat release information for IT equipment racks for the next 10 years.
- Minimum 2 units shall be provided for networking server room 131. HZ would like NMSU to confirm.
- HZ shall consider implementing hot aisle – cold aisle containment partitions.
- The research server room 129C will be separated from the main server room with secured chain-link type partition extended from the floor slab up to the roof deck to allow for free air flow under floor and above ceiling.
- As it was discussed at earlier meeting the existing chilled water loop in the building and the operation procedures at the Central Plant allow for the uninterrupted chilled water supply to the cooling equipment of the Data Center. Therefore redundant DX-type cooling equipment is not required.
- Existing secondary chilled water pumps in ITC building and in Science Hall serving existing computer center shall be provided with emergency power supply.
- HZ will provide the Owner with pros and cons of the pre-action wet pipe fire protection system over existing clean agent fire suppression system for the final approval of the fire protection system for the new Data Center.
- The air handling unit for the future offices will be located in one of the existing North-East mechanical rooms.
- NMSU shall verify if the existing fiber distribution racks can be moved and integrated into rack aisles shown on schematic layouts.
- The implementation of the in-room floor-mounted chilled water CRAC units will allow for eliminating existing air handling units at the second floor and for use of that free that space as desired by the Owner.

- Discussed replacement of primary switch that selects either the feeder from the cogeneration plant or the feeder from the Tortuga substation. H-Z recommends the replacement with a switch that does not require extensive maintenance or use SF6 gas. H-Z also recommends that the switch be provided with an automatic throwover function that will transfer the load to the alternative feeder if the preferred feeder fails.
- There was mention that the Tortuga feeder may be loaded to its maximum limit. We discussed bringing in a third primary feed such as the Hospital feeder from the Tortuga Substation. Mention was made that the Hospital Feeder, in fact, the whole Tortuga Substation may be loaded to its limit.
- H-Z as recommended that an additional feeder, transformer, and low voltage service be brought into the building as a backup in case the normal service failed. This recommendation needs to be explored using reliability analysis and risk analysis. (Note: H-Z can determine overall reliability and system availability thereby providing the University with a Expected Mean Time Between Failure; however, determining the actual risk to the University of losing the data center has to be determined by the University staff)
- Meeting adjourned at 4:30 PM.

ACTION ITEMS

- NMSU to provide input on space and staff needs for both current and 10 year projection
- NMSU to provide nameplate information on UPS equipment
- HZ will provide the Owner with pros and cons of the pre-action wet pipe fire protection system over existing clean agent fire suppression system for the final approval of the fire protection system for the new Data Center.
- NMSU to provide contact information from El Paso Electric so we can get reliability information on the Tortuga feeders
- NMSU to provide list of equipment currently installed and the electrical load for each rack. Heat rejection loads to the space from the equipment is also needed.
- H-Z would also like to know how the University wants to have the equipment segregated and the number of racks needed for each (how many racks for servers, racks for storage, racks for distribution, etc.).
- For power growth, H-Z can project an approximate doubling of electrical power needs within 10 years. This appears to be the statistical norm for power growth.

END OF MEETING NOTES

MEETING NOTES

PROJECT: **NMSU Data Center Upgrades**

MEETING: **90 % Review Meeting at NMSU**

WHEN: **December 20, 2013**

10:00 AM

HZI PROJECT NO.: R14-0294-05

ATTENDEES:

(See Attached Sign In)

PURPOSE:

The purpose of the meeting was to review the 90% design submittal of Data Center (DC) Planning Report previously submitted to NMSU

DISCUSSIONS / COMMENTS:

- The 90% submittal has been reviewed by NMSU and is approved. NMSU has requested that some minor corrections as stated below be made to the document. These will be included in the final submittal.
- Due to the low ceiling / structural headroom in the center portion of the DC the Main Machine room may have to be expanded to the north.
- The number of offices required for the DC is seven. The area should also include a small conference room / break room. To accommodate the number of racks anticipated for the DC the new offices may require that they be constructed as an addition to the building. The north end of the building may be an appropriate area for this expansion. HZ will review this option.
- The renovation / addition will have to be phased to accommodate the operational needs of the center. This will be included in the final submittal.
- Work benches will not be required in renovated machine room.
- The programming report estimates a 40% Electrical load and HVAC load increase in the future.
- Outline potential energy savings provided by the new design.
- High-light recommendations on resolving some violations of current life safety regulations, such as fire protection, outside air provision based on their urgency.
- Verify if the proposed Data Center floor layout will work in conjunction with existing construction.
- NMSU suggested providing redundant cooling in NOC room.
- The air handling unit at the second floor mechanical room will be removed. That space will be partially occupied by the new AHU serving office area (subject for coordination with the new layout). Remaining space may house a new conference room, open office, etc. Existing access to the roof through mechanical room shall be maintained.
- NMSU will provide projected maximum load and heat release information for IT equipment racks for the next 10 years.
- Minimum 2 CRAC units shall be provided for networking server room 131. HZ would like NMSU to confirm.
- As it was discussed at earlier meeting the existing chilled water loop in the building and the operation procedures at the Central Plant allow for the uninterrupted chilled water supply to the cooling equipment of the Data Center. Therefore redundant DX-type cooling equipment is not required.

- Existing secondary chilled water pumps in ITC building and in Science Hall serving existing computer center shall be provided with emergency power supply.
- H-Z as recommended that an additional feeder, transformer, and low voltage service be brought into the building as a backup in case the normal service failed. This recommendation needs to be explored using reliability analysis and risk analysis. (Note: H-Z can determine overall reliability and system availability thereby providing the University with a Expected Mean Time Between Failure; however, determining the actual risk to the University of losing the data center has to be determined by the University staff)
- H-Z would also like to know how the University wants to have the equipment segregated and the number of racks needed for each (how many racks for servers, racks for storage, racks for distribution, etc.).
- For power growth, H-Z can project an approximate doubling of electrical power needs within 10 years. This appears to be the statistical norm for power growth.
- HZ provided the Owner with pros and cons of the pre-action wet pipe fire protection system over existing clean agent fire suppression system for the final approval of the fire protection system for the new Data Center. The dry chemical type system will be maintained for the DC. A new wet pipe FP system could be provided in the office areas.
- Meeting adjourned at 11:30 AM.

ACTION ITEMS

- NMSU to provide nameplate information on UPS equipment
- NMSU to provide contact information from El Paso Electric so we can get reliability information on the Tortuga feeders
- NMSU to provide list of equipment currently installed and the electrical load for each rack. Heat rejection loads to the space from the equipment is also needed.

END OF MEETING NOTES

HUITT-ZOLLARS

PROJECT

CLIENT JOB # BY DATE

TASK CHECKED DATE

SHEET OF

DATA CENTER
PLANNING MEETING.

12.20.13

ATTENDANCE.

NAME	REPRESENTING	PHONE
Boyd Poulter	NMSU	6-7116
Lucas Stockburger	Huitt-Zollars	817-335-3000
Richard Dickerson	" "	817-335-3000
Sergey Aleksanyan	Huitt-Zollars	(817) 335-3000
MATT OCHOA	NMSU	6-7091
John C Roberts	NMSU	6-7992
James C. Nunez	NMSU	(575) 646-5273
Glen Haubold	NMSU	575-646-2101
JOHN JARRARD	HUITT-ZOLLARS INC.	505.883.8114