

VIRGINIA DATA CENTER

Richmond Facility

Schematic Outline

February 18, 2004

ELLERBE BECKET



STRUCTURAL and ARCHITECTURAL

Codes/Standards

- A. BOCA National Building Code,
- B. Energy code assumptions: (R-Values) required to comply with Maryland Energy Code – International energy code 2000.

Structural: designed to 120 MPH wind load

1. Structural framing: 16' height to bottom of structure.
 - Precast columns and beams; 50' x 50' structural bay.
2. Roof framing:
 - Precast double tees; 10' x 50'; assume 2' structural depth.
 - Peak roof in North/South direction, shedding water to the East and West side
3. Foundation:
 - Spread footings with isolation pads for emergency generators.
4. Lateral System:
 - Precast concrete structure will be designed to accommodate 120-MPH wind load.
5. Floor slabs:
 - 7" thick slab at generator, battery, switchgear, UPS rooms and back-of-house (BOH) corridor. Generators will be located at an exterior service court on separate isolation pads that will be thicker.
 - 4" thick slab at all other rooms .
6. Seismic loads
 - As per BOCA-2000. Design for zone 2, but only for the structure – not for architectural, mechanical or electrical.

Roofing:

1. Specification:
 - Dual membrane roof system consisting of single ply EDPM loose laid ballasted roof on top of Carlisle Fleece back full-adhered membrane on concrete topping (designed for 120-MPH wind load). Exterior scuppers and downspouts.

Walls:

1. Exterior:
 - 8" + insulated precast concrete wall panels with 3' parapet resistant to 120 mph winds. Sandblasted finish on exterior. Smooth interior finish.
 - At exterior walls of office and data room provide gypsum board, vapor barrier, and insulation over metal stud framing.
2. Interior:
 - 8" (structural to verify) full height concrete masonry units (CMU) at BOH, gypsum board over metal stud framing at office areas
 - General office ceilings are at 9'0" height.

Doors:

1. Exterior: Painted insulated HM doors and welded frames storm doors.
2. Exterior Entry Doors: Aluminum or hollow metal storefront system with insulated hurricane resistant glass rated to 120 mph.
3. Interior BOH: Painted HM doors and welded frames. Oversized widths varying from 7 feet to 3 feet six inches by 9 feet high. Standard size will be 3' x 7' will typically be used.
4. Interior office: Painted wood and welded hollow metal frames.

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5. Coiling overhead garage door with vision panel. (not designed to 120 MPH wind load, but doors within room will accommodate this windspeed)

Windows:

1. Standard aluminum frames at office area only.

Depressed slabs:

1. Battery rooms - code required 4" depressed slab with sloped ramp into room
2. Raised floor areas - 30" Depressed slab under raised access floor in office(operations) and Data equipment)

Entry Canopy

1. Linear metal roof canopy supported by columns.

Signage

1. Interior:
 - Custom room signage for each room adjacent to all interior doors.
 - Handicap accessibility signage at toilets
 - Exit signage at each exit door and directional exit signage at intersections
2. Exterior:
 - Building address numbers.
 - All other exterior signage by civil.

Specialties:

1. Roof Hatch- metal hatch with locking mechanism, hold-open and ladder. Also provide ladder from lower roof to upper roof of generator rooms.

Finishes:**Data Center:**

1. Ceiling:
 - Exposed roof joists and decking.
2. Walls:
 - Vapor barrier paint on the CMU. Alternate A – Gypsum board over insulated vapor barrier
 - 4" rubber base with filler behind base at precast wall joints
3. Floor:
 - 30" deep, 24" x 24" raised access floor, laminate flooring surface.

Office Space:

1. Ceiling:
 - 2' x 4' ACT ceiling and grid at 11'-0" with indirect lighting.
2. Walls:
 - Vapor barrier paint on the exterior CMU. 4" rubber base with filler behind base at precast wall joints.
3. Floor:
 - 24" deep, 24" x 24" raised access floor, laminate flooring surface. Alternate A - would be carpet tiles per Intelsat specification over access floor.

Toilets

1. Ceiling:
 - 2x4 Acoustical material
2. Walls:
 - Glazed CMU

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3. Floor:
 - 12x12 Vinyl Composite Tile (VCT)
4. Base:
 - 4" rubber
5. Toilet Partitions
 - Ceiling mounted painted metal with chrome finish hardware
6. Countertops:
 - Cast plastic resin

Break Area

1. Ceiling:
 - 2' x 4' ACT ceiling and grid at 11'-0" with indirect lighting.
2. Walls:
 - Painted CMU. 4" rubber base.
3. Floor:
 - VCT over concrete
4. Specialties:
 - 8 lineal feet of base and upper cabinets with composite countertop and sink cutout.
 - Refrigerator, microwave, vending equipment provided by Owner.

Vestibule

1. Ceiling:
 - 2' x 4' ACT ceiling and grid at 11'-0" with recessed downlighting.
2. Walls:
 - Painted gypsum walls and 4" rubber base.
3. Floor:
 - 24" deep, 24" x 24" raised access floor, laminate flooring surface. Alternate would be carpet tiles per Intelsat specification over access floor.

Warehouse:

1. Ceiling:
 - Unpainted exposed precast tees.
2. Walls:
 - Painted CMU.
3. Floor:
 - Epoxy paint finish over concrete.
4. Exposed ductwork, piping, and supports are unpainted.

Mechanical/Electrical areas:

5. Ceiling:
 - Unpainted exposed precast tees.
6. Walls:
 - Epoxy painted CMU.
7. Floor:
 - Battery rooms: special chemical resistant and waterproof paint finish over concrete
 - Other areas: epoxy paint finish over concrete.
8. Exposed ductwork, piping, and supports are unpainted.

Furnishings:

1. All furniture, furnishings and equipment provided and installed by Owner.
2. Office (Operations) area Audio-Visual equipment to be provided and installed by Owner.

ELECTRICAL

CODES/STANDARDS

- A. NEC 2002
- B. Local Building Codes with required Amendments

BASIC MATERIALS

- A. The main and distribution switchgear will be metal-enclosed switchgear containing insulated case electronic trip circuit breakers with shunt trip coils.
- B. All panelboards will utilize bolt on, fixed trip, molded case, and thermal magnetic trip circuit breakers.
- C. Dry type transformers for general equipment will be standard, 80 degree C rise.
- D. Main electrical and communications will be routed in concrete enclosed duct banks. Manholes will be provided for runs greater than 200 feet and at right angle turns and 'T' connections.

ELECTRICAL SERVICE

- A. The electrical utility will supply power at medium voltage (MV), 15 KV. Service conductors will connect to MV vacuum circuit breaker switchgear which will connect to four 2000 KVA pad mount transformers for the four UPS systems and two 2500 KVA pad mount transformers for the building/mechanical equipment. The pad mount transformers will be located outside of the building. Initially two 2000 KVA and one 2500 KVA pad mount transformers will be needed.
- B. Feeders will be provided from the pad mount transformer to the distribution switchgear inside of the building.
- C. Metering will be provided in the MV service switchgear.
- D. The main MV switchgear will interconnect the emergency system.

EMERGENCY SYSTEM

- A. Four 1800 KW/2250 KVA, medium voltage standby rated diesel generators will be required for full build. Three generators will be required for the load and a reserve generator will be arranged to serve the load in case one of the units is unable to operate. Initially, three generators will be required. The generators will operate in a parallel mode.
- B. One low voltage standby rated 500 KW diesel generator for life safety loads.
- C. Automatic transfer systems will provide generator start, automatic operation and power transfer.
- D. Generators will be located outside of the building in a service court.
- E. 3 days fuel supply.

POWER DISTRIBUTION

- A. General building loads consisting of lighting, mechanical equipment and other auxiliary equipment will be served by 277/480 V, three phase, 4 wire distribution panels.
- B. Receptacle and other appliance loads will be served by 120/208 V, three and single phase, 4 wire panelboards.
- C. MCC's or Motor Control Panels will be provided as required and will contain fusible combination starters as required.
- D. A 2000 KW resident load bank is included for continuous periodic testing.

CRITICAL POWER

- A. The UPS system consists of four complete UPS systems, each with 1600 KVA (N) capacity at 0.9 PF, which serve the critical data processing loads. Two systems are capable of serving the entire load. Within each system, there are three 800 KVA modules, two for the load and an additional redundant module. The four systems represent a 2(N+1) configuration at 85 watts/sf. Initially, there will be two systems because of the reduced load initially.

- B. Batteries will be the lead acid, flooded cell types providing a nominal of 15 minutes of ride through.
- C. The Critical Distribution Boards (CDB's) are metal-enclosed switchgear containing insulated case electronic trip circuit breakers. The CDB's are normally served by the UPS paralleling switchgear (UPSG). The CDB's can be supplied from the generators via the UPS bypass, and UPS paralleling switchgear.
- D. Static Transfer Switch's (STS) will be required to switch between the (N+1) UPS systems. Location of these switches will be in the computer equipment area along with Power Distribution Units (PDU's).
- E. Separate panels will be provided for single cord and dual cord loads as required.
- F. EPO system will be UL Labeled custom controls utilizing supervised power-off switch stations, and control relays to shunt trip equipment in the DP area.

CONTROL AND MONITORING

- A. An Automated Power Distribution Control (APDC) will monitor status of utility availability and upon loss of power, operate generators and power flow to maintain continuous service.
- B. The power distribution system will be monitored for status, trend logging and historical data by a separate (not part of the APDC) electrical monitoring system.
- C. Systems monitored include switchgear, power distribution units, UPS and associated battery systems, static transfer switches, generator systems, fuel systems, etc.
- D. The monitoring system status will be communicated to the .
- E. Integrating the electrical monitoring and mechanical building control will be considered.

LIGHTNING PROTECTION

- A. A complete lightning protection system will be provided per UL.

GROUNDING

- A. The building grounding electrode system will consist of a building ring conductor and ground rods bonded to the main building ground system.
- B. General building power will utilize metallic raceways for the equipment grounding.
- C. Green grounding wire is provided for mechanical and data processing equipment.
- D. All building grounds are bonded together via wall mounted equipment room bus bars.

LIGHTING

- A. General office will have fluorescent parabolic fixtures.
- B. Fluorescent parabolic fixtures in the equipment (computer/data processing) areas.
- C. Industrial type fixtures in other select utility areas.
- D. Exterior building mounted HID lighting system will be provided for general illumination near the building.
- E. Exterior pole mounted HID lighting system will be provided for roadway, walkway and parking areas.
- F. Interior lighting control will be line switched locally.
- G. Exterior lighting control will automatically controlled responding to outside ambient light conditions and time.

FIRE ALARM AND OTHER DETECTION

- A. Fire alarm system to initiate and signal the presence of fire in all areas of the building.
- B. The fire alarm will be a multiplex and fully addressable (devices)
- C. An early warning (incipient type) will be utilized in the equipment area. The system will monitor under the access floor and within the room. Will utilize spot detection using ionization/photo technology for these areas.
- D. Other areas will use ionization/photo, heat and/or flame detection (generator) as needed.
- E. The entire system will be monitored continuously at the facility.

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- F. A hydrogen detection system will be provided in battery rooms for alarm when hydrogen levels reach a prescribed threshold.

SECURITY

- A. Security system will include:
 - 1. Access control with card readers and door strikes
 - 2. Monitoring with door contacts
 - 3. CCTV cameras and CCTV monitors.
- B. Components, equipment and installation is included.

VOICE/DATA

- A. Ductbank from manhole located outside of the building will be routed to the building interior.
- B. A complete raceway system will be provided within the building.

MECHANICAL

GOVERNING CODES AND STANDARDS

Local Building Codes

Latest International Codes

Accessibility: ADA Standards

Standards

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE).

The National Fire Protection Association Pamphlets (NFPA).

American National Standards Institute (ANSI).

American Society Of Mechanical Engineers (ASME).

Sheet Metal And Air Conditioning Contractors Nations Association (SMACNA).

FIRE PROTECTION

The building is fully sprinkled, with zone control valves, flow switches, tamper switches and other accessories as required by NFPA 13. The water pressure at the street must be verified to support the sprinkler system without a fire pump.

- Dry pipe pre-action, arm-over sprinkler take-offs
- Wet pipe, upright pendent
- Four zones: UPS/Battery/Switchgear/Generator Room A (dry), UPS/Battery/Switchgear/Generator Room B(dry), Data Center/Operations Area (dry) and Office support and toilets space(wet)
- Piping - Flanged, welded or threaded
- Sprinklers - intermediate temperature heads for data center, electrical rooms, mechanical room and generator room
- Data Center– light hazard coverage
- Generator room, mechanical room and electrical room – ordinary hazard coverage.

PLUMBING & PIPING

Drainage and water distribution systems will be installed to accommodate the toilet core, exterior hose bibs and battery rooms. Electric water heaters are installed to serve the building hot water requirements.

- 8 or 10 inch combined water and fire service.
- 6 or 8 inch sanitary.
- New fixtures –toilets, lavatories, 2 emergency eye wash/showers, 1 janitor sink, 4 hose bibs and 6 wall hydrants.
- Floor drains will be installed in the toilet area, break area, mechanical rooms, battery rooms and pump room.
- Area drains will be installed in the raised floor area and routed to a dry sump prior to delivery to the sanitary waste piping.

Storm Drainage

Roof drains and overflow scuppers will direct storm water to a detention basin. Storm will be routed off the east and west side of the building.

- Piping in critical spaces will be welded, schedule 40 steel piping connected to the ductile/cast-iron underground piping.
- Hubless cast iron piping will be used in all other areas.
- Drainage from the outside air intake and exhaust air shaft will be routed to the storm system.

Sanitary Drainage

The sanitary waste and vent system includes cast iron service weight waste and vent piping. A sediment and oil interceptor will be installed for the garage waste collection system. Storm water will be collected at the fuel storage retention area then sent to the detention basin.

An acid neutralizing basin will collect water in the battery area before transmitting the waste to the sanitary system.

Domestic Cold Water

Domestic cold water distribution system will arranged to serve the new toilet core and associated fixtures in the facility.

The existing water pressure must be verified to serve flush valves without a booster system.

Fuel Oil

The final installation will include two 30,000 gallon above ground fuel storage tanks. Together, the tanks will provide storage for three days of generator operation. Piping will be configured with A and B pumping and piping. Each

tank will have 2 pumps. Double wall piping will be installed outside of the building, with single wall welded piping internal to the building. The containment piping will drain back to the recessed containment space around the fuel tanks.

Fuel cleaning systems for each tank will be installed to remove water, sediment and bacteria from the fuel system on a continuous basis.

Natural Gas

No natural gas is distributed to this facility.

Compressed Air

No compressed air system is installed.

HEATING, VENTILATION AND AIR CONDITIONING

Design Criteria

Outdoor Conditions:

Summer: 94°F_{dry bulb} / 76°F_{wet bulb}

Summer: 99°F_{dry bulb} (Extreme)

Air Cooled Chillers:

Summer: 78°F_{dry bulb}

Winter: 14°F_{dry bulb}

Winter: 6°F_{dry bulb} (Extreme)

Indoor Conditions Office:

Summer: 75°F_{dry bulb} / 50%RH

Winter: 72°F_{dry bulb} / 30%RH

Internal Loads Data Center:

Equipment: 85.0 W/sf for 33,000 sq ft

Lighting: 1.5 W/sf

Internal Loads Operations Area:

Equipment: 15.0 W/sf

Lighting: 1.5 W/sf

Internal Loads Mech/Elec Support:

Equipment: calculated loads based on equipment selection

Lighting: 1.5 W/sf

Exterior Building Envelope:

Walls: $U_{\text{overall}} = 0.10$ (R-10)

Roof: $U_{\text{overall}} = 0.06$ (R-17)

Glass: (based on Viracon VE3-2M)

$U_{\text{summer}} = 0.30$, $U_{\text{winter}} = 0.29$, $SC = 0.27$

Occupant Density: 300 sf per person.

Occ. Heat Gain: 255 btuh sensible and 255 btuh latent heat gain per person

Outdoor Air: 20 cfm per person

Exhaust Rates: 2 cfm/sf for toilet and janitor's rooms

Noise Criteria:

Private and Open Office areas: NC 45

All Other areas: NC 45

Adjacent Buildings: dBA 60

Ductwork: Medium pressure supply (upstream of VAV box inlet), return, relief and exhaust ductwork is sized for 0.12"wg pressure drop per 100 ft, 2,000 fpm maximum velocity. All other ductwork is sized for 0.10"wg pressure drop per 100 ft.

Piping: Hydronic piping is sized for 4 ft hd pressure drop per 100 ft, 10 fps maximum velocity. Domestic water, waste, vent and storm piping is sized per code.

Louvers: Sized for 500 fpm face velocity.

Cooling Coils: Sized for 500 fpm face velocity.

Heating Coils: Sized for 700 fpm face velocity.

Air Handling Units

Data Processing Areas-

- 45 – 20 ton nominal downflow, chilled water, modular cooling units.
- Two – 17,000 cfm constant volume humidification/dehumidification/ventilation unit

Office – The office area is served by two units, each with the capability to support the operations area if there is a failure or systems are down for maintenance.

- Two- 50,000 cfm variable air volume air handlers.

Plant Support- Support areas of the plant are served by a constant volume air handler arranged to provide make-up air to the battery rooms and condition/ventilate the remaining areas. The factory fabricated indoor air handling unit will have an outside air economizer cycle.

- One-20,000 cfm constant volume air handler, electric heating

Each UPS room is cooled with chilled water modular cooling units. This provides N+N redundancy within each UPS room. The other rooms in the plant area will be supplied with ventilation requirements and cooling air necessary to maintain space conditions. Electric reheat will be installed for rooms that are considered occupied.

- Eight – 15 ton downflow, chilled water, modular cooling units

The battery rooms will have fan coil units with electric reheat to maintain 77-degree room conditions.

- Two- 2 ton fan coil units

Exhaust fans provide ventilation air and exhaust battery and toilet areas to ensure outside air is delivered to the necessary spaces.

- battery rooms – exhaust 1 cfm/sf
- toilet room – exhaust fan 2 cfm/sf

Generator Room Heating and Ventilation

The generator room is ventilated utilizing the propeller fans associated with the radiators. Outside air enters the building via a sidewall outside air intake and sound attenuation. This air passes over the generator and is either recirculated or exhausted through a roof outlet exhaust plenum, attached to the radiators. Attenuation is provided for the exhaust air to reduce generator noise exterior to the building.

Electric unit heaters will maintain space temperature when the generators are not operating during the heating season. An exhaust fan will ventilate the room during the cooling season.

- generator room ventilation fans – 2-1500 cfm

Electrical Switchgear Room

- Conditioned by the M/E Support space air handler.

COOLING

Three 650 ton water-cooled chillers will support the building. The system is designed with redundant primary piping between the chillers and the pump room. There is one primary pump for each chiller system.

The system is designed so that the load can be supported by any two of the chillers. Connections are provided for emergency chiller connections in the event of a catastrophic loss of the outdoor chillers. There is also a 750,000 gallon stratified thermal storage tank.

A double-ended secondary piping arrangement provides redundant cooling supply and return to each cooling load. Multiple isolation valves provide a means to isolate critical sections of piping for maintenance or repair while maintaining systems operations. All piping is either welded or threaded.

BUILDING AUTOMATION

Each piece of equipment will be individually controlled, monitored and alarmed by a local manufacturer's DDC controller. A basic central building monitoring system will collect and monitor all transferable points from the individual DDC controllers. The system will notify the operator of all alarms, trouble and equipment status. These points will be reported both locally and to a remote location in the administrative building.

This system will control sequences for chiller and pumping operations.

In addition the building automation system will monitor, alarm and report trouble for the electrical power control, lighting, fire and security systems.