

Section 16620
PowerPak (15-300 KVA) Power Distribution Unit (PDU) Specification

1.0 General Requirements

1.01 Scope

- A. Furnish factory assembled PDU in accordance with the contract documents and the following specification with all elements to conform to all relevant standards of manufacturing and construction, including but not limited to, NFPA, IEEE 519-1991, ANSI C33.4, UL67, UL50, UL489, UL478, NEMA ST-20, NEMA AB-1, NEMA PB-1, NEC, UL695, UL60950, FIPS, OSHA and all relevant local codes.
- B. Work of this section, as shown or specified shall be in accordance with the requirements of the contract documents.
- C. The bidder shall participate in determining the means available for receiving and handling the equipment.
- D. Off-loading, installation, interconnecting cables and lugs and all associated costs are the responsibility of the contractor. Installation shall be in accordance with the manufacturer's recommendations.

1.02 Work Included

- A. Furnish components for PDU units as herein specified for installation under another contract.
- B. Provide all materials and services for manufacturing, testing, and delivery to a designated jobsite. The work required under this contract shall include the following:
 - 1. Furnishing PDU as herein specified.
 - 2. Complete configuration drawings and installation drawings.
 - 3. Factory tests as herein specified.

1.03 Submittal Requirements

- A. The information with the bid shall include, at a minimum, the following items:
 - 1. Technical proposal, including specification and description of all components, lug sizes, transformer ratings, frame sizes and current ratings of circuit breakers and operation.
 - 2. Outline and installation drawings showing dimensions and weight of the equipment, along with external power cable connections and recommended cable entrances and exits.
 - 3. Proposed fabrication schedule, factory test dates and delivery date per contract documents.
 - 4. Warranty schedule
- B. Bidders shall provide a compliance review of all specifications and addenda. The review will be a paragraph-by-paragraph review designating Compliance ("C"), Deviation ("D"), Exception ("E") with numbered footnotes explaining reasons for the proposed deviations or exceptions and how the intent of the specification will be satisfied.

1.04 Shop Drawings

- A. The Seller shall submit a minimum of four (4) sets of shop drawings within two weeks of receipt and acceptance of purchase order and prior to proceeding with any fabrication or assembly of equipment.
- B. All submittals shall be a complete package properly indexed and cross referenced. Submittals shall contain all required and detailed information.

1.05 Operating and Maintenance Instructions and Manuals

- A. The seller shall submit a minimum of one (1) set of operating and maintenance instructions and manual, covering the complete operation and maintenance of the equipment furnished hereunder to the owner.
- B. The Seller shall provide sufficient operation and maintenance instruction for building operators, with on-the-job factory trained engineers representing the manufacturers. The instruction shall be scheduled at time(s) convenient to the Owner's personnel.

1.06 Installation

- A. Installation shall be in compliance with all of the manufacturer's recommendations and local codes. All start up and warranty troubleshooting shall be performed by the manufacturer or an authorized representative. Initial startup and site testing shall be done by the manufacturer or an authorized representative.

1.07 Guarantee

- A. The PDU shall be warranted by the manufacturer to be free from defects in workmanship and material for a period of eighteen (18) months from initial shipment or one (1) year from start-up, whichever ever occurs first. This warranty is contingent upon having a factory authorized representative perform the start-up. Warranty shall include all costs of repair, parts, labor, travel and living expenses for the service personnel.

1.08 Standards

- A. The complete System shall be in accordance with the standards previously listed and in compliance with the applicable portions of Underwriters Laboratories UL 60950. All equipment is to be listed and labeled prior to shipment by UL, ETL or CSA.

2.0 Product Specification

2.01 General

- A. The Power Distribution Unit (PDU) shall be a transformation and distribution system that delivers computer grade power from a single input power source. The PDU shall be custom configured and assembled in a cabinet combining a **Transformation Module** for voltage transformation, isolation, and/or harmonic reduction, and a **Distribution Module** that is configured to feed and protect specific downstream loads. The performance and operation of the PDU shall be controlled and monitored through an **Operator Interface Module**.

2.02 Construction

- A. Enclosure for the PDU shall be constructed in modular configuration to NEMA Type-1 standards. The enclosure shall be primed and painted with a suitable semi-gloss enamel both inside and out. Color shall be manufacturer's standard: IBM Pearl White (or "computer hardware off-white"). Optional colors are available upon request. The entire system shall be housed within a cabinet with the following dimensions:

15-150 KVA (Two 42-Pole panelboards Included): 74.75"H x 36.5"W x 32.75"D

200-300 KVA (Two 42-Pole panelboards included): 74.75"H x 36.5"W x 39"D

Dimension adder per side access side car (Max two per PDU): 9"W

Dimension adder per front /side access side car (Max two per PDU): 21"W

Dimension adder for standard I-Line panel: 12"W (Side facing)

Dimension adder for standard I-Line panel: 36"W (Front facing)

- B. Each PDU cabinet shall be designed for mounting on both fixed and raised flooring. Each cabinet shall contain full swivel, heavy duty casters. Once the system is placed in its final position, the unit should feature stop-feet for stabilization of the unit.
- C. The cabinet enclosure shall include a pre-punched output cable landing panel to provide ample output cable space for both immediate and future cabling requirements.
- D. All operator controls and instrumentation shall be visible through the front door. All breakers and switches shall be mounted behind closed doors to limit control access to only authorized personnel.
- E. All wiring shall be rated per the National Electric Code. The PDU shall include a computer grade single point ground in accordance with FIPS Pub 94 and the requirements of the NEC.

2.03 System Modules

A. Transformer Module

1. The PDU shall be fed from an integral three (3) phase, copper-wound, high isolation transformer rated XXX kVA. Each unit is complete with dual electrostatic shielding and six (6) full load two and one-half percent (2 1/2%) compensation taps (two [2] above and four [4] below nominal). Transformer taps face the rear of the PDU cabinet, but can be rearranged to face the front if front access/service is required. NOTE: If front access/service is required, all distribution shall be mounted in side cars. No devices should be mounted in front of the transformer which would obstruct IR of the transformer. The transformer is specifically designed for this application and provides voltage transformation, high isolation, conditioning, shielding, and voltage adjustment.
2. Each PDU shall be provided with a 480V main input circuit breaker with a minimum of 25k amps interrupting capacity (65kAIC is optional). This thermal-magnetic circuit breaker shall be manually operated and sized in compliance with the 2005 NEC standard and contain an internally powered shunt trip mechanism to operate a local Emergency Power Off (EPO). A 24VDC shunt trip signal shall be available to interface with Remote Emergency Power Off (REPO) stations.
3. **The following is available upon request: Selective coordination (to 30 KAIC) of main input circuit breaker, subfeed circuit breaker, secondary main circuit breakers and branch circuit breakers.**
4. The K-20 transformer shall contain six (6) thermal overload protection devices to monitor core temperature in each winding. The first set of thermal devices shall be calibrated at 180°C. The second thermal device shall be calibrated at 200°C. In the event of any winding reaching a 180°C core temperature condition, the thermal overload protection device will close a set of contacts for remote annunciation of a potential over-temperature. In the event of any winding reaching a 200°C core temperature condition, the thermal overload protection device will close a set of contacts and initiate an automatic shutdown event.

-OPTIONAL - Quad Wye Harmonic Cancellation Module

5. The Transformation Module shall utilize PDI's patented Quad Wye Technology. This UL Listed method shall reduce the harmful effect of load generated harmonics by combining the negative energy of these to cancel each other. This cancellation effect occurs through the multiple output windings of the Transformation Module.

5. Output Characteristics

- A. Quad Wye: two (2) outputs, each individual output shall be rated at 100%; or three (3) output, each individual output rated at 50% ; or four (4) outputs, each individual output rated at 33%.
- B. 208/120 Volts AC
- C. 3 Phase, 4 Wire Plus Ground
- D. 60 Hz
- E. Operating frequency shall be a nominal 60 Hertz with an overall range of 57 to 63 Hertz.
- F. Magnetic field strength around the Quad Wye PDU shall be less than 0.1 gauss at 1.5 feet.
- G. Common mode attenuation shall be a minimum of -120 dB.
- H. Transverse mode attenuation shall be a minimum of -30 dB per decade
- I. Efficiency shall be 98% nominal
- J. Voltage match between outputs shall be a maximum of 0.5%.
- K. Impedance (phase to phase) match shall be a maximum of 0.5%.
- L. Impedance (line to neutral) match shall be a maximum of 0.5%.

B. Distribution Module

1. The PDU system shall include up to ten (10) 42-pole distribution panelboards. Each panelboard shall be rated 225 amperes and contain all-copper busbars. Each panelboard shall be provided with a 42-position ground bus kit and a 200% rated neutral assembly to accommodate the effects of non-linear loads. Each panelboard bus structure shall be designed to accept either snap-in or bolt-on branch circuit breaker protective devices. Access to the each panelboard shall be through a hinged door. Within this door shall be another hinged dead front panel that allows wiring access without removing the cover.

Each 42 pole distribution panelboard shall be protected by a 3 pole, 240 volt rated secondary main circuit breaker. This thermal-magnetic protective device shall be rated at 22,000 AIC and shall be sized in compliance with the 2005 NE standards

AND/OR Subfeed Circuit Breakers

2. The PDU shall be equipped with (___) 3-pole, 225 amp frame, AND/OR () 3-Pole 400 amp frame subfeed circuit breaker. Access to the each subfeed breaker shall be through a hinged door. Within this door shall be another dead front panel that allows wiring access.

C. Contractor Interface Board

1. A low voltage control junction box shall not be included on this equipment. All Remote Emergency Power Off, HVAC Interlocks, building alarms, communication ports and other control wiring shall be terminated onto a Contractor Interface Board which is an integral component within the PDU system itself. The Contractor Interface Board shall contain, as a minimum the following:
 - a. Two remote emergency power off interconnect positions
 - b. Summary Alarm Contacts (1 x NO & 1 x NC plus common) rated 2amps
 - c. HVAC Contacts (1 x NO & 1 x NC maintained and 1 x NO & 1 x NC momentary) rated 2 amps
 - d. Four Building alarm contacts rated 2 amps
 - e. Remote monitoring connection ports (ModBus RTU Protocol, RS-422/485 port) or optional SNMP

D. Optional Modules

1. OPTIONAL - Power Junction Box

Each PDU shall include one (1) screw-covered, NEMA 12 power junction box. The box shall contain four (4) mechanical power terminal blocks accommodating ___ (Qty) Feeds at ___ MCM AWG copper/aluminum wire for the connection of the DELTA configured incoming power feeds to the distribution system.

Each power junction box is equipped with a ten foot (10') long system main input power cable. The cable consists of liquid-tight flexible metal conduit and contains the appropriate size and number of copper conductors to comply with the 2005 NEC standards. This Power Junction Box should not be larger than 24"H x 18"W x 6"D.

2. OPTIONAL - Transient Voltage Surge Suppression

The PDU shall have an internal high energy surge suppressor system with a solid state, bipolar, clamping device designed to suppress both positive and negative transients from either the line or the critical load, and integral capacitors for noise attenuation. The TVSS shall be designed to turn on in less than 5 nanoseconds. The line to neutral suppression levels should be equivalent to 160 volts rms. (nominal rms. of 120 volts) and line to line suppression limit to 300 volts rms. (120 v nominal line to line). The total surge capacitance shall be either 60,000 amperes (80,000 amperes optional).

3. OPTIONAL - Lightning Arrestor/Surge Suppressor

The PDU shall include a Lightning Arrestor/Surge Suppressor which features an air gap device engineered to attenuate high energy impulses up to 3,000 volts. The unit should be a three phase secondary class Lightning Arrestor to divert high energy transients to ground. It shall be mounted

in parallel ahead of all electrical components to provide maximum protection and be capable of repeated transient voltages and surge currents. The device should utilize zinc oxide elements to limit the voltage being subjected to sensitive circuits. The Lightning Arrester should be UL listed and rated 650 volts maximum rms. with a discharge current of 20,000 amperes. The Surge Suppressor shall provide an additional surge element to reduce the rate of rise of high energy transient voltages to increase the effectiveness of the Lightning Arrester. The system shall consist of a three phase capacitor designed to coordinate with the Lightning Arrester for high speed, high energy operation.

4. OPTIONAL – Manual Restart Option

The PDU shall contain a manual restart circuit to protect the connected load during a system restart sequence. A circuit shall be provided to allow this feature to be field deactivated

E. Operator Interface Module

A microprocessor based panel (containing an 40x16 character and graphics LCD display) shall be mounted on the front of the system to monitor power points within the PDU unit. The Operator Interface Module shall be easily accessible from the front of the PDU, but should not be mounted on the front door. Each power conductor supplying the Operator Interface Module must allow upgrades or preventative maintenance without “live” power. A monitor maintenance switch and shunt trip disconnect shall be provided isolate the monitor during maintenance. The operator interface module shall employ an audible alarm to annunciate and fault condition. A USB port shall be provided on the Operator Interface Module front face for service / calibration use only.

The PDU shall continuously monitor the core temperature of the main isolation transformer. The transformer shall be equipped with two thermal sensors, one to announce high temperature conditions (180 degree C) and the other to shut down the PDU upon hazardous temperature condition (200 degree C).

The PDU monitoring panel shall contain a red illuminated EPO pushbutton assembly. This control circuit shall be interconnected to the shunt trip device and shall allow the operator to completely remove the PDU from the line by tripping the main circuit breaker.

The monitor shall be on a draw out assembly / slide mechanism for easy repair / board maintenance.

The Interface shall consist of the following:

Operator Controls

Maintained Switches for Operator Control shall include:

Guarded Illuminated Emergency Power Off (EPO) Push Button

Audible Alarm **SILENCE (Enter)**

Scrolling Control to view stored alarms as well as monitored parameters

Annunciation Panel

The system shall include an audible notification method to notify operators of existing or pending failures. This method shall be available at the Annunciation Panel and shall include: Audible Alarm, Alarm Silence, and Summary Alarm indication.

Digital Display Panel

The PDU shall be equipped with a front accessible LCD display. Momentary push buttons allow the Operator to scroll and hold on any of the following parameters for display:

True RMS Analog Readouts of:

- a. Total Harmonic Distortion - Input Voltage
- b. Input Voltage (V_{L-L})

- c. Output Voltage (V_{L-L} , V_{L-N})
- d. Phase Current (A,B, & C)
- e. Output Neutral and Ground Current (amps)
- f. Output kVA, kW, kWh, Power Factor
- g. Load Level (in % total kVA)
- h. Frequency (Hz)
- i. Phase Rotation
- j. Time of Day
- k. Date

Alarm Messaging for Internal Faults and Customer Selected External Points:

- a. Transformer Over Temp
- b. Phase Rotation Error
- c. Summary Alarms
- d. Input Voltage High
- e. Input Voltage Low
- f. Output Voltage High
- g. Output Voltage Low
- h. Phase Loss
- i. High Current
- j. Ground Fault
- k. Frequency Deviation

In addition to the above monitoring features, the system shall have the ability to accept either normally open or normally closed contacts from up to four building alarm interface points. The PDU Operator Interface Panel shall provide the user the name of the unit as well as the ability to assign a name of the building alarm point. The ability to program a corrective action message shall also be included.

2.04 Electrical Characteristics

- A. PDU Input Source voltage: 600, **480**, 208 Vac nominal, three-phase, three-wire plus ground.
 - B. PDU kVA rating: XXX kVA @ K-rating (Choice of K1, K13 or K20)
 - C. Input Frequency: 60 Hz. +/- 5 Hz, 50 Hz optional
 - D. Power factor from .5 leading to .5 lagging.
 - E. Full Load Efficiency: 97.5%
 - F. Insulation Class: Class "R"
 - G. Standard Temperature Rise: 150 °C (130°C, 115°C & 80°C are optionally available)
 - H. Harmonic Distortion: 0.5% max
 - I. Percent Reactance: 3.0%
 - J. Percent Impedance: 3.0 to 5.0%
- Minimum Noise attenuation: -120db common mode, -30db transverse mode
- L. Standard Inrush:

2.05 Environmental Requirements

- A. Storage temperature shall be between -36°C to +70°C (-33°F to 158°F).
- B. Operating temperature shall be between 0°C to +40°C (32°F to 104°F).
- C. Relative humidity from 0% to 95% non-condensing.
- D. Maximum Operating Altitude 2,500 Meters
- E. Non-Operating Altitude: 15,000 Meters
- F. Audible Noise: 45db maximum @ three meters

3.0 Execution

3.01 Factory Tests

- A. The manufacturer shall provide test reports with each PDU certifying that the unit has passed the following tests.
 - 1. Functional test: All meters, alarms and shunt trips.

3.02 Hi-pot test at 2 kV for 1 minute. Packaging and Shipping

- A. The manufacturer shall provide adequate packaging to ensure there is no damage to the unit(s) while in transport.
- B. The manufacturer shall provide adequate notice to the contractor of shipping and arrival times.
- C. The contractor shall arrange for receiving and provide storage for any units prior to installation. Unit storage should be provided in accordance with the environmental conditions outlined in this specification.

3.03 Field Service

- A. All field service work shall be performed by the manufacturer's trained and certified personnel.
- B. A 24 hour telephone service organization shall be provided and the phone numbers displayed on the door of each enclosure.
- C. The manufacturer shall provide on-site training for the customer's personnel in the operation of the equipment.

3.04 Installation

- A. The contractor shall provide labor for the installation of the new equipment in accordance with the manufacturer. All rigging for unloading and installation shall be the responsibility of the contractor. The manufacturer shall assist the contractor as required in interpreting the installation instructions.
- B. The manufacturer shall provide all inter-cabinet wiring as required.
- C. The contractor shall install the equipment as shown on the drawings and ensure all required working clearances are maintained.
- D. Following installation, the manufacturer shall verify the correct installation of the PDUs.

3.05 Start-Up Commissioning

- A. The manufacturer shall provide the services of a qualified technician to perform the manufacturer recommended start-up procedures. Upon completion, the manufacturer shall provide a commissioning report to the owner.
- B. The contractor shall notify manufacturer at least ten (10) days in advance of the date when start-up will be required. The contractor shall coordinate with the manufacturer and the engineer to establish an agreeable start-up and testing schedule
- C. Required load banks for testing and acceptance are the sole responsibility of the contractor.
- D. The manufacturer shall provide the services of a field service engineer for site testing and installation supervision as required to complete the check out.

3.06 Acceptance

Final Acceptance shall occur when the certified start-up reports are submitted to the owner.

Appendix A – PDU Weights and Heat Generation.

PowerPak PDU Weight and Heat Generation

| kVA | Output Heat kBTU | Full Load Amperage | | | Weight (Lbs) |
|-----|---------------------|--------------------|-----|-----|-----------------|
| | | 208 | 480 | 600 | |
| 15 | 2.7 | 42 | 18 | 14 | 574 |
| 30 | 4.8 | 83 | 36 | 29 | 945 |
| 50 | 7.1 | 139 | 60 | 48 | 1,302 |
| 75 | 7.6 | 208 | 90 | 72 | 1,470 |
| 100 | 8.4 | 278 | 120 | 96 | 1,785 |
| 125 | 10.4 | 347 | 150 | 120 | 1,855 |
| 150 | 12.2 | 416 | 180 | 144 | 1,967 |
| 200 | 15.6 | 555 | 241 | 192 | 2,149 |
| 225 | 17.6 | 625 | 271 | 217 | 2,457 |
| 300 | 21.0 | 833 | 361 | 289 | 3,297 |
| 400 | 34.6 | 1110 | 481 | 385 | 2789 |
| 500 | 43.3 | 1388 | 601 | 481 | 4000 |
| 625 | 54.1 | 1735 | 752 | 601 | 4489 |
| 750 | 64.9 | 2082 | 902 | 723 | 5390 |

Notes:

1. Weights listed include transformer in standard cabinet without side car(s).
2. Add 150 pounds per side facing sidecar.
3. Add 250 pounds per front/side facing sidecar.
4. Weights are estimates only, shipping weight may vary.

Appendix B – Input Breaker Sizing

Input Breaker Sizing Chart

Main Breaker Amperage Rating Chart: Input Voltage

| kVA | Transformerless | | PowerPak | |
|-----|-----------------|---------|----------|---------|
| | 208/120 Vac | 208 Vac | 480 Vac | 600 Vac |
| 15 | 60 | 60 | 30 | 20 |
| 30 | 110 | 110 | 50 | 40 |
| 50 | 175 | 200 | 80 | 70 |
| 75 | 300 | 300 | 125 | 100 |
| 100 | 350 | 400 | 175 | 125 |
| 125 | 500 | 500 | 200 | 175 |
| 150 | 600 | 600 | 250 | 200 |
| 200 | 700 | 800 | 350 | 250 |
| 225 | 800 | 800 | 400 | 300 |
| 300 | | | 500 | 450 |
| 400 | | | 700 | CF |
| 500 | | | 800 | CF |
| 625 | | | 1000 | CF |
| 750 | | | 1200 | CF |

Notes:

1. CF=Consult Factory