1 GENERAL

1.1 Summary

This specification covers the electrical characteristics and general requirements for a continuous opening, low voltage, vertical or horizontal power busway distribution system.

System shall be designed primarily as an overhead distributed power distribution center. System shall be designed to be located near critical distribution points to power specific loads, servers and work stations. Once installed, the completed system will provide a manageable, economical means for the distribution of power and communications. Distribution of power and communications will be made through the adaptation of plug-in Tap Off Units mounted securely to the busway rails.

Tap Off points shall be easily modifiable for phase configuration and be safe for installation and decommissioning while the busway is in its live state.

System shall be 100% recyclable and be shipped in recyclable containers and packing.

1.2 Standards

The PDI PowerWave 2 Bus System shall be certified through ETL for the following standards:

- UL 857
- CSA C22.2 No. 27-09
- IEC 61439-2
- C-TICK (Australia)

In addition, the PowerWave 2 Bus System shall be designed, manufactured, tested, and installed in compliance with the following standards:

- IEC 60264
- IEC 60364
- IEC 61439-1
- ISO 9001: 2015
- Low Voltage Directive 73/23/EEC: Amendment 93/68/EEC
- NEC Art. 364 – 19 Busway
- NEMA AB-1
- NEMA KS-1
- NFPA-70
- UL 60950-1

1.3 System Description

1.3.1 Environmental Requirements

The PowerWave 2 Bus System shall have the following environmental requirements for operation and storage requirements:

- Temperature ranges:
  - Storage: -40°F to 158 °F [-40°C to 70°C]
  - Operating:
    - 250 – 400A Busway: 140°F [60°C] Maximum
    - 800A Busway: 104°F [40°C] Maximum
    - BCMS: 104°F [40°C] Maximum
- Relative Humidity:
  - Storage: Store in dry location in original packaging
  - Operating: 0% to 95% non-condensing
- Operating Altitude:
  - Up to 6,600 ft. (2,000m) above Mean Seal Level; the unit is de-rated if operated above this altitude.

1.3.2 Electrical Specification

The PowerWave 2 Busway System shall accept input power rated at 250A, 400A, and 800A.

The PowerWave 2 Busway System shall accept alternating current frequencies of 50 Hz, 60 Hz, and 400 Hz.

The PowerWave 2 Busway System shall accept input voltages of 208/120V, 380/220V, 400/230V, 415/240V, 480/277V, 600/377V or any voltage less than or equal to 600V. Voltage drop-off along the bus run per 100' of installed system shall be approximately 2V.

The PowerWave 2 Busway System shall have the following short-circuit withstand ratings:

- 250A Bus Systems:
  - 42 kAIC up to 208VAC
  - 35 kAIC up to 480VAC
  - 22 kAIC up to 600VAC
- 400A Bus Systems:
  - 42 kAIC up to 208VAC
  - 35 kAIC up to 480VAC
  - 22 kAIC up to 600VAC
- 800A Bus Systems:
  - 42 kAIC up to 600V

1.4 Documentation

1.4.1 Drawings

PowerWave 2 Busway System submittal drawings shall be furnished for busway and Tap Off Units.

1.4.2 Installation and Operations Documentation

A PowerWave 2 Busway System Installation and Operations Manual shall be furnished.

1.4.3 Contact List

A contact list for PDI functions, such as Service and Accounting, shall be provided.

1.5 Warranty

The manufacturer shall provide a warranty against defects in materials and workmanship for a period of 12 months from initial start-up or 18 months from shipping date, whichever period ends first.

1.6 Quality Assurance

The PDI PowerWave 2 Busway shall be designed and manufactured according to internationally recognized quality standards, including those listed in section **1.2 Standards**. The manufacturer shall be ISO 9001 certified.

The PDI PowerWave 2 Busway shall be factory tested before shipment. Testing shall include at minimum:

- Hi-Pot Test at two times the unit's rated voltage plus 1000 volts, per UL 60950
- Receptacle or Connector and Breaker Configuration
- Phase Wiring/ Connectivity Test
- Ground Fault Path Test

2 PRODUCT

2.1 Busway

2.1.1 Busway System

The busway system shall be constructed to allow any individual section to be removed and replaced without disruption to adjacent sections.

The busway system shall be finger safe IP2X rated and tested.

2.1.2 Bus Rail Housing

Bus rail housing shall be of single-piece extruded aluminum that is designed to act as a 100% ground conductor. The extrusion shall have a corrosion resistant anodized surface finish. Standard lengths shall include 3, 5, 6, 10, and 12 foot. Removing the end cap assembly shall allow extending the bus run length.

The extruded housing must accommodate the direct insertion of hanger assemblies which attach directly to the housing assembly.

The complete assembly shall be of the continuous opening design and shall have a slotted opening on one side of the bus to accommodate the insertion of the Tap Off Units.

2.2 Bus Bars

2.2.1 Bus Bar Construction

All phase and neutral conductors shall be made of copper with a minimum of 98.9% electrical grade purity that is silver plated with a nickel undercoat per ASTM B700-08 and sized to handle a minimum of 100% of the continuously rated current. All conductors shall be electrically isolated from the housing using a Class H fiber-reinforced Glastic material with non-propagating properties. All insulators must be UL recognized.

2.2.2 Bus Power Junctions

All critical bus power junctions shall be made with CouplerTek™ technology and shall be maintenance fee. Bolted bus connections that can loosen, sag, and result in connection hotspots are not allowed.

2.2.3 Bus Bar 150% Neutral (Optional)

A 150%-rated Neutral shall be available as a factory integrated feature of the bus rails.

2.2.4 Isolated Ground Bus Bar (Optional)

An Isolated Ground Bus Bar shall be optionally installed in the existing rail channel and tested.

2.2.5 Conductive Fittings and Components

All conductive fittings including Tees, Elbows, etc. shall be of the same material from the same manufacturer. All insulating material shall be Class H fiber-reinforced Glastic material. All insulators must be UL recognized.

2.2.6 Insertion Points

The entire bus open channel with the exception of the small area at the bus bar coupling shall be available for Tap Off Unit insertion. The maximum busway coupler keep-out area shall be as follows:

- 250-400 Amp = 3.75" keep-out area
- 800 Amp = 9" keep-out area

2.3 Suspension and Bus Hangers

2.3.1 Hanger Assemblies

Hanger assemblies shall allow ceiling mounting and must not interfere or obstruct the housing opening intended for the installation of Tap Off Units. The Installing Contractor shall supply threaded rod where required for hanging the busway.

The busway shall be hung from the ceiling using threaded rod. The Installing Contractor shall be responsible for supplying the threaded rod and making connections to bus hangars and End Feed enclosures and to the supporting structure. Maximum hanger spacing will be no more than 10' on center.

2.3.2 Vertical or Horizontal Suspension

Bus Hangers shall be available for vertical or horizontal bus mount applications. Hangers shall be compatible with standard hardware and Unistrut.

2.4 End Feed

End Feeds shall be designed for conduit landing and input feed connection. Vertical or horizontal End Feeds shall be available.

2.5 Tap Off Units

2.5.1 Tap Off Unit Enclosure

The Tap Off Unit enclosure shall be available in vertical- and horizontal-mount configurations and shall be compatible the 250, 400, and 800 amp bus rails.

Plug-in Tap Off Units shall be polarity matched to the busway system.

2.5.2 Tap Off Unit Electrical Specification

The Tap Off Unit maximum amperage shall be 128A.

The Tap Off Unit can support a maximum of 12 poles without BCMS monitoring or 6 poles with BCMS monitoring.

Finger safe multi-pole fuse holders are optional and may be used for current limiting requirements.

2.5.3 Circuit Breakers

Circuit breaker ampacity shall be appropriate for the NEMA or IEC / Pin-and-sleeve connector circuit as indicated on drawings and maybe installed directly on the Tap Off Unit or suspended from a multi-conductor cable (drop cord).

Plug-in Tap Off Units shall use Square D, Eaton, Siemens, Schneider, ABB, or PDI factory-approved circuit breakers for branch circuit protection.

Circuit breaker withstand rating shall be 5, 10, 22, 35, or 50 kAIC.

2.5.4 Connectors and Receptacles

Connectors and Receptacles shall be as indicated on submittal drawings.

2.5.5 Drop Cords

Drop cord length shall be specified by the customer at time of purchase order. The drop cord length shall be the length of the drop cord not including the pre-assembled connector.

Plug-in Tap Off Units requiring a cord assembly shall be manufactured with cord grips and the receptacles as specified in the submittal drawings.

2.5.6 Tap Off Unit Safety

Plug-in Tap Off Units shall have inherently safe two-step insertion and removal in isolate sequential steps: (1) mechanically securing and then (2) energizing contact with the bus rail conductors. Plug-in Tap Off Units shall make ground contact prior to full insertion into the bus rail. The two-step insertion and removal process complements safety and change procedures at Mission Critical sites.

2.5.7 Tap Off Unit Monitoring

All Tap Off units can be equipped to provide current/voltage information for optional Branch Circuit Monitoring System (BCMS) and BCMS Hub devices. When equipped with the BCMS option, the Tap Off Units shall be plug-and-play. No installer wiring shall be required.

2.6 Branch Circuit Monitoring System (Optional)

2.6.1 BCMS Integration and Protocols

Branch Circuit Monitoring shall be optionally integrated into the busway delivering the measurement and management of the busway and Tap Off Unit loads to the customer's building management system through Modbus RTU, Modbus TCP/IP, or SNMP protocols. Modbus TCP/IP and SNMP each

require a front-end converter. The BCMS option shall be integrated at the factory and shall not require any additional installed wiring between the End Feeds and Tap Off Units.

2.6.2 Monitoring Specification

The Branch Circuit Monitoring System shall be capable of monitoring and providing all power calculations for the total input power for each busway run. It shall be housed on the outside wall of the power input End Feed Units and shall provide:

- Voltage (L-L, L-N) for all three phases
- Overvoltage/Undervoltage Alarm Threshold
- Voltage THD
- Current – Phase, Ground, and Neutral
- Minimum & Maximum Current
- Demand and Percent Load Current
- Crest Factor
- Warning and Alarm Threshold
- kW, kVA, kVAR, Power Factor, kWH

Tap Off Units shall provide:

- Voltage (L-L, L-N) for all three phases
- Overvoltage/Undervoltage Alarm Threshold
- Voltage THD
- Phase Current
- Minimum & Maximum Current
- Demand and Percent Load Current
- Crest Factor
- Warning and Alarm Threshold
- kW, kVA, kVAR, Power Factor, kWH

2.6.3 BCMS Local Display (Optional)

The 7” Local Touchscreen Display shall address up to 6 End Feeds, 15 Tap Off Units per End Feed or a total of 96 devices. The Display shall be wall-mounted at eye level. The Display shall not be mounted overhead on End Feeds.

2.6.4 BCMS Hub (Optional)

The BCMS Hub shall integrate multiple BCMS devices (up to 240), from various PDI equipment with BCMS installed. The BCMS Hub shall include the following:

- Modbus RTU protocol and TCP/IP (with customer-provided Ethernet connection) allowing Modbus TCP/IP protocol for remote monitoring.

- WaveStar® 10.4" color touch screen monitor shall display graphical representations with discrete addresses and event time stamps of all monitored devices, including End Feeds, Tap Off Units, and other BCMS-monitored equipment in connected PDI Remote Power Panels (RPPs) or JCOMMs. The BCMS Hub display should be wall-mounted at eye level in a central location. The display shall not be mounted overheard on End Feeds.

2.7 Load Bank Testing (Optional)

Load Bank Connection Units shall be available for 250 Amp and 400 Amp PowerWave 2 Bus Systems. Load Bank Connection Units shall allow for 100% loading of an installed busway system. A Load Bank Connection Unit must be installed on a disconnected system for safety. Load Bank Connection Units shall be available for rental.

3 EXECUTION

3.1.1 Packaging and Shipping

The manufacturer shall provide adequate packaging for protection of shipped items during transport and normal handling circumstances.

The Installing Contractor shall provide for receiving, unloading, and storage of busway components prior to installation. Storage shall be provided in accordance with the environmental requirements indicated in this specification.

3.1.2 Installation

The Installing Contractor shall install all components of the new busway in accordance with the busway manufacturer's installation instructions. If Branch Circuit monitoring has been selected for this application the Installing Contractor must be sure to have the customer's Communications Systems Integrator on hand during the startup day for configuration of the busway communications features. The Installing Contractor is responsible for communications wiring to and from End Feeds, BCMS Hub, BCMS Local Display, and to end user systems.

The Installing Contractor shall install the equipment as shown on the drawings and insure all required working clearances are maintained.

3.1.3 Busway Manufacturer's Field Service

A Factory Assisted Startup is required. After the Busway has been installed and are ready to energize the Installing Contractor shall coordinate scheduling of the busway manufacturer's certified and authorized Field Service Technician to perform the manufacturer's standard one day on site factory startup procedure

On the scheduled date of startup the factory-supplied Field Technician shall provide basic operational maintenance instruction.

3.1.4 Certified Test Report

A certified factory test report shall be provided for each unit upon request.