

Vertiv™ Liebert® FPC with VPMP GUIDE SPECIFICATIONS 15 - 300 kVA Power Conditioning Center

1.0 GENERAL

1.1 Summary

These specifications describe requirements for a complete power conditioning and distribution center, supplying power to sensitive electronic loads. The specified center shall provide isolation*, distribution, control and monitoring of AC power. It shall include all equipment to properly interface the AC power source to the intended load.

* Units without a transformer do not provide isolation.

1.2 Standards

The specified system shall be designed, manufactured, tested and installed in compliance with:

- American National Standards Institute (ANSI)
- Canadian Standards Association (CSA)
- Federal Information Processing Standards Publication 94 (FIPS Pub 94)
- Department of Energy (DOE)
- Institute of Electrical and Electronics Engineers (IEEE)
- ISO 9001
- National Electrical Code (NEC - NFPA 70)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA 75)
- Underwriters Laboratories (UL)

The Liebert® FPC shall be UL-listed as a complete system under UL 60950 Standard for Information Technology Equipment (UL listing applies to 60 Hz units only). 50Hz units shall comply with EN and the European Low Voltage Directive and be CE-marked.

The specified center shall comply with latest FCC Part 15 EMI emission limits for Class A computing devices and the emission and immunity limits of EN50081-2/EN550022 Class A and EN50082-2.

The FPC shall safely withstand without misoperation or damage:

- Transient voltage surges on the AC power input as defined by ANSI/IEEE C62.41 for Category B3 locations (high surge exposure industrial and commercial facilities),
- Electrostatic discharges (ESD) up to 10kV at any point on the exterior of the unit and
- Electromagnetic fields from portable transmitters within 3 ft. (1m) of the unit.

1.3 System Description

1.3.1 Electrical Requirements

Output capacity shall be (15) (30) (50) (75) (100) (125) (150) (200) (225) (300) kVA.

Input voltage shall be (600) (480) (415) (400) (380) (240) (208) (____) volts AC, (60) (50) Hz, three-phase, (three) (four)-wire-plus-ground.

Output voltage shall be (208/120) (380/220) (400/230) (415/240) (____) volts AC, three-phase, four-wire-plus-ground, wye configuration.

1.3.2 Environmental Requirements

1. **Storage temperature range:** -67° to +185°F (-55° to +85°C).
2. **Operating temperature range:** +32° to 104°F (0° to 40°C).
3. **Relative humidity:** 0% to 95% without condensing.
4. **Operating altitude:** Up to 6,600 ft. (2,000m) above Mean Sea Level. Derated for higher altitude applications.
5. **Storage/transport:** Up to 40,000 ft. (12,200m) above Mean Sea Level.
6. **Audible noise:** Under normal operation, noise level shall not exceed the NEMA ST-20 standard for transformers.

1.4 Documentation

1.4.1 Drawings

Submittal drawings shall include:

- One-line wiring diagrams
- Outline drawings including weight, dimensions, heat dissipation and recommended service clearances
- Location and detailed layout of customer power and control connections
- Outline drawings of options if supplied

1.4.2 Equipment Manual

The manufacturer shall furnish an installation, operation and maintenance manual with installation, startup, operation and maintenance instructions for the specified system.

1.4.3 Spare Parts

A list of recommended spare parts shall be supplied at the customer's request.

1.4.4 User's List

An in-service user's list shall be furnished upon request.

1.5 Warranty

The manufacturer shall provide a one-year warranty against defects in material and workmanship for 12 months after initial startup or 18 months after ship date, whichever occurs first. (Refer to the Warranty Statement for details.)

1.6 Quality Assurance

The specified center shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, “Hi-Pot” Test (two times rated voltage plus 1000 volts, per UL requirements) and Metering Calibration Tests. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

2.0 PRODUCT

2.1 Components

2.1.1 Frame Construction and Enclosure

The frame shall be constructed of galvanized steel and pop riveted to provide a strong substructure. The enclosure shall be mounted on four (4) heavy-duty swivel casters for portability and ease of installation and shall be provided with four permanent leveling jacks for final installation. The unit shall have easily removable output cable trays on the top and bottom to allow matching the size and number of cable/conduit openings to the site requirements. A minimum of 42 cable/conduit openings shall be provided for each output panelboard. All service shall be capable of being performed with access to the front, rear and top. Retrofitting additional power distribution cables shall require access to the rear of the unit only. A tool shall be required to remove the exterior panels, which access the hazardous voltage area of the unit.

The unit shall have lockable, removable, hinged front and rear doors that are 16-gauge perforated sheet metal construction to maximize ventilation. A two-point latch with key lock is provided for security. Doors shall provide access to the main input circuit breaker and to all output circuit breakers. Doors and side panels (if supplied) shall be manufacturer's standard color, black gray matte. Optional custom-painting to match or accent the data processing equipment shall be available.

(On 15-225kVA units) The unit shall be naturally convection-cooled. No fans for forced-air cooling system shall be used. The convection cooling method shall allow continuous full-load operation without activation of overtemperature circuits. (On 300kVA only) The unit shall be forced air-cooled. Fans shall be redundant so that a single fan failure will not cause temperature to increase beyond acceptable limits. Heat rejection shall be through a screened protective top that shall prohibit entry of foreign material.

The frame shall be configured to accept future field installation of additional bolt-on distribution sections containing additional panelboards. Unit shall be designed as a stand-alone power center or it can be used in a rack line-up.

The complete Vertiv™ Liebert® FPC dimensions shall be a maximum of (23.5in./597mm [15-125kVA]) (47in./1194mm [150-300kVA]) Wide by 78.5 in./1994mm High by 39.5 in./1003mm Deep. The distributed floor weight shall be less than 250 lb./sq.ft. (1225 kg/sq. m).

2.1.2 Input Power Connections

An input voltage junction box shall be provided for input power connections. Power terminal blocks or busbar for two-hole lugs shall be provided for connection of the input power conductors and a parity-sized insulated ground conductor. The junction box shall have maximum dimensions of Width, 22 in. (559 mm); Length, 38 in. (965mm); Height, 6 in. (153mm).

A main input conduit with cables shall be provided for connection between the specified unit and the input voltage junction box. Parallel input conduit with cables shall be used on higher ampacity units. The UL/CSA listed liquid-tight, flexible metal conduit shall be 10 ft. (3m) long and consist of the appropriate number and size of conductors inside.

The conductors shall be UL/CSA listed, 194°F (90°C) minimum insulation, copper conductors, sized in accordance with the NEC, based on the main input circuit breaker rating. Both for reliability and per the NEC, no plug-and-receptacle connectors shall be used for the input power cable(s).

2.1.3 Cable Entry

The Liebert® FPC shall have provisions for top and bottom cable entry and exit.

NOTE: Liebert® FPC with I-Line panelboard and Vertiv™ Liebert® LDMF branch circuit monitoring is bottom exit only.

2.1.4 Main Input Circuit Breaker

The specified unit shall be equipped with a main input circuit breaker to provide overcurrent protection and a means for disconnecting all power to the unit. The main input circuit breaker shall be a three-pole molded case circuit breaker sized for 125% of the specified full load input current and rated for 600VAC. The minimum UL-listed interrupting rating for the main input circuit breaker shall be (65,000) RMS symmetrical amperes at (480) VAC for 125-300kVA ratings. The main input circuit breaker shall include a 24VDC shunt trip mechanism to interface with unit controls, EPO buttons and other remote controls.

2.1.5 Isolation Transformer

(NOTE: For the “Transformerless Configuration,” delete this section.)

The unit shall contain an electrostatically shielded, TP-1 listed isolation transformer with a rating as described in Section 1.3. The transformer shall be a dry-type, double-shielded, three-phase, common-core, convection air-cooled transformer. The transformer shall conform to UL1561, with 302°F (150°C) maximum temperature rise. All transformer windings shall be copper. The transformer shall be energy efficient and shall meet DOE standard TP-1 2016. The transformer shall exhibit the following characteristics: percent impedance 3.3 to 5.3%; common mode noise attenuation 120 dB; harmonic voltage distortion 0.5% maximum additive; full-load efficiency 96.3 (15 KVA) to 98.2% (300 KVA).

The isolation transformer shall be provided with six full-capacity compensation taps at 2-1/2% increments to accommodate field adjustment to match the source voltage. These compensation taps shall be easily accessible by removing the front accent panel. Tap changes include: two above nominal voltage (upper range limit of +5%), nominal voltage and four below nominal voltage (lower range limit of -10%).

The unit shall be provided with thermal overload protection for the transformer. An alarm shall notify personnel if the transformer temperature reaches 356°F (180°C). The unit shall shut down automatically if the transformer temperature reaches 392°F (200°C). Temperature sensors shall be located in each coil of the three phase windings.

2.1.6 Manual Restart

The specified unit shall be equipped with a manual restart feature to allow for an orderly, supervised startup after power failure. The control circuit shall automatically energize the shunt trip mechanism of the main input breaker upon sensing output voltage failure. A field-selectable auto-restart mode shall be provided to deactivate the manual restart, if desired.

2.1.7 Emergency Power Off (EPO)

The local EPO shall include a covered “Emergency Power Off” push button. Pressing the EPO switch shall immediately shut down the unit by activating the shunt trip of the main input circuit breaker. As part of the EPO circuit, an interface shall also be provided for connecting one or more normally open or normally closed remote EPO switches to the EPO circuit. For flexibility in meeting shutdown control schemes, the local EPO (unit shutdown) circuit shall be isolated from the remote EPO (room shutdown) circuit. The remote EPO circuit shall be designed to allow direct connection of multiple units with single and multiple shutdown control contacts.

2.1.8 Computer Grade Ground

The Vertiv™ Liebert® FPC shall include a single-point ground in accordance with sensitive electronic load manufacturer's recommendations, IEEE Std. 1100 and the requirements of the NEC. The transformer output neutral shall be solidly grounded in accordance with NEC article 250-26. Grounding conductors shall be sized in accordance with IEC 364-HD-384 and applicable national and local codes.

2.1.9 Output Distribution Panelboards

The specified system shall contain (one) (two) (three) (four) vertically mounted (Square D) (GE) (bolt-in) (plug-in) output panelboard(s) for distribution to the intended loads. Each output distribution panelboard shall be individually protected by a main panelboard circuit breaker. Each panelboard shall be totally enclosed with a hinged accent panel that provide access to that panelboard without exposing other portions of the unit. The panelboard shall have a rating of 225 amperes, with an overall short-circuit current rating of 22kA (not available @380-415V) RMS symmetrical amperes. The panelboards shall provide a total of (42) (84) (126) (168) single-pole branch circuit breaker positions. Each panelboard shall include separate isolated neutral and safety-ground busbars for the neutral and safety-ground connections for at least 42 output circuits. The neutral bus bar and wiring shall be sized for at least 1.73 times the panelboard full load rating to accommodate high harmonic neutral currents associated with single-phase nonlinear loads.

2.2 Power Monitoring System

The specified Vertiv™ Liebert® FPC shall be equipped with a microprocessor-based power monitor panel. The monitor panel shall gather and process information from electrical and environmental sensors, relays and switches both internal and external to the unit. The monitored parameters and alarms shall be displayed on the unit monitor panel and shall also be available for communication to a Liebert centralized monitoring system using a two-wire, twisted-pair, low-voltage signal circuit for reliable communication up to 3280ft. (1000m). Additionally, the monitor panel shall be equipped with a DB-9 setup port for adjusting parameters and performing diagnostics. Three Vertiv™ Liebert® IntelliSlot ports shall be provided to allow communication to remote monitoring systems using Liebert® IntelliSlot cards.

2.2.1 Monitored Parameters

The monitoring system shall monitor and display all of the following parameters:

- Input Voltage, Line-to-Line for all three phases
- Output Voltages, Line-to-Line for all three phases
- Output Voltages, Line-to-Neutral for all three phases
- Output Voltage Total Harmonic Distortion (THD) for all three phases
- Output Current for all three phases
- Output Current Total Harmonic Distortion (THD) all three phases
- Output Current Crest Factor (Peak/RMS) for all three phases
- Output Current Harmonic K-Factor for all three phases
- Output Neutral Current
- System Ground Current
- Output Frequency
- Output kVA
- Output kW

- Output Power Factor
- Output kW-Hours
- Percent Load
- Date
- Time

All three phases of the three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accurate representation of non-sinusoidal waveforms typical of computers and other sensitive loads.

2.2.2 Alarm Annunciation

The monitoring system shall detect and annunciate by audible alarm and alarm message the following conditions:

- Output Overvoltage
- Output Undervoltage
- Output Overcurrent
- Neutral Overcurrent
- Ground Overcurrent
- Output Voltage Distortion
- Frequency Deviation
- Phase Sequence Error
- Phase Loss
- Transformer Overtemp

All alarm thresholds for monitored parameters shall be adjustable by way of the VPMP DB-9 setup port to match site requirements. The factory setpoints for the alarms shall be as follows:

- **Output Overvoltage** - output voltage exceeds +6% of nominal
- **Output Undervoltage** - output voltage falls below - 13% of nominal
- **Output Overcurrent** - output current exceeds 95% of full load amps
- **Neutral Overcurrent** - neutral current exceeds 95% of full load amps
- **Ground Overcurrent** - ground current exceeds 5 amps (15-125kVA), 10 amps (150-225kVA), 15 amps (300kVA)
- **Output Voltage Distortion** - output voltage THD exceeds 10%
- **Frequency Deviation** - output frequency exceeds ± 0.5 Hz of nominal

To facilitate troubleshooting, all alarms shall be stored in battery-backed (non-volatile) memory until reset to protect against erasure by a power outage. Alarms shall be able to be manually reset after the alarm condition has been corrected either at the unit or by way of the central monitoring system.

2.2.3 Custom Alarm Annunciation

The monitoring system shall be capable of providing alarm annunciation for up to five contact closures (four N.O. and one N.C.). A custom alarm message up to 20 characters shall be provided for each contact. Alarm messages shall be programmable by way of the VPMP DB-9 setup port to match site requirements.

2.2.4 Summary Alarm Contact

A Form C (one N.O. and one N.C.) Summary Alarm Contact shall be provided for remote alarm status. The contacts shall change state upon occurrence of any alarm and shall rest upon alarm silence.

2.2.5 Display

All monitored parameters and alarm messages shall be displayed on a high visibility liquid crystal display (LCD) located on the unit front door within a decorative bezel. Included in the bezel shall be a covered Emergency Power Off (EPO) switch, an Alarm Silence/Reset switch, control keys, LEDs and an audible alarm.

The Alarm Silence switch shall be used to silence the audible alarm and reset inactive alarms.

3.0 ACCESSORIES (OPTIONAL COMPONENTS)

3.1 Low Voltage Control Junction Box

A separate low-voltage control junction box shall be provided for connecting all building interface alarms and controls, centralized monitoring and all Remote Emergency Power Off (REPO) switches. The low-voltage junction box shall also contain a 24VDC, DPDT building interface relay for interfacing with environmental systems, alarm panels, etc. The relay contacts shall be rated for use up to 10 amps at 240VAC. The low-voltage junction box shall have maximum dimensions of Width, 8 in. (203 mm); Length, 10 in. (254 mm); Height, 4 in. (102 mm).

A low-voltage control cable shall be provided for connection between the unit and the control junction box. The low-voltage control cable shall utilize UL/CSA listed liquid-tight, flexible metal conduit, measuring 10 ft. (3m) long.

3.2 EZ-View Doors

The enclosure shall be provided with rear lockable, hinged removable doors with a clear acrylic scratch- and impact-resistant Plexiglas insert to allow for external viewing of the branch breakers without opening the door. The front doors shall be solid sheet metal.

3.3 Solid Sheet Metal Doors

The enclosure shall be provided with front and rear lockable, hinged removable solid sheet metal doors.

3.4 Side Panels

Unit shall be supplied with 18-gauge sheet metal (right) (right and left) side panel(s). A tool shall be required to remove the exterior panels that access the hazardous voltage area of the unit.

3.5 Input Lightning/Surge Arrester

The specified unit shall be equipped with a secondary-class surge arrester to divert high-voltage input power surges quickly and safely to ground. The surge arrester shall be mounted ahead of all electrical components to provide maximum protection of the unit insulation and wiring. The surge arrester shall be capable of repeated operations. It shall consist of utility-grade metal-oxide varistors rated for up to 20,000A of surge current. The surge arrester shall be rated for maximum FOW sparkover of 3200V with maximum discharge voltage of 2.2kV at 1500A, assuming a standard 8 x 20 microsecond waveform.

3.6 Output Surge Suppression Module (Basic)

The unit shall be equipped with a surge suppression module to eliminate high-speed, high-energy transients and to filter high-frequency noise. The surge suppression module shall be mounted on the output of the unit. The surge suppressor components shall be UL-recognized.

The surge suppressor shall utilize high-energy metal oxide varistors with less than 1 nanosecond response time. The clipping level shall be 212V on a system with a nominal peak line voltage of 170V and 354V on a system with a nominal peak line voltage of 340V. Peak current handling capability shall be at least 13,000 amperes based on an 8 X 20 microsecond waveform. Energy absorption capability shall be at least 200 joules per phase.

A passive filter, utilizing metalized polypropylene film capacitors, shall provide normal mode noise attenuation of at least 20dB from 10 kHz to 1 MHz. The capacitors shall be equipped with an integral pressure-sensitive interrupter to provide short-circuit current interrupting capability of up to 10,000A at 600 VAC.

3.7 High Energy Output Surge Suppression

The unit shall be equipped with a high energy, UL1449 and UL1283 listed, Transient Voltage Surge Suppression (TVSS) module connected to the unit output with minimal interconnecting wiring for maximum surge suppression. The TVSS shall consist of multiple, gapless Metal Oxide Varistor (MOV) arrays with their clamping voltages matched to within 1%. Each MOV shall be individually fused to protect against MOV failure while still allowing maximum rated surge current to flow without fuse operation. The fuses shall have a 100kA interrupting capacity. Each array shall be capable of withstanding at least 1250 IEEE C62.41 category C3 surges (20kV, 10kA) without failure. The complete TVSS module shall have a total surge current capacity of 80kA per phase based on a standard 8 x 20 microsecond surge waveform. The UL1449 surge clamping rating shall not exceed 400V for a 120/208V system. The maximum continuous operating voltage shall be at least 150VAC for a 120/208V system. The TVSS shall also provide electrical noise attenuation of 25dB from 100kHz to 100Mhz (based on MIL220A and 50 Ohm impedance). An alarm contact of the TVSS module shall be connected to the unit monitoring system to annunciate any TVSS failure.

3.8 Subfeed Output Circuit Breaker

(One [up to 250A on 23" frame units]) ([One] [Two] [Three] on 47" frame units) three-pole (100) (125) (150) (175) (200) (225) (250) (300) (350) (400A) ampere, 240VAC-rated, molded-case circuit breaker(s) shall be provided to protect subfeed circuit(s) to an expansion or remote distribution cabinet or other loads. The subfeed circuit breaker shall be rated for 65kA amperes symmetrical minimum interrupting capacity at 240VAC and shall be powered ahead of the panelboard main breakers on the output of the unit. Each subfeed breaker shall include padlock-off provisions to allow circuit lock-out for safety in accordance with OSHA lock-out/tag-out requirements.

3.9 K-Rated Transformer

Unit transformer shall have a K20 rating in accordance with UL 1561 to allow full load operation with highly nonlinear loads. Transformer neutral shall be sized for at least 200% of full load. The transformer shall be designed to operate with 100% single-phase, switch-mode power supplies and associated harmonic phase and neutral currents without derating.

The transformer shall be energy efficient and meet DOE standards TP-1 2016. The transformer shall exhibit the following characteristics: percent impedance, 3.4 to 4.6%; common mode noise attenuation, 120 dB; harmonic voltage distortion, 0.5% maximum additive; and full-load efficiency, 96.4 (15 KVA) to 98.2% (300 KVA).

The isolation transformer shall be provided with six full-capacity compensation taps at 2-1/2% increments to accommodate field adjustment to match the source voltage. These compensation taps shall be easily accessible by removal of one exterior panel. Tap changes include: two above nominal voltage (upper range limit of +5%), nominal voltage and four below nominal voltage (lower range limit of -10%).

The unit shall be provided with additional thermal overload protection for the transformer. An alarm shall notify personnel if the transformer temperature reaches 356°F (180°C). The unit shall automatically shut down if the transformer temperature reaches 392°F (200°C). Temperature sensors shall be located in each coil of the three-phase windings.

3.10 Remote Emergency Power Off (REPO) Switches

Provisions shall be available for adding multiple REPO switches to meet specific site needs and local codes. The REPO switch shall activate the shunt trip of the main input circuit breaker to shut down the system. Each REPO shall be a fully guarded, normally open, illuminated switch in a wall box. REPO switch shall have (50 ft. [15m]) (100 ft. [30m]) (150 ft. [46m]) (200 ft. [61m]) (250 ft. [76m]) of three-conductor cable to connect to the specified system.

3.11 Phase Rotation Meter

A hand-held phase-rotation meter shall be included to verify rotation of any three-phase circuit rated 600VAC or less. It shall indicate “ABC” or “ACB” phase rotation.

3.12 Floor Pedestals

Floor pedestals shall be furnished to level the unit and to provide bottom cabling access without relying upon a raised floor for support. The nominal height of the floor pedestals shall be (6 in. [152 mm]) (12 in. [305mm]) (18 in. [483mm]) with adjustment for ±3 in. (76mm).

3.13 Floor Stands

A floor stand shall be furnished to support and level the unit and to provide bottom cabling access without relying upon a raised floor for support. The nominal height of the floor pedestals shall be (18 in. [483mm]) (24 in. [610mm]) (30 in. [762mm]) (36 in. [914mm]) with adjustment for ±1.25 in. (32mm).

3.14 Transformer High-Temperature Alarm

The transformer high-temperature shutdown sensors shall be connected to provide a “Transformer Hightemp” alarm instead of automatically shutting down the unit when the temperature reaches 392°F (200°C). Temperature sensors shall be located in each coil of the three-phase windings. The NC contact off the temperature sensors shall be connected to Power Monitoring Panel Customer Alarm Number 5 and shall annunciate a “Transformer Hightemp” alarm.

3.15 Isolated Ground Busbar

An isolated ground busbar shall be provided for each panelboard to connect the output cable isolated ground conductor. The isolated ground busbar shall be in addition to the standard equipment ground busbar.

3.16 Plug-In Main Panelboard Circuit Breaker

Plug-in main panelboard circuit breakers shall be provided to allow easy replacement. The plug-in feature of the breaker shall include an interlock, which prevents the breaker from being unplugged without being in the Off (open) position. (This option is not available with GE panelboards.)

3.17 Square D I-Line Panelboard

The Vertiv™ Liebert® FPC shall be supplied with one vertically mounted I-Line output panelboard for distribution to the intended loads. The panelboard shall be totally enclosed with an accent cover that shall provide access to the panelboard without exposing other portions of the unit. The panelboard shall have a rating of (600 [15-200kVA units]) (800 [225kVA units]) (1200 [300kVA units]) amperes, with an overall short-circuit current rating of 65,000 AIC. The panelboard shall provide space for 100A through 250A (through 400A on 225 and 300kVA units) three-pole branch circuit breakers. Panelboard shall include separate isolated neutral busbar and safety-ground busbar for the neutral and safety-ground connections.

The output distribution section shall be of dead-front construction, with filler plates provided for unused circuit breaker positions. The panelboard shall employ copper busbars and be capable of accepting plug-in type circuit breakers up to 3-pole 250 (400A on 225 and 300kVA units) amps.

Panelboard shall have a removable output cable landing tray. A circuit breaker ID number shall be provided for each breaker installed.

The neutral busbar and wiring shall be sized for at least 1.73 times the panelboard full load rating to accommodate high harmonic neutral currents associated with nonlinear loads.

Conduit landing plates shall be provided on top and in the bottom for output cable exit.

The manufacturer shall provide () * (100) (125) (150) (225) (300) (350) (400) A 3-pole circuit breakers. The fault current withstand rating for the circuit breakers shall be 42,000 AIC.

* Total of 10 breakers up to 250A can be specified. 800 and 1200A panelboards can accommodate three 300-400A and six 100-250A breakers.

NOTE: Vertiv™ Liebert® FPC with I-Line panelboard and Vertiv™ Liebert® LDMF branch circuit monitoring is bottom exit standard, top exit by special request.

3.18 Emergency Power Off (EPO) Button Deduct

The local EPO button shall be removed from the monitoring bezel at the factory. An interface shall be provided to connect one or more normally open or normally closed remote EPO switches that can be used to remotely shunt trip the main input breaker.

3.19 No-Monitoring System

The no-monitoring system shall have transformer overtemperature and Emergency Power Off (EPO) circuits. All indicators and controls shall be on the front door.

The transformer overtemperature circuit shall include an audible and visual alarm if any internal transformer winding temperature reaches 356°F (180°C). A “Silence/Reset” switch shall be provided to quiet the audible alarm. The transformer overtemperature circuit shall also trip the main input breaker to remove power automatically when any transformer winding temperature reaches 392°F (200°C).

3.20 Current Plus Monitoring with Display

The Current Plus Monitoring (CPM) shall monitor the current and voltage of the panelboard main circuit breaker and include a monochrome liquid crystal display (LCD) with oval bezel that includes power and alarm LEDs, an audible alarm and an alarm silence push button. The CPM shall display the power parameters and alarms listed below for each panelboard main. The display shall be mounted on the front door, the display and switches shall be accessible without opening the door.

The following metering parameters shall be displayed:

- Voltage
 - Line-to-Line
 - Line-to-Neutral
- Neutral Current
- Ground Current
- kVA
- Power Factor
- Voltage Total Harmonic Distortion (THD)
- Current Total Harmonic Distortion (THD)
- Crest Factor

Circuit identification and status of each breaker shall be displayed.

The CPM shall detect and annunciate by alarm message the following conditions:

- Overvoltage
- Undervoltage
- Neutral Overcurrent
- Ground Overcurrent
- Phase Overcurrent

- Phase Overcurrent Warning
- Summary Alarm

All alarm thresholds for monitored parameters shall be adjustable by way of the DB-9 setup port to match site requirements. The factory setpoints for the alarms shall be as follows:

- **Overvoltage** - at least one of the line-to-line voltages exceeds +6% of nominal
- **Undervoltage** - at least one of the line-to-line or line-to-neutral voltages falls below -13% of nominal
- **Phase Overcurrent Warning** - current exceeds 75% of breaker amps
- **Phase Overcurrent** - current exceeds 80% of breaker amps
- **Neutral Current** - current exceeds 95% of breaker amps
- **Ground Current** - current exceeds 5 amps (15-125kVA), 10 amps (150-225kVA), 15 amps (300kVA)

Summary Alarm

- **Summary Alarm** - shall detect and annunciate upon occurrence of any alarm.

To facilitate troubleshooting, all alarms shall be stored in non-volatile memory to protect against erasure by a power outage. Alarms shall be manually reset after the alarm condition has been corrected.

Communication

CPM shall have three Vertiv™ Liebert® IntelliSlot ports, up to three Liebert® IntelliSlot cards can be added for customer connections to a Building Management System (BMS) or Vertiv™ Liebert® LDMF and Vertiv™ Liebert® SiteScan™ monitoring interface.

3.21 Liebert® Distribution Monitoring (LDMF)

The system shall be capable of receiving input from branch current sensor modules. The Liebert® LDMF system shall monitor (one)(two)(three)(four) 42-pole panelboards. Each sensor module shall contain twenty-one 100A current transformers (CT) encapsulated in an epoxy-filled plastic enclosure designed to mount next to the panelboard. No individual current transformers mounted on a printed circuit board shall be used. Sensor module shall be designed to work with (Square D) (GE) panelboards.

In addition to monitoring the branch circuit breakers the Liebert® LDMF shall monitor the current and voltage of the panelboard main circuit breaker. These measurements are used for reporting the average RMS current, power and other parameters.

The Liebert® LDMF shall report alarm and status conditions for each branch circuit breaker and the panelboard main circuit breaker.

The manufacturer shall provide current transformers to monitor (1) (2) (3) subfeed circuit breaker(s) rated at (100A)(125A)(150A)(175A)(200A)(225A)(300A)(350A)(400A). The system shall monitor the three phases, neutral and ground of each subfeed circuit breaker.)

The Liebert® LDMF shall monitor and display the following parameters for the panelboard main circuit breaker (subfeed circuit breaker(s)) and each branch circuit breaker:

- Phase Current
- Percent Load
- kW
- kW-Hours

In addition, the Vertiv™ Liebert® LDMF shall monitor and display the following parameters for the panelboard main circuit breaker (and subfeed circuit breaker(s)):

- Voltage
 - Line-to-Line
 - Line-to-Neutral
- Neutral Current
- Ground Current
- kVA
- Power Factor
- Voltage Total Harmonic Distortion (THD)
- Current Total Harmonic Distortion (THD)
- Crest Factor

Circuit identification and status of each breaker shall be displayed.

The Liebert® LDMF shall detect and annunciate by alarm message the following conditions:

- **Overvoltage** - panelboard main breaker
- **Undervoltage** - panelboard main breaker
- **Neutral Overcurrent** - panelboard main breaker (and subfeed breaker(s))
- **Ground Overcurrent** - panelboard main breaker (and subfeed breaker(s))
- **Phase Overcurrent** – panelboard main breaker (subfeed breaker(s)) and branch breakers
- **Phase Overcurrent Warning** – panelboard main breaker (subfeed breaker(s)) and branch breakers
- **Phase Low Current Warning** – branch breakers
- Summary Alarm

All alarm thresholds for monitored parameters shall be adjustable by way of the Liebert® LDMF DB-9 setup port to match site requirements. The factory set points for the alarms shall be as follows:

Panelboard Main Breaker

- **Overvoltage** – at least one of the line-to-line voltages exceeds +6% of nominal
- **Undervoltage** - at least one of the line-to-line or line-to-neutral voltages falls below -13% of nominal
- **Phase Overcurrent Warning** - current exceeds 75% of breaker amps
- **Phase Overcurrent** - current exceeds 80% of breaker amps
- **Neutral Current** - current exceeds 95% of main breaker amps
- **Ground Current** - current exceeds 5 amps (15-125kVA), 10 amps (150-225kVA), 15 amps (300kVA)

Branch Breakers

- **Overcurrent Warning** - current exceeds 75% of breaker amps

- **Phase Overcurrent** - current exceeds 80% of breaker amps
- **Low Current Warning** – Minimum current level of a branch breaker.

Summary Alarm

- **Summary Alarm** - shall detect and annunciate upon occurrence of any alarm.

To facilitate troubleshooting, all alarms shall be stored in non-volatile memory to protect against erasure by a power outage. Alarms shall be manually reset after the alarm condition has been corrected. Alarms can be reset through the Vertiv™ Liebert® IntelliSlot card or through the Vertiv™ Liebert® LDMF Display.

Communication

LDMF shall have three Liebert® IntelliSlot ports, up to three Liebert® IntelliSlot cards can be added for customer connections to a Building Management System (BMS) or Liebert® LDMF or Vertiv™ Liebert® SiteScan™ monitoring interface.

3.22 Liebert® LDMF Display

A monochrome liquid crystal display (LCD) with oval bezel that includes power and alarm LEDs, an audible alarm and an alarm silence/reset push button. It shall display all the Liebert® LDMF power parameters and alarms listed in Section 2.3.18 for the panelboard mains and branch breakers. A display shall be mounted on the front door. The display and switches shall be accessible without opening the door.

3.23 Liebert® IntelliSlot - IS-UNITY-DP Card

The Vertiv™ Liebert® FPC shall be supplied with an IS-UNITY-DP Card for remote communication using two of the following protocols: HTTP/HTTPS, Emerson Protocol, Email, SMS, SNMP v1/v2c/v3, BACnet IP/MSTP and Vertiv™ Liebert® Modbus TCP/RTU output. A serial RS-485 two wire connector shall be supplied.

NOTE: Two of the 3rd party protocols (SNMP, Modbus or BACnet) may be configured and used simultaneously. Liebert® Modbus RTU and BACnet MSTP cannot both be enabled simultaneously.

3.24 Liebert® LDMF and Liebert® SiteScan™ Monitoring Interface

Monitoring interface module shall allow the Liebert® Distribution Monitoring (LDMF) to communicate to Liebert® SiteScan™ Web 4.0 or greater. The module shall include software and graphics that support up to 168 branch breakers using an Ethernet connection.

3.25 Output Distribution Cables

The cable supplying each load shall consist of UL/CSA listed liquid-tight flexible metal conduit containing the required THHN insulated copper power, neutral and parity-sized ground conductors. The flexible conduit shall be liquid-tight, insulated and shielded to minimize electrical or mechanical disturbances to the conductors. The length of each cable and the type of receptacle/termination shall be as specified on the detailed cable schedule. Each output distribution cable shall be permanently labeled at each end of the cable with the assigned circuit number and receptacle type, equipment identification and cable length. Each cable shall be thoroughly factory-checked and factory-tested. Tests shall include continuity, phase rotation and a HiPot test at twice the rated circuit voltage plus 1000V. Each cable shall be a UL-listed assembly. Each cable shall be boxed separately to facilitate handling and installation.

3.26 Transient Suppression Plate

The specified system shall have a transient suppression plate for the input power junction box to reduce effects of transients on the ground. The suppression plate shall measure one square meter.

3.27 Certified Test Report

A certified copy of the factory test report shall be provided for each unit.

3.28 Factory Witness Test

Emerson shall permit the owner or a representative to witness the factory test of each unit. The factory shall perform its standard witness test to demonstrate that the unit meets the Vertiv™ Liebert® FPC specification.

3.29 Export Crating

Heavy-duty solid wood crating shall be provided to meet international requirements regarding package strength and special markings for overseas shipments.

4.0 EXECUTION

Factory startup, preventive maintenance and full service for the specified system shall be available and included upon request. The manufacturer shall directly employ a nationwide service organization of factory-trained field service personnel dedicated to the startup, maintenance and repair of the manufacturer's power equipment. The manufacturer shall maintain a national dispatch center 24 hours per day, 365 days per year, to minimize service response time and to maximize availability of qualified service personnel.