PART 1 - GENERAL

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**NOTE TO SPECIFIER: *\*{ }* Select only the system types required for your specific application.**

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**1.01 SECTION INCLUDES**

* 1. Isolated Power Systems Equipment:
     1. Isolated Power Panel
     2. Laser/X-Ray (Control) Isolated Power Panel
     3. Dual System Isolated Power Panel
     4. Dual Output Voltage Isolated Power Panel
     5. Accessories:
        1. Remote Indicator Alarms
        2. Remote Annunciator Station
        3. Ground Power Modules and Ground Cords

**1.02 SCOPE**

* 1. The contractor shall furnish, install, and ensure proper testing and certification of the Isolated Power Systems Equipment as indicated on the electrical plans, wiring diagrams, panel schedules, and as specified herein

**1.03 REFERENCES**

* 1. NFPA 70 - National Electrical Code, Article 517
  2. NFPA 99 - Health Care Facilities Code
  3. UL1022 - Line Isolation Monitors
  4. UL1047 (4th Edition) - Isolated Power Systems Equipment
  5. UL50/50E - Enclosures for Electrical Equipment
  6. RoHS - DIRECTIVE 2002/95/EC - Restrictions of the use of certain hazardous substances in electrical and electronic equipment

**1.04 SUBMITTALS**

* 1. PRODUCT DATA: Provide dimensions, materials, fabrication details, finishes, and accessories.
  2. MANUFACTURER’S INSTRUCTIONS: Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

**1.05 MANUFACTURERS**

* 1. APPROVED MANUFACTURERS
     1. BENDER Inc. (Isotrol)
  2. QUALIFICATIONS
     1. Products shall be covered by a 5-year warranty from date of shipment when Product is tested and certified by a qualified factory technician as specified in section “Testing and Certification” herein.
     2. Supplier asking consideration as an approved equal shall submit full guaranteed performance data on similar units in service for five or more years.

**1.06 REGULATORY REQUIREMENTS**

* 1. Conform to requirements of ANSI/NFPA 70.
  2. Products shall be listed and/or recognized as classified by Underwriters Laboratories, Inc. or ETL, as suitable for purpose specified.
  3. All furnished products shall conform to requirements of RoHS -Directive 2015/863

PART 2 - PRODUCTS

**2.01 ISOLATED POWER PANEL**

* 1. Provide Isolated Power Panels for operating rooms and patient areas as indicated on the contract drawings.
  2. Isolated Power Panels shall be constructed of a four‑piece assembly consisting of: Back Box, Front Trim, Interior Assembly, and Transformer Kit.
  3. Isolated Power Panels shall include provisions for field installation of panel mount receptacle ground modules as defined on project plans.
  4. Panels shall be single-phase, 60HZ, with Primary Voltage, Secondary Voltage and load rating as indicated on panel schedule(s).
  5. Where contract drawings call for panels to be installed outside of the room being served, a Remote Indicator Alarm shall be connected to the Line Isolation Monitor and be installed inside the room served.
  6. Each System shall include provisions for field upgrading the system with one or all the following: individual circuit fault location system(s), individual circuit load monitoring, receptacle & ground jacks, & system communication gateway.
  7. Total system depth shall not exceed 8” for units up to 10kVA
  8. Model “MIP” manufactured by BENDER Inc. shall be basis of design.

**2.02 LASER/X-RAY (CONTROL) ISOLATED POWER PANEL**

* + 1. Laser/X-Ray (Control) Isolated Power Panels shall be pre-assembled and pre-wired and shall contain: Line Isolation Monitor (LIM), programmable control system via PLC, primary main and total quantity of secondary branch circuit breakers and associated contactors as indicated on panel schedule(s).
    2. System shall include contactor control system with programmable lock-out feature to protect against system overload and accidental shutdown.
    3. Panels shall be single-phase, 60HZ, with Primary Voltage, Secondary Voltage and load rating as indicated on panel schedule(s).
    4. Total system depth shall not exceed 12” for units up to 15kVA and 14” for units up to 25kVA
    5. Each circuit served by the Laser/X-Ray (Control) Isolated Power Panel shall include a Laser/X-Ray Receptacle Module which includes:
    6. Stainless steel Front Trim with hinged door over ***\*{Specify NEMA configuration}*** receptacle, door activated control switch, and Remote Alarm Indicator connected to Line Isolation Monitor at Isolated Power Panel
    7. An “In-Use” indicator to display that the supplying Laser/X-Ray (Control) Isolated Power Panel is currently at capacity and power will not be available at the given receptacle.
    8. Panel Model “MIC” with Laser/X-Ray Receptacle Modules Model “XRM” manufactured by BENDER Inc. shall be basis of design.

**2.03 DUAL OUTPUT VOLTAGE ISOLATED POWER PANEL**

* 1. Provide Dual Output Voltage Isolated Power Panels for operating rooms and patient areas as indicated on contract drawings. Dual Output Voltage Panels are intended to simultaneously provide power for both 120V equipment and 208 or 240V portable laser and x-ray equipment.
  2. Dual Output Voltage Isolated Power Panels shall contain a single Isolation Transformer with a single input and dual output windings. Panels shall be pre-assembled and pre-wired, and shall contain:
     1. One (1) Primary Main Circuit Breaker
     2. Two (2) Secondary Main Circuit Breakers (one for each output winding)
     3. Secondary branch circuit breakers for the 120V output section as indicated on panel schedule(s).
     4. Secondary branch circuit breakers for the 208 or 240V output section at the rating as indicated on panel schedule(s).
     5. Two (2) Line Isolation Monitors (LIM) (one for each output voltage)
  3. Panels shall be single-phase, 60HZ, with Primary Voltage, Secondary Voltages and load ratings as indicated on panel schedule(s).
  4. Each System shall include provisions for field upgrading the system with one or all the following: individual circuit fault location system(s) (16 circuit section only), individual circuit load monitoring, receptacle & ground jacks, & system communication gateway.
  5. Total system depth shall not exceed 12” for units up to 15kVA and 14” for units up to 25kVA
  6. Where contract drawings call for panels to be installed outside of the room being served, a Remote Indicator Alarm shall be connected to each Line Isolation Monitor and shall be installed inside the room served.
  7. Model “MID” manufactured by BENDER Inc. shall be basis of design.

**2.04 DUAL (DUPLEX) SYSTEM ISOLATED POWER PANEL**

* 1. Provide Dual System Isolated Power Panels for operating rooms and patient areas as indicated on contract drawings. Dual System Isolated Power Panels are intended to serve 120V equipment in a single patient area where demand requires multiple panels installed in one common enclosure.
  2. Dual System Isolated Power Panels shall contain two independent Isolated Power Systems, physically separated by a barrier. Panels shall be pre-assembled and pre-wired, and shall contain the following:
     1. Two (2) Primary Main Circuit Breakers (one for each transformer input winding)
     2. Two (2) sets of Secondary Branch Circuit Breakers as indicated on panel schedule(s).
     3. Two (2) Line Isolation Monitors (LIM) (one for each transformer input winding)
  3. Panels shall be single-phase, 60HZ, with Primary Voltage, Secondary Voltages and load rating as indicated on panel schedule(s).
  4. Each System shall include provisions for field upgrading the system with one or all the following: individual circuit fault location system(s), individual circuit load monitoring, receptacle & ground jacks, & system communication gateway.
  5. Total system depth shall not exceed 8” for units up to 10kVA
  6. Where contract drawings call for panels to be installed outside of the room being served, Remote Indicator Alarms shall be connected to each Line Isolation Monitor and be installed inside the room served.
  7. Model “MIX” manufactured by BENDER Inc. shall be basis of design.

**2.05 COMPONENTS**

* 1. INTERIOR ASSEMBLY
     1. Terminal blocks shall be provided to facilitate connections of Remote Indicator Alarm conductors and auxiliary equipment.
     2. The total leakage for all panel types shall not exceed the values shown in table 30.1 of UL 1047
     3. Shall include provisions for field upgrading the system with one or all the following: individual circuit fault location system(s), individual circuit load monitoring, receptacle & ground jacks, & system communication gateway.
        1. Each field upgrade shall not require replacement or change of the existing enclosure.
     4. CIRCUIT BREAKERS
        1. Primary main circuit breaker(s) shall be provided on the primary line side(s) of the Transformer(s). Breaker(s) shall be 2-pole and thermal magnetic type, with minimum 10,000 AIC. Breaker shall be sized according to transformer primary voltage and kVA rating.
        2. Panels shall accommodate up to sixteen (16), 2-pole, branch breakers. Refer to panel schedule for quantity and sizes. Breakers shall be thermal magnetic type, with minimum 10,000 AIC.
        3. Circuit breakers shall be manufactured by: Schneider Electric (Square D Company), Eaton (Cutler-Hammer), or General Electric (GE).
     5. LINE ISOLATION MONITOR (LIM)
        1. All of the specifications listed within this section shall be contained within one unit and be automatically detected by the system or user-selectable via the LIM’s on-board menu, thus allowing the LIM to be interchanged from system to system. The LIM shall have the following electrical specifications:
           1. Operating voltage: 85 to 265 VAC (auto-detection)
           2. Operating frequency: 50 or 60 Hz (auto-detection)
           3. Alarm level: 2 or 5 mA (selectable via Menu)
        2. The LIM shall use microprocessor-based digital signal processing to continually monitor the (THC) Total Hazard Current from all secondary conductors of the Isolated Power systems to ground. The LIM shall be capable of measuring all combinations of capacitive and resistive faults including balanced, unbalanced and hybrid faults.
        3. The LIM shall incorporate a momentary test switch. When pressed, it shall check and recalibrate the unit. Additionally, the test switch shall perform a complete test of all indicating lights and meters on the face of the LIM and at any remote indicating alarm stations.
        4. The LIM shall recheck its calibration and recalibrate the system to original performance specifications according to a user defined schedule in at least 60 minutes intervals. Additionally, by pressing the LIM’s momentary test switch, an immediate check and recalibration of the LIM shall be performed.
        5. The LIM shall provide digital indication of the Isolated Power System’s hazard current. Indication shall be provided by a digital numeric meter and LED bar graph type meter calibrated from 0 (zero) to 160% of the alarm setting of the LIM.
        6. The LIM shall have a green safe light and red hazard light on the faceplate. The red hazard light shall remain illuminated for the duration when the Isolated Power System’s hazard current is above the selected alarm level of the LIM. An audible alarm shall be incorporated into the unit and shall activate in conjunction with the red hazard light. The audible alarm shall have user-selectable high, low, and off settings. A silence button shall be provided on the face of the unit to silence the audible alarm during fault conditions. Upon silencing the audible alarm, a yellow indicating light shall illuminate to indicate the audible alarm has been silenced. The red hazard light and yellow silence light shall automatically reset when the fault condition is eliminated. During fault conditions, the red hazard light and all red segments to the LED bar graph shall blink at a constant rate.
        7. The LIM shall have a minimum of two (2) Single Pole Double Throw (SPDT) user-programmable contacts, rated 3A at 120 VAC for use with external alarm systems. The LIM shall also provide a 12 VDC / 200mA output signal to power remote indicator alarm units. This 12 VDC output signal shall not increase the hazard current of the system being monitored.
        8. The LIM shall incorporate a loss-of-ground feature which will activate the audible and visual alarms when connection is lost with the reference ground of the Isolated Power System being monitored.
        9. The LIM shall be capable of monitoring the Isolated Power System’s transformer load with the use of a current sensing transformer (CT). The alarm threshold for the transformer’s load current shall be user-selectable via the LIM’s on-board menu. When the load threshold is exceeded, the LIM shall display the text “Transformer Overload” and shall display the load value as the percentage “%” (via Bar graph or Numeric value) of total load utilized.
        10. The LIM shall incorporate a signal generator capable to be interfaced with EDS Series ground fault location evaluators. In the event that both the THC and Insulation Resistance threshold are exceeded, the LIM shall be capable of automatically generating this signal to work in conjunction with the EDS system to locate the potentially faulty circuit. The settings and activation of this signal generator shall be user-selectable via the LIM’s on-board menu from (off, on, and auto).
        11. The LIM shall incorporate aRS485communication protocol (BMS) for transmitting pertinent Isolated Power System data directly to connected BMS compatible devices. The LIM shall also be able to communicate with 3rd party building communication systems (Modbus TCP/IP) and modern PC networks via the use of Bender COMTRAXX Series gateway device.
        12. The LIM shall be UL component recognized under UL1022 Standard for Line Isolation Monitors, and cUL recognized as meeting CSA 22.2 the Canadian Standard for Line Isolation Monitors.
        13. Model LIM2010 manufactured by BENDER shall be basis of design.
     6. SYSTEM LOAD MONITORING

***Engineering Notes:*** *The STW3 system load (separate device from the LIM) works in conjunction with the LIM to monitor the load current of the total load of the isolation power panel and provides alarms* ***thru*** *the LIM once a predetermined threshold is reached (alarm set at 80% load). Utilization can reduce the likelihood of accidental system overload.*

* + - 1. A current sensing transformer to continually monitor the total load of each Isolated Power panel’s isolation transformer shall be provided. The current sensing transformer shall work in combination with the LIM to alert the staff that the system has reached its usable capacity.

***Engineering Notes:*** *The CMS load current evaluator (separate device from the LIM) works in conjunction with the LIM to monitor the load current of the individual circuits in an isolated power system and provides alarms once a predetermined threshold is reached. Utilization can reduce the likelihood of accidental circuit overload.*

* + - * 1. Model series “STW” manufactured by BENDER Inc. shall be basis of design.
      1. A Load Current Evaluator system shall be provided to measure the current consumption of all individual circuits.
         1. All of the specifications listed within this section shall be contained within one unit:

Measures R.M.S. values

The scanning time for up to 12 measuring channels shall not exceed 180ms (parallel scanning)

Shall incorporate a serial interface RS-485 for transmitting pertinent data directly to connected BMS compatible devices.

Shall be capable to connect to a system with up to (1080) measuring circuits

* + - * 1. Model series “CMS” manufactured by BENDER shall be basis of design.
    1. FAULT LOCATION EVALUATOR SYSTEM

***Engineering Notes:*** *The EDS fault location evaluator (separate device from the LIM) works in conjunction with the LIM to quickly and automatically locate ground faults due to resistive faults in the corresponding branch circuit while the isolated power system remains energized and online. This greatly reduces the amount of time required to identify the offending circuit.*

* + - 1. A Fault Location Evaluator system shall be provided to automatically identify and locate circuit insulation fault(s).
      2. All of the specifications listed within this section shall be contained within one unit:
         1. The scanning time for up to 12 measuring channels shall not exceed 10secs (parallel scanning)
         2. Shall continuously monitor the connection status of associated CTs
         3. Shall incorporate a serial interface RS-485 for transmitting pertinent data directly to connected BMS compatible devices.
         4. Shall be capable to connect to a system with up to (1080) measuring circuits
      3. Model series “EDS” manufactured by BENDER shall be basis of design.
  1. BACK BOX
     1. The Back Box shall be fabricated of RoHS compliant galvanized steel per Directive 2015/863.
     2. The Back Box shall be constructed in accordance with UL 50/50E and shall be flush mounted, unless indicated otherwise.
  2. FRONT TRIM
     1. The Front Trim shall be constructed of stainless steel.
     2. In an effort to limit the potential spread of infectious diseases:
        1. There shall be no fasteners accessible from the face of the front trim excluding those to fasten the trim to the enclosure.
        2. Any full-length type “door-in-door” hinge shall be completely concealed without any exposed seams.
     3. The Front Trim shall have a hinged door, with keyed lock, to give access to the circuit breakers.
        + 1. All supplied panels shall be keyed alike.
     4. Front Trim shall incorporate a hidden barrel tool free lift-off hinge along one side, allowing easy access during maintenance and testing without having to remove hinge.
        1. Hinge shall be completely concealed to facilitate regular cleaning and disinfecting of trim surface
     5. The maximum Front Trim surface temperature rise shall not exceed a 30° C above room ambient under full load continuous operation.
  3. TRANSFORMER
     1. The Hospital Isolation Transformer shall be single-phase, 60Hz, with kVA, primary and secondary voltage(s) as listed in the drawings and/or schedule.
     2. The total leakage current to ground from the Transformer shall not exceed the values shown in Table 30.2 of UL 1047.
     3. The inherent regulation of the Transformer at rated input voltage shall be such that the difference between output voltage at no load and output voltage at rated current at unity power factor shall not exceed 3% of the output voltage at rated current.
     4. Class H rated insulation shall be used in the manufacture of the transformer and the temperature rise shall be limited to not exceed the values indicated in Table 29.1 of UL 1047 when tested in accordance with UL 1047 Section 29.
     5. The core shall be of stacked design and securely clamped, welded and/or bolted. The core and coils shall be internally isolated from the enclosure by means of a suitable vibration dampening system.
     6. The “XM” Transformer Series manufactured by BENDER Inc. shall be basis of design.

**2.06 ACCESSORIES**

* 1. REMOTE INDICATOR ALARM
     1. Remote Indicator Alarms shall be supplied as indicated on the drawings. Remote Indicator Alarms shall be compatible with the Isolated Power System’s LIM and shall provide visual and audible indication of LIM’s alarm status.
        1. When the hazard current is within the predetermined limit for the circuits being monitored, a constant green light will remain illuminated. When the limit is exceeded, the green light will extinguish, a red indicator will illuminate, and an audible signal will sound. Total Hazard Current value shall be displayed as either a numeric or bar graph display.
        2. A silencing switch for the audible signal shall be provided. When pressed, it will cause a yellow warning light to illuminate, indicating that the audible signal has been silenced. When the current flow to ground returns to an acceptable level, the unit will automatically reset. The wiring from the LIM to the indicator alarm shall not contribute any leakage current to the Isolated Power System.
        3. Model “MK2000CBM” manufactured by BENDER shall be basis of design.

***Engineering Notes:*** *A Remote Annunciator Station (separate device from the LIM) is compatible with LIM, EDS and CMS devices and it can monitor multiple devices at the same time at a centralized location. The alarm messages can be configurable with PC software provided by the manufacturer.*

* 1. REMOTE ANNUNCIATOR STATION
     1. A Remote Annunciator Station(s) shall be furnished to provide centralized monitoring of all installed Isolated Power Systems for a particular area. Refer to contract drawings for exact location and quantity of the Remote Annunciator Station(s).
     2. Each Remote Annunciator Station shall be capable of monitoring and providing system status alarms for each LIM including all enabled optional features monitored by the LIM as specified in corresponding Isolated Power System(s).
        1. The Remote Indicator Alarms shall be capable of providing indication of up to 32 LIMs and display all status information of the connected LIMs using the Remote Indicator’s on-board Menu. Information displayed shall include the following as a minimum:
           1. Total Hazard Current value (numeric or bar graph display)
           2. Transformer Load % (if supplying panel is equipped)
           3. Identification of Potentially Faulty circuit (if supplying panel is equipped)
     3. The Back Box shall be flush mounted and fabricated of RoHS compliant galvanized steel per Directive 2002/95/EC and be flush mounted.
     4. The Front Trim shall be constructed of stainless steel with a #4 brushed finish.
  2. SYSTEM GATEWAY / WEB-SERVER

***Engineering Notes:*** *The System Gateway device allows operators to view all the devices connected within the isolated power system (i.e. LIM, EDS, etc.) via a web browser. All devices including the System Gateway device must be connected in the same RS-485 network. Additionally, the system gateway device can be integrated into the building management system via Modbus/TCP.*

* + 1. A combination gateway/web server device shall be furnished to convert data from the Bender-BMS bus into TCP/IP protocols and provide simple and fast presentation of data from BMS systems via web browser.
    2. All of the specifications listed within this section shall be contained within one unit:
       1. History memory
       2. Assignment of individual texts for devices and measuring points
       3. Fast, simple parameter setting of BMS devices using the web browser
       4. Report functions that save measured values and settings. Saved settings can then be compared with the current settings made on the COMTRAXX device
       5. User assignable device visualization without any programming.
          1. For example, measured values or alarms can be arranged on a floor plan and visualized
  1. GROUND POWER MODULES & GROUND CORDS
     1. Ground Power Modules shall be supplied as indicated on the contract drawings.
     2. The module shall be capable of containing 30A green ground jacks, hospital grade duplex receptacles and/or locking hospital type receptacles. (Quantity and Configuration as specified on the detail drawings).
     3. The Module’s Back Box shall be fabricated of RoHS compliant galvanized steel per Directive 2002/95/EC and be flush mounted.
     4. The Front Trim shall be constructed from stainless steel with a #4 brushed finish. The only exposed screws on the Front Trim shall be the screws holding the Front Trim to the Back Box.
     5. The ground bus contained in these Modules shall contain a minimum of one lug suitable for connection of one #1/0 wire and eighteen #4-14 wire.
     6. Ground Cords for connection to Ground Power Models shall consist of an extra flexible stranded copper conductor with neoprene insulation.
        1. Two (2) Ground Cords terminated with Lugs and two (2) Ground Cords terminated with alligator clips shall be provided per Ground Power Module.
        2. Each Ground Cord provided shall be 15feet in length.
        3. Models HGC-15L and HGC-15C manufactured by BENDER Inc. shall be basis of design.

PART 3 – INSTALLATION

**3.01 ASSEMBLY**

* 1. Equipment should be installed and assembled as per manufactures recommendations.

**3.02 WIRING**

* 1. The contractor shall wire all branch circuits to the Isolated Power System using copper stranded conductors having a cross-linked polyethylene insulation, or equivalent with a dielectric constant of 3.5 or less.
  2. Under no circumstances shall wire pulling compound be used when pulling the wire for isolated circuits.
  3. All wiring shall be color-coded in accordance with the NEC and appropriate NFPA standards.
  4. Limit the number of conductors to six in ¾” conduit.

**3.03 TESTING AND CERTIFICATION**

* 1. The contractor shall include the cost of, and make all arrangements for, testing all ungrounded isolated systems in the hospital by a qualified factory technician provided by the manufacturer of the isolation systems. The testing shall include a complete inspection of all connections and materials used. The contractor shall be prepared to demonstrate to the factory technician that proper polarity was observed, and installation practices were in accordance with the drawings and specifications for these systems.
  2. The factory technician shall check and record system current leakages. The factory technician shall further simulate faults on the isolated system of a magnitude high enough to bring the total system leakage, which the LIM detects, above the calibrated point, thus verifying correct operation of the LIM.
  3. The factory technician shall check the resistance between the ground point of each receptacle and the reference point, and it shall be less than 0.1 ohms. The voltage potential difference between any exposed conductive surfaces in the patient vicinity shall be checked. These tests are required by NFPA No. 99 for new construction areas.
  4. The factory technician shall instruct the hospital maintenance staff in the use of the following:
     1. the panel and LIM as a leakage measuring device
     2. how instrument leakage areas can be measured and labeled
     3. how to perform leakage tests
  5. The technician shall also test the system impedance of the entire isolated power system to ensure compliance with the applicable sections of NFPA No. 99. The measured system impedance shall become part of the permanent logged records of each panel.
  6. After all tests are complete, a letter shall be given to the hospital and the consulting engineer. The letter shall state that the system conforms to applicable codes, good installation practices, and the specifications.
  7. Upon completion of all tests, the factory technician shall meet with hospital medical and maintenance staff to thoroughly explain the operation of the equipment installed, and the need and procedure for periodically testing and logging test results. The technician shall furnish log books to the maintenance department, enter the first readings of all panels in these log books, and clearly instruct the hospital maintenance staff how to enter future readings.
  8. All questions from the hospital staff shall be answered completely and thoroughly at this time. The consulting engineer shall be notified of the dates and times of all tests so the consulting engineer may witness any of the tests or meetings conducted by the factory technician.

END OF SECTION