SECTION 26 24 17– ISOLATED POWER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Section Includes:

1. Isolated power panels.
2. Three phase laser isolated power panels
3. Line isolation monitors.
4. Associated power and grounding outlets.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 REFERENCES

A. The surgical facility panels, isolated power panels, portable laser and X-Ray panels and all components shall be designed, manufactured and tested in accordance with the latest applicable edition of the following standards:

1. NFPA 99 – Health Care Facilities
2. NFPA 70 – National Electrical Code (NEC)
3. UL Standard 1047 – Isolated Power System Distribution Equipment
4. UL Standard 1022 – Line Isolation Monitors

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Isolated power panels.
2. Three phase laser isolated power panels
3. Line isolation monitors.

4. Associated power and grounding outlets.

B. Submittal shall include “Overcurrent Protective Coordination Study” as specified elsewhere in Division 26 Section which confirms all overcurrent protective devices submitted are in compliance with those requirements.

C. Shop Drawings: For each isolated power panels, three phase laser isolated power panels, laser, line isolated monitors, associated power and ground outlets and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Impedance for transformers.

D. Qualification Data: For qualified testing agency.

E. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

G. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

H. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain isolated power panels, three phase laser isolated power panels, line isolation monitors, associated power and grounding outlets from single source from single manufacturer.

1. Isolated power panels.
2. Three phase laser isolated power panels
3. Line isolation monitors.
4. Associated power and grounding outlets.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.9 COORDINATION

A. Coordinate layout and installation of isolated power panels, three phase laser isolated power panels, line isolation monitors, associated power and grounding outlets with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR ISOLATED POWER SYSTEMS

A. The back box housing the isolation transformer and related components shall be a minimum of 14 gauge steel which shall be degreased, phosphatized, primed and finish painted with a coat of baked enamel paint. 14 gauge galvanized steel is acceptable for flush mounted panels. The maximum depth of the panel shall be the minimum as manufactured by specified vendor.

B. The front trim shall be 12 gauge type 304 stainless steel polished to a #4 satin/brushed finish and shall have a 1.5 inch return flange on all sides. Front trim shall have a hinged door with keyed lock to give access to the circuit breakers and LIM and allow for testing. The entire section behind the hinged door shall be a dead front design. All hinges shall be concealed.

C. The front trim shall not contain any type of grille or louver for the purpose of ventilation. The panel and transformer shall be so designed that the heat generated by the transformer under full load conditions shall not affect the normal operation of the circuit breakers, LIM or ground detector. The maximum front panel temperature shall not exceed 30 degrees C under full load continuous operation. Certification of the temperature test shall be provided to the Engineer upon request.

D. Back boxes for accessories shall be fabricated of mild steel. When accessories are surface mounted the back box shall have a finished appearance, all seams shall be welded and ground smooth with the outer surface of the box. The front trim shall be 14 gauge type 304 stainless steel with a #4 satin/brushed finish..

2.2 ISOLATION POWER SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following listed in paragraph below:

B. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Square D; a brand of Schneider Electric
2. Isotrol Systems

C. Isolated Power Panels

1. Isolation transformers shall be single phase, 60 hertz, 10 kVA with 277 volt primary and 120 volt secondary.

D. Laser Isolated Power Panels

1. Isolation transformers shall be three phase, 60 hertz, 25 kVA with 480 volt three phase, primary and 208/120 volt, three phase secondary.

E. Single Phase Transformers

1. The transformer shall be wound with an electrostatic shield between the primary and secondary windings which shall be grounded to the enclosure. The electrostatic shield shall be designed such that it will prevent direct shorting of the primary winding to the secondary winding and reduce the coupling of harmonic distortions between the primary circuits and secondary circuits.

2. Regulation shall not exceed 2.6% at 0.8 power factor at 20 degrees C above the full load continuous operating temperature in accordance with NEMA-ANSI Standards.

3. The transformer shall have a Class H insulation system with a temperature rise of 55 degrees C above ambient under full load conditions when tested in accordance with NEMA-ANSI Standards.

Transformer shall have a 220 degrees C UL recognized insulation system.

4. The transformer shall be of the stacked core design and shall be securely clamped and bolted. The core and coils shall be internally isolated from the enclosure by means of a suitable vibration dampening system. The core and coils shall be varnish impregnated and shall have a final wrap of insulating material to prevent exposure of bare conductors.

5. Transformers shall meet or exceed Class 1 efficiency levels per NEMA TP-1-2002, or the latest adopted edition.

C. Three Phase Transformers

1. The transformer shall be wound with an electrostatic shield between the primary and secondary windings. The shield shall be connected to the reference ground point within the isolation panel. The electrostatic shield shall be designed such that it will prevent direct shorting of the primary winding to the secondary winding and reduce the coupling of harmonic distortions between the primary circuits and secondary circuits.

2. Regulation shall not exceed 3.0% at unity power factor with the transformer current at full rated capacity in accordance with UL 1047. The manufacturer shall supply certified test data indicating compliance with this operating characteristic to ensure adequate voltage for critical equipment during high power demand conditions in the operating room.

3. The transformer shall have a Class H insulation system with a temperature rise of 80 degrees C above ambient under full load conditions when tested in accordance with NEMA-ANSI Standards. Transformer shall have a 180 degrees C UL recognized insulation system.

4. The transformer shall be of the stacked core design utilizing “E” or “I” shaped laminations. The laminations shall be securely clamped and bolted. Core laminations of the “wound” type, split “C” or “I” shaped will not be acceptable. The core and coils shall be internally isolated from the enclosure by means of a suitable vibration dampening system. The transformer assemblies shall be varnish impregnated and shall have a final layer of insulating material to protect the coils from damage during transport and installation.

D. The total leakage current to ground from the transformer shall not exceed the values shown in UL 1047, Standard for Hospital Isolating Panels, Table 29.2

E. Noise levels shall not exceed the values in the following table:

Transformer Rating (kVA)	Noise Level (db)
3	27
5	27
7.5	35
10	35
15	35
25	35

F. Transformers shall meet or exceed Class 1 efficiency levels per NEMA TP-1, the latest adopted edition.

2.3 CIRCUIT BREAKERS

A. Provide a primary and secondary main circuit breaker for each isolated power panel transformer. Refer to the drawings and schedule for voltage and ampere ratings and number of poles.

B. Single Phase Isolated Power Panels

1. All circuit breakers for single phase isolated power panels shall be 2 pole with a minimum interrupting rating of 10,000 amperes. Panel shall have a minimum capacity of 16 secondary circuit breakers.

C. Three Phase Isolated Power Panels

1. All circuit breakers for three phase isolated power panels shall be three pole with a minimum interrupting rating of 10,000 amperes. Panels shall have a minimum capacity of 8 secondary circuit breakers

D. All circuit breakers shall be of the thermal-magnetic type.

E. Refer to drawings for sizes and quantities of circuit breakers.

2.4 LINE ISOLATION MONITOR

A. Each isolated power panel, duplex isolated power panel, three phase laser isolated power panel shall be equipped with a line isolation monitor (LIM).

B. The LIM shall be microprocessor based, digital and shall use circuitry to continuously monitor the impedance from all secondary conductors of the isolated power system to ground. The LIM shall be capable of detecting all combinations of resistive and capacitive faults whether they are balanced, unbalanced or hybrid. LIM's that internally switch between either line to ground will not be acceptable. The LIM shall not contribute more than 25 microamperes to the total hazard current of the system.

C. The LIM shall have the following specifications:

1. Operating voltage: 85 to 265 VAC
2. Accuracy: 5% or better

3.	Alarm level:	2 or 5 mA (selectable)
4.	Alarm bandwidth:	Zero (0)
5.	Alarm hysteresis (on/off):	50 micro amperes
6.	Mode:	Single- or three-phase
7.	Monitor hazard current:	50 micro amperes
8.	Operating frequency:	50 or 60 Hz

D. The LIM shall alarm when the total hazard current reaches a value of 5 milliamperes. When the total hazard current is less than 5 milliamperes, a green light shall be illuminated indicating normal conditions. Should the total hazard current reach 5 milliamperes, a red light shall illuminate and a buzzer shall sound indicating alarm. A silence switch shall be provided to quite the buzzer, which, when operated shall cause an amber warning light to illuminate, indicating that the audible signal has been silenced. The LIM shall automatically reset to normal status when the fault condition is corrected. The LIM shall also detect and signal an alarm if the ground connection to the LIM is broken. All lamps shall be long life LED type.

E. A momentary test switch shall be provided for periodic testing of the LIM circuitry. When presses, the test switch shall check and recalibrate the unit. The test switch shall also perform a complete test of all indicating lamps and meters on the face of the LIM and at any remote indicating stations. Test switches that require manual reset will not be acceptable.

F. In addition to the test switch recalibration, the LIM shall be capable of automatically checking its calibration and recalibrating itself to original performance specifications every 90 minutes. If internal components are more than 30% out of original specifications because of aging or failure, the LIM shall notify the user by displaying an error message.

G. The LIM shall contain both analog and digital indication of the isolated power system's hazard current. Digital indication shall be provided by a digital meter and the analog indication shall be graph type calibrated from 0 – 160% of the alarm setting of the LIM.

H. Provide an external set of normally open and normally closed dry contacts, rated 3 amperes at 120 volt for use with external alarm systems. The LIM shall also provide an output signal of sufficient capacity to power remote indicator alarm units. This output signal shall not increase the hazard current of the system being monitored.

I. 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. The unit shall also display an error code in the digital display.

J. The LIM shall be flush mounted on the front of the panel and flush mounted in a remote location as indicated on the drawings so that the LIM signals are clearly visible at all times. The LIM signals must not be obscured when the circuit breaker door is open.

2.5 MASTER REMOTE ANNUNCIATOR PANEL

A. The LIM in each isolated power panel, and three phase laser isolated power panel shall report to a Master Remote Annunciator panel.

B. Provide a master remote annunciator panel to provide centralized monitoring of all isolated power systems. The master remote annunciator panel shall be located at the nurses station.

C. The annunciator panel shall have one set of red, green and amber lights and a silence switch for each isolated power system. A buzzer shall provide audible annunciation of an alarm. The master remote annunciator shall be flush mounted. The lights shall mimic the lights on the associated line isolation monitor. The lights in the remote annunciator shall also mimic the lights on the LIM when the test switch on the LIM is depressed.

2.6 POWER AND GROUND OUTLETS

A. Provide a Power Module with 8300-R, duplex straight blade and 23000HG, twist lock power receptacles and ground jacks. Devices shall be flush mounted and located as indicated on the drawings. All receptacles shall be firmly attached with concealed fasteners that do not appear on the surface of the trim.

B. Provide Master Ground Module, located as indicated on the drawings. A copper ground bus with 24 terminals for wire sizes #14 AWG to #6 AWG and a #14 AWG to #1/0 AWG main lug shall be included.

2.7 LASER OUTLETS

A. Provide Laser Outlets to match the laser plug in locations as shown on the drawings mounted in an angular recessed compartment. The laser outlet shall include a plug control interface switch. A door over the recessed compartment shall conceal the receptacle when not in use. The laser outlet shall be flush mounted. The remote line isolation monitor signals, consisting of red and green indication lights, warning buzzer and silence switch, shall be incorporated into the front trim.

B. Provide a Plug in Control system for selective activation of each branch circuit so only those circuits with a laser machine plugged in will be energized. All other circuits will remain OFF. The system shall interface with the outlet module. A series of branch circuit contactors and relays shall be provided to control both the power and the line isolation monitor signals for each circuit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

A. All components within the isolation panel shall be prewired using low leakage type XLP wire. A barriered compartment shall be provided for the incoming primary feeder and separation shall be maintained between grounded and ungrounded conductors. Terminal blocks shall be provided for connection of branch circuits and remote signal conductors.

B. All branch circuit conductors of the isolated power system shall be stranded copper having cross linked polyethylene insulation or equivalent with a dielectric constant of 3.5 or less. Type XLP is suitable for this purpose. Each branch circuit conductor shall be color coded in accordance with the National Electrical Code. Wire pulling compound produces an adverse effect upon the dielectric constant of conductor insulation and shall not be used when pulling the wire of the isolated power system.

C. All wiring within isolation panels, remote accessories and field wiring installed by the Electrical Subcontractor shall be color-coded in compliance with the NEC and NFPA No. 99.

3.3 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Stub four 1-inch empty conduits from recessed panelboards into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

K. The Electrical Subcontractor shall ensure that no piping, ductwork or other equipment foreign to the electrical trade passes through the area extending from the floor to the structural ceiling with the width and depth equal to that of the electrical distribution equipment plus 6" on either side of panel.

L. All electrical equipment shall be installed such that the handle of the highest circuit breaker does not exceed 6'-6" above finished floor.

M. Electrical distribution equipment that is part of the emergency distribution system shall be located in spaces fully protected by an approved automatic fire suppression system or in spaces with a one (1) hour fire resistance rating.

N. The life safety branch, critical branch and equipment branch of the emergency electrical system shall be kept entirely independent of all other wiring, devices and equipment, and shall not enter the same raceways, boxes or cabinets with each other or other wiring, except where allowed by code.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:

      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

F. The factory technician shall check and record system leakage currents and shall simulate faults, on each system panel, of a magnitude high enough to bring the total system leakage, which the line isolation monitor detects, above the calibrated point, thus verifying correct operation of the LIM. The faults simulated shall be combinations of resistive and capacitive faults.

G. The factory technician shall check the resistance between the ground point of each receptacle and the reference point and ensure it is less than 0.1 ohms. The voltage potential difference between any exposed conductive surfaces in the patient vicinity shall be checked and shall be no more than 40 millivolts. Tests shall be per requirements in NFPA 99.

H. The technician shall also test the system impedance of the entire isolated power system to ensure compliance with the applicable sections of NFPA 99, chapter 4. The measured system impedance shall become part of the permanent logged records of each panel.

END OF SECTION