

SECTION 16010

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 REFERENCES

- A. Conditions of the Contract, Specifications, Change Orders, Addenda, Drawings and Division 1 General Requirements, apply to work of this section. Where paragraphs of this section conflict with similar paragraphs of Division 1, requirements of this section shall prevail.
- B. As used in this section, "provide" means "furnish and install", "furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support and to store in a secure area in accordance with manufacturers instructions", and "install" means "to unload at the delivery point at the site or retrieve from storage, move to point of installation and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project".

1.2 EXAMINATION OF SITE

- A. Before submitting a bid, the Electrical Subcontractor shall visit and carefully examine site to identify existing conditions and difficulties that may affect the work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions.
- B. Before starting work in a particular area of the project, the Electrical Subcontractor shall examine the conditions under which work must be performed including preparatory work performed under other Sections of the Contract, or by the Owner and report conditions which might adversely affect the work in writing to the Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

1.3 SCOPE

- A. The work to be accomplished under these specifications includes providing all labor, materials, equipment, consumable items, supervision, administrative tasks, tests and documentation required to install complete and fully operational electrical systems as described herein and shown on the Drawings. The Electrical Subcontractor shall completely coordinate the work of this section with the work of other trades.
- B. The Electrical Subcontractor shall file plans, obtain permits and licenses, pay fees and obtain necessary inspections and approvals from authorities that have jurisdiction, as required to perform work in accordance with all legal requirements.

- C. The Work shall be complete from point of service to each outlet or device with all accessory construction and materials required to make each item of equipment or system complete and ready for operation. The work shall include but not be limited to the following. The Electrical Subcontractor shall provide:
1. Complete power and lighting distribution systems including, panelboards, overcurrent devices, raceway, cable and wire.
 2. Branch circuits and devices for power and convenience receptacles.
 3. All motor wiring, safety disconnects, and motor starters unless integral with equipment.
 4. Complete interior lighting system including normal and emergency fixtures, exit signs, lamps, controls, trim and accessories.
 5. Modification to existing Honeywell fire alarm system including new notification and initiating devices shown on drawings, boxes, conduit, wiring, equipment and programming for a complete and operable system.
 6. Provide all components, conduit, and wiring for voice/data, clock, and public address systems. All wiring for voice/data to be plenum rated. Refer to Maine Medical Center Telecommunications specification 16600 for all other specifications.
 7. Control wiring not provided by Division 15000.
 8. All support material and hardware for raceway, cable tray and electrical equipment.
 9. Termination of all cable and wire unless otherwise noted.
 10. Complete isolated power system. Refer to specification section 16475.
- D. Install the following items furnished by others:
1. Motors
 2. Control Panels

1.4 RELATED WORK IN OTHER SECTIONS

- A. The following work is not included in this Section and shall be performed under other sections:
1. Concrete work, including concrete housekeeping pads and other pads and blocks for vibrating and rotating equipment.
 2. Cutting and patching of masonry, concrete, tile, and other parts of structure, with the exception of drilling for hangers and providing holes and openings in metal decks.
 3. Installation of access panels in ceilings and wall construction.
 4. Painting, except as specified herein.
 5. Temporary water, heat, gas and sanitary facilities for use during construction and testing.
 6. Outdoor air intake or exhaust louvers.
 7. Control wiring specifically indicated as part of Division 15.
- B. The Electrical Subcontractor shall identify locations of penetrations, excavations, structural supports, etc. required for the completion of the Work of this Section to the General Contractor in a timely manner.

1.5 CODES, STANDARDS, AND AUTHORITIES

- A. All work shall be performed strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have lawful jurisdiction. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of publications, standards, rulings, and determinations of:
1. Local and state building, plumbing, mechanical, electrical, fire and health department and public safety codes agencies.
 2. National Fire Protection Association (NFPA)
 3. Occupational Safety and Health Act (OSHA)
 4. Factory Mutual Association (FM)
 5. National Electrical Code (NEC)
 6. National Electrical Safety Code (NESC).
 7. The BOCA National Building Code.

- B. All materials and equipment shall be listed by Underwriters Laboratories (UL), and approved for intended service.
- C. When requirements cited in this Paragraph conflict with each other or with Contract Documents, the most stringent requirements shall govern conduct of work. The Architect may relax this requirement when such relaxation does not violate the ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

1.6 WARRANTY

- A. Refer to Division 1 General Requirements for Warranty Requirements.

1.7 CONTRACT DRAWINGS

- A. Work to be performed under this section is shown on the electrical drawings listed in Division 1 General Requirements.
- B. The listing of electrical drawings does not limit responsibility of determining full extent of work required by contract documents. The Electrical Subcontractor shall refer to architectural, plumbing, HVAC, structural, and other drawings and other sections that indicate types of construction with which work of this section must be coordinated. The Electrical Subcontractor shall check with the General Contractor and other subcontractors to determine whether there will be any interference by such trades with the electrical work. If the Electrical Subcontractor fails to check with the General Contractor and subcontractors and the electrical work is later found to interfere with their work, then he shall make necessary changes, without additional cost to the Owner, to eliminate such interference.
- C. Drawings are diagrammatic and indicate general arrangement of systems and work included in contract. Information and components shown on riser diagrams or called for in the specifications but not shown on plans, and vice versa, shall apply and shall be provided as though required expressly by both. It is not intended to specify or to show every offset, fitting, or component; however, contract documents require components and materials whether or not indicated or specified as necessary to make electrical installation complete and operational.

1.8 DISCREPANCIES IN DOCUMENTS

- A. It shall be the responsibility of each bidder to examine the drawings and specifications carefully before submitting his bid, with particular attention to errors, omissions, conflicts with provisions of laws and codes imposed by authorities having jurisdiction, conflicts between portions of drawings, or between drawings and specifications, and ambiguous definition of the extent of coverage in the contract. Any such discrepancy discovered shall be brought to the immediate attention of the Architect for correction. Should any of the aforementioned errors, omissions, conflicts or ambiguities exist in either or both the drawings and specifications, the Electrical Subcontractor shall have the same explained and adjusted in writing before signing the contract or proceeding with work. Failure to notify the Architect in writing of such irregularities will cause the Architect's interpretation of the

Contract Documents to be final. No additional compensation will be approved because of discrepancies thus resolved.

- B. The drawings and these specifications are intended to comply with all the above mentioned rules and regulations. If discrepancies occur, the Electrical Subcontractor shall immediately notify the Architect in writing of said discrepancies and apply for an interpretation and, unless an interpretation is offered in writing by the Architect prior to the execution of the contract, the applicable rules and regulations shall be complied with as a part of the contract.
- C. In case of difference between building codes, specifications, state laws, industry standards and the contract documents, the most stringent shall govern. Should the Electrical Subcontractor perform any work that does not comply with the requirements of the applicable building codes, state laws, and industry standards, he shall bear all costs arising in correcting these deficiencies.

1.9 EQUIPMENT AND MATERIALS

- A. All equipment and materials shall be new and of the quality specified. All materials shall be free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged during construction shall not be repaired at the jobsite, but shall be replaced with new materials.
- B. All equipment installed on this project shall have local representation, local factory authorized service and a local stock of repair parts.
- C. No equipment or material shall be installed in such a manner as to void a manufacturer's warranty. The Electrical Subcontractor shall notify the Architect of any discrepancies between the Contract Documents and manufacturer's recommendations prior to execution of the work.

1.10 RECORD DRAWINGS

- A. As work progresses, and for duration of the Contract, the Electrical Subcontractor shall maintain a complete and separate set of prints of Contract Drawings at job site at all times and record work completed and all changes from original Contract. Drawings shall clearly and accurately include work installed as a modification or added to the original design.
- B. At completion of work and prior to final request for payment, the Electrical Subcontractor shall submit a complete set of reproducible record drawings showing all systems as actually installed.

1.11 SHOP DRAWINGS

- A. After the Contract is awarded, but prior to proceeding with the Work, the Electrical Subcontractor shall obtain complete shop drawings, product data and samples from manufacturers, suppliers, vendors, and Subcontractors for all materials and equipment

specified herein, and submit data and details of such materials and equipment for review by the Architect. Prior to submission of the shop drawings, product data and samples to the Architect, the Electrical Subcontractor shall review and certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Further, the Electrical Subcontractor shall check all materials and equipment after their arrival on the jobsite and verify their compliance with the Contract Documents. A minimum period of ten working days, exclusive of transmittal time will be required in the Engineer's office each time shop drawings, product data and/or samples are submitted or resubmitted for review. This time period shall be considered by the Electrical Subcontractor when scheduling his Work.

- B. The Electrical Subcontractor shall submit to the Architect four (4) copies of shop drawings. All copies shall be neatly bound in folders. Additional copies required for distribution shall be the responsibility of the Electrical Subcontractor after reviewed copies are returned to him with the Architect's review comments and notes.
- C. Each shop drawing shall indicate in the lower right hand corner, and each product data brochure shall indicate on the front cover the following: Title of the sheet or brochure; name and location of the building; names of the Architect and Engineer, Contractor, Subcontractor, manufacturer, supplier, vendor; the date of submittal; and the date of each correction and revision. So far as is practical, each shop drawing, product data and/or samples shall bear a cross-reference note to the page or sheet number of the Drawings and/or Specifications showing the Work. Unless the above information is included, the submittal will be returned for resubmittal without review.
- D. The shop drawing submittal shall include all data necessary for interpretation as well as manufacturer's name and catalog number. Sizes, capacities, colors, etc., specified on the drawings shall be specifically noted or marked on the shop drawings.
- E. Submittals shall contain only information specific to systems, equipment and materials required by Contract Documents for this Project. Do not submit catalogs that describe products, models, options or accessories, other than those required, unless irrelevant information is marked out or unless relevant information is highlighted clearly. Marks on submittals, whether by Contractor, Subcontractor, manufacturer, etc., shall not be made in red ink. Red is reserved for review process.
- F. All specification sheets, drawings and diagrams shall be submitted within 30 days from the date of Electrical Subcontractor signs the Contract. The Architect's review of such drawings shall not relieve the Subcontractor of responsibility for deviations from the Contract, Drawings or Specifications, unless he has in writing called the attention of the Architect to such deviations at the time of the submission. The Architect's review shall not relieve the Electrical Subcontractor from responsibility for errors or omissions in such drawings.
- G. If the Electrical Subcontractor proposes an item of equipment other than that specified or detailed on the drawings which requires any redesign of the wiring or any other part of the mechanical, electrical or architectural layout, the required changes shall be made at the expense of the trade furnishing the changed equipment at no cost to the Owner.

- H. Manufacturer's names are listed herein and on the drawings to establish a standard for quality and design. Where one manufacturer's name is mentioned, products of other manufacturers will be acceptable if, in the opinion of the Architect the substitute material is of quality equal to or better than that of the material specified. Where two or more manufacturer's names are specified, material shall be by one of the named manufacturers only.

1.12 BULLETINS, MANUALS, AND INSTRUCTIONS

- A. The Electrical Subcontractor shall obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items and assemble literature in coordinated manuals with additional information describing combined operation of field assembled units, including as-built wiring diagrams. Manuals shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into two sections or books as follows:
1. Directions for and sequence of operation of each item of electrical systems, e.g. emergency generator, sound system, fire alarm system, etc.
 2. Detailed maintenance and trouble shooting manuals containing data furnished by manufacturer for complete maintenance.
- B. Furnish three copies of manuals to the Architect for review and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- C. Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct the Owner's operating personnel in any and all parts of various systems. Such instructions shall cover period of control such as will take mechanical equipment through complete cycle. Make adjustments under actual operating conditions.

1.13 MARKING AND LABELING

- A. The isolation panel shall be labeled with engraved laminated plastic plates, minimum 3/4" high with 3/8" engraved letters. Punch tapes with mastic backings are not acceptable.
- B. All starters, disconnect switches and other specified equipment shall be marked with engraved laminated plastic plates, minimum 1/2" high with 1/4" engraved letters. Where individual switches or circuit breakers in power or distribution panelboards do not have cardholders, they shall be marked with 1/2" high labels.
- C. All empty conduits shall have labels tied to the pull string at each end of each empty conduit, marked as to identification of each end. Junction boxes with circuits provided for future use shall be labeled with appropriate circuit designation.
- D. Cardholder for the isolation panel shall be filled out with typewritten identification of each circuit, except that the word "spare" shall be written in soft pencil to identify all circuit breakers installed that are not used.

1.14 WORK IN EXISTING FACILITIES

- A. All work shall be accomplished while the Owner's facility is in normal operation. All construction activities shall be conducted with minimal disruption to the Owner's operation.
- B. Power outages, bus tie-ins, and the like shall be scheduled in writing with the Owner.

1.15 WIRING METHODS

- A. Unless otherwise noted all wiring shall be installed in raceway.

Except as noted in Paragraph 1.15B, wiring shall be installed as follows:

1. All conduit installed outdoors, all risers between floors and conduit exposed to physical damage shall be rigid steel, rigid aluminum or intermediate metal conduit.
2. Unless otherwise noted, all other power distribution wiring including feeders and branch circuits shall be installed in electrical metallic tubing (EMT).
3. All fire alarm system wiring shall be installed in EMT.
4. All control wiring including automatic temperature control wiring provided by Division 15000 shall be installed in EMT.

END OF SECTION 16010

SECTION 16060

INSTALLATION OF WIRE AND CABLE

PART 1 - GENERAL

1.1 GENERAL

- A. The Provisions of Section 16010 General Requirements for Electrical Work apply to the Work of this Section.

1.2 CODES AND STANDARDS:

- A. Products shall comply with the following codes and standards and shall be UL-listed and labeled where applicable.

UL 486A Wire Connectors and Soldering Lugs for use with Copper Conductors.

UL 510 Electrical Insulating Tape

1.3 SUBMITTALS

- A. Manufacturers product data sheets

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

- A. Wire and cable are specified in other Sections of Division 16000.

2.2 TERMINATIONS AND SPLICES

- A. Power Wiring:

1. Terminal lugs, connectors and splices shall be tin plated, high conductivity copper compression type. They shall have chamfered barrels and be permanently identified with conductor sizes.
2. Terminal lugs for conductors No. 3/0 AWG and larger shall be long barrel NEMA two hole type.
3. Splices shall be long barrel butt type with a center stop in the splice barrel.
4. Hydraulic crimping tools with proper die sizes which require full closure before reopening shall be used.

- B. Lighting and branch circuits

1. Splices and taps in lighting and branch circuit wiring shall be 3M Hyflex connectors or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Conductors shall be carefully handled during installation to avoid damage of any kind. They shall be unreeled or uncoiled slowly in order to prevent damage to the insulation or sheath due to sudden bending. Repeated bending shall be avoided. Sharp kinks shall be avoided in unreeling, uncoiling and pulling.
- B. Suitable precautions shall be made to protect all installed wiring against damage due to construction activities.

3.02 PREPARATION OF RACEWAYS

- A. Raceways shall be substantially completed before any wiring is installed in them. Before any wiring is pulled into a conduit, the conduit shall be cleaned and tested for obstructions and cleared of foreign material that may be found. **Extreme care should be taken to keep conduits containing Isolated Power System conductors dry during construction. Keep conduit ends capped so they remain free from moisture. If moisture accidentally enters the conduits they must be swabbed and thoroughly dried before conductors are pulled.**

3.3 PULLING INTO RACEWAYS

- A. All possible care shall be taken in pulling of wiring into conduits or other raceways. The cable reels or coils shall be set up in such a way that the conductor may be trained into the raceway as directly as possible with a minimum number of changes of direction or amount of bending. Where several cables are contained in one conduit, all such cables shall be pulled in together.
- B. The use of pulling lubricants shall be restricted to non hardening type, approved by UL and the cable manufacturer. **No wire pulling compound shall be used in conduits containing Isolated Power System conductors.**
- C. Maximum allowable pull tension as specified by the cable manufacturer shall not be exceeded. Cables shall not be bent or pulled around sheaves less than the minimum radius recommended by the manufacturer.

3.4 SPLICES AND TERMINATIONS

- A. All power and control wiring shall be continuous and shall not be spliced unless otherwise indicated on the Drawings.
- B. Bolts, nuts and hardware used for terminations shall be silicone bronze. All terminations shall be properly torqued and provided with Belleville washers.
- C. Where terminations are made on insulated buses, the terminations shall be insulated using the proper tape(s) and fillers for the voltage level of the cable.

- D. Connections in motor terminal boxes shall be made by installing compression type lugs on the motor branch circuit conductors and the motor leads and bolting the lugs together then insulating with motor lead connection kits, Raychem, 3M or equal.
- E. Control wiring terminated on terminal blocks provided with saddle clamps does not require terminal lugs. Where screw or stud type terminal blocks are provided, control wiring shall be terminated with insulated, crimp type locking forks, Thomas & Betts STA-KON or approved equal.

3.5 IDENTIFICATION

- A. All power wiring conductors shall be color coded as follows:

<u>Phase</u>	<u>208Y/120V</u>	<u>480Y/277V</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

- B. All Isolated Power System branch circuit conductors shall be color coded as follows.

<u>CONDUCTOR #</u>	<u>120V</u>
1	Orange
2	Brown
Ground	Green

- C. Each cable shall be permanently identified at the device end with the panel and circuit number from which it was fed.

END OF SECTION 16060

SECTION 16200

600 VOLT WIRE

PART 1 - GENERAL

1.1 GENERAL

- A. The provisions of Section 16010, General Requirements for Electrical Work apply to the Work of this Section.

1.2 CODES AND STANDARDS

- A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

ASTM B-3	Soft or Annealed Copper Wire
ASTM B-8	Concentric Lay Stranded Copper Conductors
NEMA WC-5	Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
UL 44	Rubber Insulated Wires and Cables
UL 83	Thermoplastic Insulated Wires and Cables

1.3 SUBMITTALS

- A. Manufacturer's product data sheets.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All conductors shall be annealed copper in accordance with ASTM B-3.

- B. The jacket of all wire shall be printed with the following information:

1. Manufacturer
2. Size
3. Insulation type
4. Maximum voltage
5. UL label

- C. All insulation shall be rated 600 volt.

2.2 POWER WIRING

- A. Feeders and motor branch circuits shall be type XHHW.

- B. All power wiring shall be stranded, Class B strand in accordance with ASTM B-8, minimum size #12 AWG.

2.3 BRANCH CIRCUITS

- A. All lighting and convenience receptacle branch circuit wiring (except wiring originating from the Isolated Power System) shall be type THHN/THWN.
- B. All wiring origination from the Isolated Power System shall be cross-linked polyethylene (XLP) having a mineral filler instead of a carbon black filler. Minimum wire insulation wall thickness shall be 2/64". The wire dielectric constant shall be 3.5 or less. Wire shall be manufactured by Rome Cable Corporation and be type FR-XLP (VW-1 XHHW-2) or approved equal by the engineer.
- C. Branch circuit wiring shall be solid or stranded conductor, minimum size #12 AWG.

2.4 CONTROL WIRING

- A. Wiring for control circuits shall be THHN/THWN.
- B. Control wiring shall be stranded, Class B strand in accordance with ASTM B-8, minimum size #14 AWG.

2.5 FIXTURE WIRE

- A. Where high temperature fixture wire is required it shall be silicone rubber type SF-2.

PART 3 - EXECUTION

3.1 GENERAL

- A. All wire shall be installed in accordance with Section 16060, Installation of Wire and Cable.
- B. All wire shall be tested in accordance with Section 16030, Electrical Acceptance Testing.

END OF SECTION 16200

SECTION 16475

ISOLATED POWER SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

- A. The provisions of Section 16010, General Requirements for Electrical Work, Section 16060, Installation of Wire and Cable, Section 16200, 600 Volt Wire apply to the Work of this Section..

1.2 CODES AND STANDARDS

- A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

NEMA AB-1	Molded Case Circuit Breakers
NEMA PB-1	Panelboards
NFPA 70	National Electrical Code
NFPA 99	Health Care Facilities
UL 50	Enclosures for Electrical Equipment
UL 67	Panelboards
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 1022	Line Isolation Monitors
UL 1047	Isolated Power Systems Equipment
UL 2601-1	Medical Electrical Equipment, Part 1 : General Requirements for Safety

1.3 SUBMITTALS

- A. Manufacturer's product data sheets.

1.4 MANUFACTURERS

- A. Subject to compliance with the Specification requirements:

Square D
Approved Equal

PART 2 - PRODUCTS

2.1 ISOLATION TRANSFORMER

- A. The transformer shall be wound with an electrostatic shield between the primary and secondary windings. The shield shall be grounded to the enclosure. The electrostatic shield shall be designed to prevent direct shorting of the primary winding to the secondary winding, and to reduce the coupling of harmonic distortions between the primary and the secondary circuits.

- B. The total leakage current to ground from the transformer shall not exceed the values shown in Table 29.2 of UL 1047.
- C. Regulation shall be certified not to exceed 2.5% at 0.8 power factor (PF) at 20°C above the full load continuous operating temperature in accordance with NEMA-ANSI standards.
- D. The transformer shall be single phase, 60 Hz, with a primary voltage of 277 Volts and a secondary voltage of 120 Volts.
- E. Class H rated insulation shall be used in the manufacture of the transformer and the temperature rise shall be limited to 55° above ambient under full load conditions when tested in accordance with NEMA-ANSI standards. Transformers must have a 220°C, UL recognized insulation system.
- F. The core shall be of stacked design and securely clamped and bolted. The core and coils shall be internally isolated from the enclosure by means of a suitable vibration dampening system, varnish impregnated, and shall have a final wrap of insulating material to prevent exposure of bare conductors.
- G. The design sound level of the completed unit shall not exceed 30 dB for 5.0 kVA units and 35 dB for 7.5 kVA units. Certified sound level reports shall be furnished for each individual unit when requested by the Engineer or Owner.

2.2 CIRCUIT BREAKERS

- A. The Isolated Power System shall be provided with a primary circuit breaker and 2-pole secondary circuit breakers.
- B. All panels shall be shipped with 12 secondary circuit breakers and be field expandable to 16 secondary circuit breakers.
- C. All circuit breakers shall be thermal-magnetic type with a minimum interrupting capacity of 10,000 amperes symmetrical.

2.3 LINE ISOLATION MONITOR

- A. The Line Isolation Monitor (LIM) shall be Square D ISO-GARD® Series D. The LIM shall use microprocessor based digital signal processing to continually monitor the impedance 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. An LIM which internally switches between either line and ground shall not be accepted. The LIM shall not contribute more than 50 uA to the total hazard current of the system being monitored.
- B. 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 (Factory set at 5mA)
4.	Alarm Bandwidth	Zero (0)
5.	Alarm Hysteresis (on/off)	50uA
6.	Mode	Single phase
7.	Monitor Hazard Current	50uA
8.	Operating Frequency	60Hz

- C. All of the listed specifications shall be contained within one unit and be user selectable thus allowing the LIM to be interchanged from system to system.
- D. 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 lamps and meters on the face of the LIM and at any remote indicating stations.
- E. The LIM shall use digital signal processing to determine the hazard current of the system being monitored. The algorithms used to determine the system hazard current shall be preprogrammed into the LIM's microprocessor. At least every 65 minutes, the unit shall recheck its calibration and recalibrate the system to original performance specifications. Additionally, by pressing the LIM's momentary test switch, an immediate check and recalibration of the LIM shall be performed.
- F. If internal components are more than 30% out of original specifications because of aging or failure, the LIM shall notify the user by displaying a unique error code thus eliminating the need for periodic manual testing to determine the unit's integrity. LIM's which use analog signal processing technology and/or require manual testing or calibration will not be accepted.
- G. The LIM shall provide both analog and digital indication of the isolated power system's hazard current. Digital indication shall be provided by a digital meter and analog indication shall be provided by an LED bar graph type meter calibrated from 0 (zero) to 160% of the alarm setting of the LIM. LIM's with only analog or only digital indication will not be accepted.
- H. The LIM shall have a green safe light and a red hazard light on the front panel. The red hazard light shall remain illuminated for the duration when the isolated power system 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 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. All lamps shall be long life LED type.
- I. A set of normally open and normally closed contacts, rate 3 amperes at 120 VAC shall be provided on the LIM for use with external alarm systems. The LIM shall also provide a 12 VAC output signal rated at 10 VA to power remote indicator alarm units. This 12 VAC

output signal shall not increase the hazard current of the system being monitored. Provisions for connection of the remote metering shall also be provided as part of the LIM. These connections shall have the ability to operate either an analog or digital type remote meter.

- J. 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. In addition to activating the alarm, the unit shall display an error code in the digital display of the LIM.
- K. All switches, meters, and indicating lamps shall be flush with the face of the LIM to provide a neat and clean appearance. The entire front face of the unit shall have a polymer overly that protects the unit from the intrusion of housekeeping cleaning agents. LIM's with exposed fuses, meters, switches, or circuit breakers will not be accepted.
- L. The design of the LIM shall consist of two circuit boards interconnected by a ribbon connector. The two boards shall contain all of the unit's electrical components and be mounted in the rear housing of the LIM. A phenolic cover shall complete the assembly. The unit shall not contain any components, such as circuit breakers, meters, switches or indicating lamps, which are mounted on or attached to the front cover of the LIM. Access to the inside of the LIM shall be through the front of the unit, thus eliminating the need to remove the unit from its mounting position to change any of the settings. Unique fasteners shall attach to the front cover of the unit to prevent unauthorized access to the interior of the LIM.
- M. The LIM shall be manufactured by Square D Company, UL component recognized under UL 1022 Standard for Isolation Monitors.

2.4 ENCLOSURE

- A. The enclosure shall be 12 gauge steel which is degreased, phosphatized, primed, and finish baked enamel paint. The front trim shall be 304 stainless steel with a brushed finish. The enclosure shall be flush mounted unless otherwise stated on the plans; 5 kVA units shall have a maximum depth of 8 inches; 7.5 kVA units shall have a maximum depth of 12 inches. The flush trim panels shall have a hinged door, with keyed lock, to give access to the circuit breakers and LIM, and to provide for testing.
- B. The front panel shall not contain any type of grille or louver for ventilation. The panel and transformer shall be so designed that heat generated by the transformer under full load conditions shall not affect the normal operation of the circuit breakers and LIM. The maximum front panel temperature shall not exceed 30°C under full load continuous operation. Certification of this temperature test shall be provided to the Engineer or Owner upon request. The entire section behind the hinged door shall be of a dead front design. All hinges shall be concealed.

2.5 WIRING

- A. Wiring within all panels shall meet all applicable NEC standards. Low leakage insulation shall be used on all secondary wiring. The total leakage for all panel types shall not exceed the values shown in Table 29.1 of UL 1047.
- B. The panel manufacturer shall provide certified test data on each individual panel as to the maximum leakage of each complete assembly.
- C. The Electrical Contractor shall wire all external receptacles to the panels using copper stranded conductor having a cross-linked polyethylene insulation with a dielectric constant of 3.5 or less. Under no circumstances shall wire pulling compound be used when pulling the wire for isolated circuits. All wiring shall be color-coded in accordance with the NEC.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Electrical Contractor shall provide an isolated distribution system panel in OR room #100. Location of this panel cannot be changed without written permission from the Engineer, Architect and Owner.
- B. The panels shall be factory wired and tested and include a shielded low leakage isolation transformer, primary circuit breaker, secondary circuit breakers and LIM.

3.2 TESTING

- A. The Electrical Contractor shall include the cost of, and make all arrangements for, testing all ungrounded isolated power systems provided as part of this contract. The testing shall be by a qualified factory technician provided by the manufacturer of the isolated power 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 the system.
- B. 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. The faults simulated shall be combinations of resistive and capacitive faults.
- C. 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, the difference to be no more than 40 millivolts. These tests are required by NFPA 99 for new construction areas.
- D. 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.
- E. 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 3. The measured system impedance shall become part of the permanent logged records of each panel.
- F. After all tests are complete, a letter shall be given to the hospital and the Engineer. The letter shall state that the system conforms with all codes, good installation practices, and the specifications.
- G. 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.
- H. All questions from the hospital staff shall be answered completely and thoroughly at this time. The Engineer shall be notified of the dates and times of all tests so that he/she may witness any of the tests or meetings conducted by the factory technician.

END OF SECTION 16475

SECTION 16490

SAFETY SWITCHES

PART 1 - GENERAL

1.1 GENERAL

- A. The provisions of Section 16010 General Requirements for Electrical Work apply to the Work of this Section.

1.2 CODES AND STANDARDS

- A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

NEMA KS-1	Enclosed Switches
UL 98	Enclosed and Deadfront Switches

1.3 SUBMITTALS

- A. Manufacturer's product data sheets.

1.4 MANUFACTURERS

- A. Subject to compliance with the specification requirements:

General Electric
Square D
Siemens
Cutler Hammer

PART 2 - PRODUCTS

- 2.1 Safety switches shall be 600 VAC, NEMA heavy duty, horsepower rated visible blade type. Switches shall be non-fused or fused as indicated on the Drawings.
- 2.2 The switch operating mechanism shall be spring activated quick make - quick break.
- 2.3 The external operating handle shall indicate the switch position, ON in the up position, OFF in the down position and shall be padlockable in the OFF position. A defeatable interlock shall be provided to prevent opening the cover when the switch is ON and prevent closing the switch contacts when the cover is opened.
- 2.4 Switches shall be provided with arc suppressors and line terminal shields.
- 2.5 Single speed motors shall be provided with three pole switches. Two speed motors shall be provided with six pole switches.

- 2.6 Switches shall be provided with a factory supplied ground kit.
- 2.7 Safety switches installed indoors shall be provided with NEMA 1 enclosures. Safety switches installed outdoors or in wet areas shall be provided with NEMA 3R enclosures.

END OF SECTION 16490

SECTION 16500

INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 GENERAL

- A. Provisions of Section 16010 General Requirements for Electrical Work, and Section 16060 Installation of Wire and Cable, apply to the work of this section.

1.2 CODES AND STANDARDS

- A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

CBM Labels	Certified Ballast Manufacturers Assoc.
NEC Art. 410	National Electrical Code
FCC, Part 18	RFI and EMI
ANSI C62.41	Line Transient Protection
UL 1570	Fluorescent Lighting Fixtures
UL 1572	HID Lighting Fixtures
UL 1571	Incandescent Lighting Fixtures
UL 924	Emergency Lighting and Power Equipment
UL 1088	Temporary Lighting

1.3 SUBMITTALS

- A. Submit manufacturer's product data, photometrics, and installation instructions for each type of light fixture specified. Fixture submittals will be in booklet form with separate sheet for each fixture assembled in "luminaire type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet.
- B. Submit on a separate sheet for each HID and fluorescent fixture type specified, the ballast manufacturer, type and technical data for that ballast.
- C. Submit on a separate sheet for each light fixture specified, the proposed lamp and manufacturers data for that lamp.

1.4 MANUFACTURERS

- A. Provide products of the manufacturers specified on the contract drawings and as listed under Part 2 of this section.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Light fixtures shall be provided with housings, trims, ballasts, lamp holders, sockets, reflectors, wiring and other components required, as a factory-assembled unit for a complete installation.
- B. Provide electrical wiring within light fixtures suitable for connecting to branch circuit wiring in accordance with N.E.C. Article 410, Paragraph 24.
- C. Deliver interior lighting fixtures in factory fabricated containers and wrapping, which properly protect fixtures from damage.
- D. Store interior lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, humidity, extreme temperatures, laid flat and on skids to keep off floors and ground.
- E. Fixtures installed in ceilings, suspended from ceilings or on walls shall have a plastic film covering protecting lens, louver and lamps from dust, dirt and debris. Plastic film shall not be removed until construction is completed.

2.2 FLUORESCENT FIXTURES

- A. General: Provide fluorescent fixtures of sizes, types and ratings indicated and specified in the Lighting Fixture Schedule on the Contract Drawings.
- B. Fluorescent-Lamp Ballasts: Provide low-energy solid state fluorescent lamp ballasts, operating lamps with a frequency of >20KHz and capable of operating lamp types indicated. Ballasts shall be high power factor >0.90, Class A sound rating and have a lamp current crest factor of 1.7 or less and total harmonic distortion less than 20%. Ballasts shall be UL listed, Class P, and meet FCC 47CFR Part 18 Non-Consumer and meet applicable ANSI standard. Ballast shall have a 5 year warranty.
 - 1. Ballasts that operate T8 lamps shall have the following requirements:
 - a. Ballast factor shall be 0.90
 - b. Ballast shall be instant start for maximum efficiency and parallel wired such that if one lamp fails, the remaining lamps stay lit.
 - c. Ballast must be capable of 0□ starting.
 - 2. Ballasts that operate T5, T4, compact fluorescent and smaller diameter lamps shall have the following requirements :
 - a. Ballasts shall have an end of lamp life sensing circuit capable of shutting the lamp down to prevent lamp glass from cracking and lamp base sockets from melting.
 - b. Ballast factor shall be 0.80 - 1.15.

- c. Ballasts for T4 compact fluorescent lamps shall be Programmed Rapid Start type to operate lamps in series. Ballast shall digitally control lamp starting to maintain manufactures rated lamp life under any lamp starting cycles. Ballast input voltage shall be a dedicated input voltage, i.e. 120V.
3. Manufacturers: Subject to compliance with the requirements, provide ballasts by one of the following:
 - a. Osram Sylvania Inc.
 - b. Advance
 - c. Magnetek
- C. Fluorescent Dimming Ballasts: Provide solid state electronic dimming ballasts, capable of operating lamp, types specified, with high power factor rapid start, and Class A sound rating. Ballast shall have a lamp crest factor of 1.7 and below and a total harmonic distortion not to exceed 20%. Ballast shall have a 5 year warranty.
 1. Ballasts shall be Programmed Rapid Start to operate lamps in series. Ballast shall digitally control lamp starting to maintain manufacturers rated lamp life under any lamp starting cycles.
 2. Ballasts shall have anti-flash circuitry, such that lamp will start in any light level mode without flashing to full light output.
 3. T5 or T8 lamp dimming range shall be 100% - 5% with a ballast factor range of 0.96 - 0.06
 4. Manufacturers: Subject to compliance with requirements provide dimming ballasts by one of the following:
 - a. Lutron Electronics Co., Inc.
 - b. Osram Sylvania, Inc.

2.3 LAMPS

- A. Provide fluorescent lamps of types as indicated on the contract drawings.
- B. T8 Lamp Type:
 1. Lamp shall have a average rated life of 20,000 hours, and a minimum 82 CRI. A 32 Watt lamp shall be minimum 2950 lumens.
 2. Lamp color temperature shall be 4100K in "OR" room and in all other rooms color temperature shall match existing.

- C. T5 Lamp Type:
 - 1. Lamp shall have a average rated life of 20,000 hours, and a minimum 82 CRI. A 24 Watt lamp shall be minimum 1760 lumens.
 - 2. Lamp color temperature shall be 4100K unless otherwise noted.
- D. Compact Fluorescent (T4) Lamp Type:
 - 1. Compact fluorescent lamp shall be as called for in the fixture schedule.
 - 2. Lamps shall have 4 pin bases for operation on electronic ballasts.
 - 3. Lamp color temperature shall be 4100K unless otherwise noted.
 - 4. Lamps shall have a color rendering index of 82 CRI.
- E. ANSI Standards. Lamps shall comply with applicable ANSI standards.
- F. Lamps shall be manufactured by Osram Sylvania, Philips Lighting Co. or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine all areas and conditions under which lighting fixtures are to be installed and structure which will support lighting fixtures. Notify the General Contractor in writing of any conditions which are detrimental to proper installation and completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Coordinate light fixture installations with other trades. Fluorescent light fixtures should be installed at least two feet away from smoke detectors. Coordinate all lighting fixtures with mechanical piping and duct work to allow for proper clearance.

3.2 INSTALLATION

- A. Install all lighting fixtures at locations and heights indicated, in accordance with the architectural reflected ceiling plans.
- B. All recessed lighting fixtures installed in ceiling which require a fire resistance rating shall be installed in accordance with the 1996 BOCA National Building Code Section 713.
- C. Provide fixtures and/or fixture outlet boxes with hangers, channel or other method of fastening and supporting fixtures required for proper installation.

- D. Tighten connectors and terminals, including screws and bolts in accordance with equipment manufacturer's published torque tightening values for equipment connectors. All screws and bolts shall have washers.

3.3 SPLICES AND TERMINATIONS

- A. Twist on wire connectors shall be installed which utilize square-wire spring grips and thermo plastic shells. Install connectors to meet the manufacturer's torquing requirements. Install wire connectors of size required as not to exceed the manufacturers UL-listed CSA recognized wire combinations.

3.4 FIELD QUALITY CONTROL

- A. At date of substantial completion, all lamps which are not functioning, have color deficiencies, or are noticeably dimmed shall be replaced with new lamps as determined by the Engineer.
- B. All lamps used for temporary lighting in new light fixtures shall be replaced with new lamps.
- C. All light fixtures shall be cleaned of dirt and debris upon completion of construction. All finger prints and smudges shall be cleaned.
- D. All installed fixtures during remainder of construction shall be protected in accordance with Section 2.1 Paragraph E of this specification section.
- E. All light fixtures shall be grounded in accordance with article 250 and 410 of the NEC. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.
- F. All light fixtures damaged in shipping or during installation shall be replaced with new fixtures at no cost to the Owner.
- G. Furnish stock or replacement lamps amounting to 15%, but no less than six lamps, of each type and size lamp used in each type of lighting fixture. Deliver replacement stock as directed to Owner's storage space.
- H. All fixtures being reused shall have new lamps installed at job completion.

END OF SECTION 16500

