SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.

B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.

C. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.

B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction

and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
   a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
   b. Are periodically inspected by a NRTL.
   c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturer’s Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

B. Product Qualification:
   1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
   2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of

receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.

B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.

B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The Contractor shall notify the Government through the Project Engineer a minimum of 45 working days prior to the manufacturer’s performing the factory tests.
2. Two copies of certified test reports shall be furnished to the Project Engineer two weeks prior to final inspection and not more than 90 days after completion of the tests.
3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.

1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
3. Damaged equipment shall be repaired or replaced, as determined by the Project Engineer4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.

B. Job site safety and worker safety is the responsibility of the Contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized.

D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall

be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.

F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working clearances shall not be less than specified in the NEC.

C. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

1.11 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

1.12 SUBMITTALS

A. Submit to the Project Engineering accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.

C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.

D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, VA contract number, VA project number, VA project title, specification number and applicable paragraphs, and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit two copies electronic PDF and two copies bound in hardback binder for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.

2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number, VA contract number, VA project number, VA project title. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
4. The manuals shall include:
   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.
   c. Description of the function of each principal item of equipment.
   d. Installation instructions.
   e. Safety precautions for operation and maintenance.
   f. Diagrams and illustrations.
   g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
   h. Performance data.
   i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
   j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

1.13 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this

reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 ACCEPTANCE CHECKS AND TESTS

A. The Contractor shall furnish the instruments, materials, and labor for tests.

B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.

C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.15 WARRANTY

A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.16 INSTRUCTION

A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.

B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be trained in operating theory as well as practical operation and maintenance procedures.

C. A training schedule shall be developed and submitted by the Contractor and approved by the Project Engineerat least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

SECTION 26 05 12
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.

B. Construction Phasing

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on the drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Project Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Provide temporary wiring and connections to maintain existing systems in service during construction.

C. Existing Electrical Panels and Equipment: Disable system only to make switchovers and connections. Minimize outage duration.

1. Obtain permission from Owner at least 3 weeks before partially or completely disabling panels and equipment.
2. Make temporary connections to maintain service in areas adjacent to work area.
3. Provide temporary connections to areas that remain in service during construction. All hospital operations shall remain functional at all times.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes which are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

J. Install junction boxes in walls, ceilings or floors if required to continue circuiting.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CONSTRUCTION PHASING

A. All work shall be phased to create minimal electrical service disruption to the daily operations of the hospital. Provide temporary connections to branch circuit devices, light fixtures, panelboards, motor starters, MCC's, etc. during switchover operations to keep downtime to any piece of equipment or areas of the building to a minimum.

B. Switchover work may need to be completed outside of normal work hours to keep disruption to hospital operations minimized.

C. Phasing schedules are to be submitted to VA Project Engineer at least two weeks prior to any power outages for approval. Outages are to be scheduled at least two weeks prior to the outage date with the VA Project Engineer.

3.5 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised

circuiting arrangement.

3.6 MATERIAL DISPOSAL

A. Material and equipment deemed salvageable by the Owner shall remain the property of Owner. Contractor shall dismantle these items to manageable size and deliver to designated storage area on site. The Owner shall have first right of refusal on all material and equipment.

B. All other materials and equipment shall become property of Contractor and must be removed from site and disposed of by approved method.

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SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.

B. American Society of Testing Material (ASTM):

D2301-10.....Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

D2304-10.....Test Method for Thermal Endurance of Rigid Electrical Insulating Materials

D3005-10.....Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

C. National Electrical Manufacturers Association (NEMA):

WC 70-09.....Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

44-10.....Thermoset-Insulated Wires and Cables

83-08.....Thermoplastic-Insulated Wires and Cables

467-07.....Grounding and Bonding Equipment

486A-486B-03.....Wire Connectors

486C-04.....Splicing Wire Connectors

486D-05.....Sealed Wire Connector Systems

486E-09.....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

493-07.....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

514B-04.....Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.

B. All conductors shall be copper.

C. Single Conductor and Cable:

1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
2. No. 8 AWG and larger: Stranded.
3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
4. Insulation: THHN-THWN.

E. Color Code:

1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
2. No. 8 AWG and larger: Color-coded using one of the following methods:
   a. Solid color insulation or solid color coating.
   b. Stripes, bands, or hash marks of color specified.
   c. Color using 19 mm (0.75 inches) wide tape.

4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

6. Lighting circuit “switch legs”, and 3-way and 4-way switch “traveling wires,” shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the Project Engineer.
7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

A. Splices shall be in accordance with NEC and UL.

B. Above Ground Splices for No. 10 AWG and Smaller:
   1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
   2. The integral insulator shall have a skirt to completely cover the stripped conductors.
   3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.

C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
   1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
   2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
   3. Splice and insulation shall be product of the same manufacturer.
   4. All bolts, nuts, and washers used with splices shall be zinc-plated steel.

D. Above Ground Splices for 250 kcmil and Larger:
   1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper conductors.
   2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
   3. Splice and insulation shall be product of the same manufacturer.

E. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper conductors.

B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper conductors.

C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

2.4 CONTROL WIRING

A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. -22 AWG. Low voltage control wiring (48v and lower) may also utilize cables that include twisted pair conductors within an overall jacket per the equipment manufacturers printed requirements.

B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND

A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.

PART 3 - EXECUTION

3.1 GENERAL

A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.

B. Install all conductors in raceway systems.

C. Splice conductors only in outlet boxes, junction boxes,and pullboxes.

D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.

E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.

H. Conductor and Cable Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
2. Use nonmetallic pull ropes.
3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
4. All conductors in a single conduit shall be pulled simultaneously.
5. Do not exceed manufacturer’s recommended maximum pulling tensions and sidewall pressure values.

I. No more than three branch circuits shall be installed in any one conduit.

J. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 SPLICE AND TERMINATION INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer’s published torque values using a torque screwdriver or wrench.

B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

3.3 CONDUCTOR IDENTIFICATION

A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes and pullboxes,. Apply the last two laps of tape with no tension

to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.5 EXISTING CONDUCTORS

A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.6 CONTROL WIRING INSTALLATION

A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.

B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.7 CONTROL WIRING IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.

B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.

C. Wire markers shall retain their markings after cleaning.

3.8 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests: Inspect physical condition.
2. Electrical tests:
   a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
   b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megaohms for 300 V rated cable and 100 megaohms for 600 V rated cable.
   c. Perform phase rotation test on all three-phase circuits.

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.

B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.

C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

D. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground grounding electrode conductors.
2. Test Reports:
   a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Project Engineer
3. Certifications:

a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American Society for Testing and Materials (ASTM):

B1-07.....Standard Specification for Hard-Drawn Copper Wire

B3-07.....Standard Specification for Soft or Annealed Copper Wire

B8-11.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-83.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

D. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

70E-12.....National Electrical Safety Code

99-12.....Health Care Facilities

E. Underwriters Laboratories, Inc. (UL):

44-10 .....Thermoset-Insulated Wires and Cables

83-08 .....Thermoplastic-Insulated Wires and Cables

467-07 .....Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.

B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

D. Insulation: THHN-THWN and XHHW-2.

2.2 GROUND CONNECTIONS

A. Inaccessible Locations: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: Listed for use with copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
2. Connection to Building Steel: Exothermic-welded type connectors.
3. Connection to Grounding Bus Bars: Listed for use with copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.3 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.4 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 GROUNDING BUS BAR

A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 GENERAL

A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.

B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

D. For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

3.2 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):

1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.

C. Switchgear, Switchboards, Panelboards, and other electrical equipment:

1. Connect the equipment grounding conductors to the ground bus.
2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

3.3 RACEWAY

A. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to

interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.

3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.

B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.

C. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

D. Wireway Systems:

1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).

E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

F. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

G. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.4 CORROSION INHIBITORS

A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.5 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.6 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.

B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.7 ACCEPTANCE CHECKS AND TESTS

A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.

B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

---END---

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.

B. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.

C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Size and location of main feeders.
   b. Size and location of panels and pull-boxes.
   c. Layout of required conduit penetrations through structural elements.
   d. Submit the following data for approval:
      1) Raceway types and sizes.
      2) Conduit bodies, connectors and fittings.
      3) Junction and pull boxes, types and sizes.

2. Certifications: Two weeks prior to final inspection, submit the following:
   a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American National Standards Institute (ANSI):
C80.1-05.....Electrical Rigid Steel Conduit
C80.3-05.....Steel Electrical Metal Tubing
C80.6-05.....Electrical Intermediate Metal Conduit

C. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):
1-05.....Flexible Metal Conduit
6-07.....Electrical Rigid Metal Conduit - Steel
50-95.....Enclosures for Electrical Equipment
467-13.....Grounding and Bonding Equipment
514A-13.....Metallic Outlet Boxes
514B-12.....Conduit, Tubing, and Cable Fittings
514C-07.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
797-07.....Electrical Metallic Tubing
1242-06.....Electrical Intermediate Metal Conduit - Steel

E. National Electrical Manufacturers Association (NEMA):
FB1-12.....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
FB2.10-13.....Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate

Metallic Conduit, and Electrical Metallic Tubing)

FB2.20-12.....Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

F. American Iron and Steel Institute (AISI):

S100-2007.....North American Specification for the Design of Cold-Formed Steel Structural Members

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than (3/4-inch) unless otherwise shown. Where permitted by the NEC, 1/2 inch flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:

1. Size: In accordance with the NEC, but not less than 3/4 inch.
2. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
3. Flexible Metal Conduit: Shall conform to UL 1.

C. Conduit Fittings:

1. Electrical Metallic Tubing Fittings:
   a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Setscrew Couplings and Connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.
   d. Indent-type connectors or couplings are prohibited.
   e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible Metal Conduit Fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp-type, with insulated throat.

D. Conduit Supports:

1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.

2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
2. Rustproof cast metal where required by the NEC or shown on drawings.
3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

F. Floor Boxes – Poke Through
1. 6 inch round assembly comprising service fitting, poke- through component, firestops and smoke barriers, junction box for conduit termination, and communication adapter plate for conduit connections.
2. Devices: Two 20 ampere duplex receptacles, Bracket for mounting up to 8 RJ45 jacks, Brackets as needed for devices as shown on the drawings.
3. Fire Rating: 2 hours. UL listed for scrub water exclusion. ADA compliant.
4. Cover: Flush style cover assembly, die cast aluminum with nickel finish.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:
1. Do not cut through structural elements such as ribs or beams.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by Project Engineer where working space is limited.

B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the

spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

3.2 INSTALLATION, GENERAL

A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.

B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.

C. Install conduit as follows:

1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut conduits square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
10. Conduit installations under fume and vent hoods are prohibited.
11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
12. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:

1. Make bends with standard conduit bending machines.

2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the Project Engineer.

3.3 CONCEALED WORK INSTALLATION

A. Above Furred or Suspended Ceilings and in Walls:
1. Conduit for Conductors 600 V and Below: EMT. Mixing different types of conduits in the same system is prohibited.
2. Align and run conduit parallel or perpendicular to the building lines.
3. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
4. Tightening set screws with pliers is prohibited.
5. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.
6. Flexible metal conduit may only be used as indicated in paragraph 3 and within existing walls to serve devices that are required to be cut into the surface. VA Project Engineer shall approve the use of flexible metal conduit for this application prior to the installation.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
B. Conduit for Conductors 600 V and Below: EMT. Mixing different types of conduits in the system is prohibited.
C. Align and run conduit parallel or perpendicular to the building lines.
D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
E. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.

F. Surface Metal Raceways: Use only where shown on drawings.

G. Painting:

1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

3.5 MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

B. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.6 CONDUIT SUPPORTS

A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
   a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
   b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
   c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

M. The use of combination type box and conduit hangers similar to 'Caddy' combo box/conduit hangers that utilize wires or rods for support is prohibited. Utilize steel channel that is directly attached to the wall, ceiling structure or other structural elements to support conduits.

3.7 BOX INSTALLATION

A. Boxes for Concealed Conduits:
   1. Flush-mounted.
   2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.

C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.

F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall.

Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.

G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.

H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."

I. On all branch circuit junction box covers, identify the circuits with black marker.

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SECTION 26 05 38
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cable trays and accessories.

B. Firestopping within (not around) cable trays.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping: Firestopping around cable trays.

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

1.3 REFERENCES

A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.

B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.

C. NEMA VE 1 - Metallic Cable Tray Systems; National Electrical Manufacturers Association; 2002.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.

1.4 SUBMITTALS

A. See Section 01 33 23 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for fittings and accessories.

C. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.5 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. CABLOFIL - EZ Tray.

B. B-line.

C. Flextray.

D. Chalfant.

E. Or Equal.

2.2 WIRE BASKET TYPE CABLE TRAY

A. Description: Wire Basket Runway Cable Tray NEMA VE1.

B. Material: Steel.

C. Finish: ASTM A 510, electro zinc finish.

D. Inside Width: 12 inches unless shown otherwise on the drawings.

E. Inside Depth: 4 inches

F. Straight Section Mesh Spacing: 4 inches on center, 2 inches in width.

G. Provide manufacturers standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

H. Provide support brackets to mount tray to wall or structure.

I. Provide bending radius clips.

2.3 GROUNDING

A. Provide grounding lug and bond all sections to building grounding system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as on shop drawings.

3.2 INSTALLATION

A. Install metallic cable tray in accordance with NEMA VE 1.

B. Support trays in accordance with Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 ft maximum.

C. Use expansion connectors where required.

D. Provide firestopping under provisions of Section 07 84 00 and 26 05 34 to sustain ratings when passing cable tray through fire-rated elements.

E. Properly seal around cable tray passing through partitions to prevent passage of smoke and flame. Provide fireproofing which preserves the fire resistant rating of the partition and can be removed and replaced for future cable routing requirements.

F. Provide fireproofing pillows where cable tray passes through partitions. See Specification Section 07 84 00 and 27 10 05 and 26 05 34.

G. Ground and bond cable tray under provisions of Section 26 05 26.

1. Provide continuity between tray components.

2. Provide 2 AWG bare copper equipment grounding jumper to bond each

section of tray; or utilize cable tray connecting hardware if rated as a bonding connection, bond to each component.

3. Connections to tray may be made using mechanical or exothermic connectors.

- - - END - - -

SECTION 26 09 23
LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation and connection of the lighting controls.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.

E. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

F. Section 26 51 00, INTERIOR LIGHTING: Luminaire ballast and drivers used in control of lighting systems.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Submit the following information for each type of lighting controls.
   b. Material and construction details.
   c. Physical dimensions and description.
   d. Wiring schematic and connection diagram.
   e. Installation details.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data

sheets, wiring diagrams, and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the Contractor that the lighting control systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Green Seal (GS):

GC-12-03.....Occupancy Sensors

C. National Electrical Manufacturer's Association (NEMA):

C136.10-10.....American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing

ICS-1-08.....Standard for Industrial Control and Systems General Requirements

ICS-2-05.....Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment

ICS-6-11.....Standard for Industrial Controls and Systems Enclosures

D. National Fire Protection Association (NFPA):

70-14.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):

20.....Standard for General-Use Snap Switches

773-95.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

773A-06.....Nonindustrial Photoelectric Switches for Lighting Control

98-04.....Enclosed and Dead-Front Switches
916-07.....Standard for Energy Management Equipment Systems
917-06.....Clock Operated Switches
924-06.....Emergency Lighting and Power Equipment (for use when controlling emergency circuits).

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
   2. Sensor Output: Contacts rated to operate the connected relay. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
   4. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
   6. Bypass Switch: Override the on function in case of sensor failure.
   7. Manual/automatic selector switch.
   8. Automatic Light-Level Sensor: Adjustable from 21.5 to 2152 lx (2 to 200 fc); keep lighting off when selected lighting level is present.
   9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

B. Dual-technology Type: Ceiling mounting; combination PIR and ultrasonic detection methods, field-selectable.
   1. Sensitivity Adjustment: Separate for each sensing technology.
   2. Detector Sensitivity: Detect occurrences of 150 mm (6-inch) minimum movement of any portion of a human body that presents a target of not less than 232 sq. cm (36 sq. in), and detect a person of average

size and weight moving not less than 305 mm (12 inches) in either a horizontal or a vertical manner at an approximate speed of 305 mm/s (12 inches/s).

C. Detection Coverage: Shall be sufficient to provide coverage as required by sensor locations shown on drawing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.

B. Aim outdoor photoelectric sensor according to manufacturer's recommendations. Set adjustable window slide for 1 foot candle turn-on.

C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer’s recommendations.

D. Set occupancy sensor "on" duration to 5 minutes.

E. Locate photoelectric sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the available light level at the typical work plane for that area.

F. Label time switches and contactors with a unique designation.

G. Program lighting control panels per schedule on drawings.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations.

B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.

D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function in the presence of Project Engineeer.

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

A. Section 09 91 00, PAINTING: Painting of panelboards.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
2. Manuals:
   a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.
      1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
      2) Include information for testing, repair, troubleshooting, assembly, and disassembly.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. International Code Council (ICC):
IBC-12.....International Building Code

C. National Electrical Manufacturers Association (NEMA):
PB 1-11.....Panelboards
250-08.....Enclosures for Electrical Equipment (1,000V Maximum)

D. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)
70E-12.....Standard for Electrical Safety in the Workplace

E. Underwriters Laboratories, Inc. (UL):
50-95.....Enclosures for Electrical Equipment
67-09.....Panelboards
489-09.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.

B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.

C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.

D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.

E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.

F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.

G. Neutral bus shall be 100 percent rated, mounted on insulated supports.

H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.

I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.

J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.

K. Series-rated panelboards are not permitted.

2.2 ENCLOSURES AND TRIMS

A. Enclosures:

1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
2. Enclosures shall not have ventilating openings.
3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:

1. Hinged "door-in-door" type.

2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key for entry. Hand-operated latches are not acceptable.Keyed to match existing panelboards within the facility. Key shall be a Square D NSR251 only.
4. Inner and outer doors shall open left to right.
5. Trims shall be flush or surface type as shown on the drawings.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.

B. Circuit breakers shall be bolt-on type.

C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
1. 120/208 V Panelboard: 10,000 A symmetrical.
2. 120/240 V Panelboard: 10,000 A symmetrical.
3. 277/480 V Panelboard: 14,000 A symmetrical.

D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. E. Circuit breaker features shall be as follows:
1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates closed, tripped, and open positions.
8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line

currents), or other accessory devices or functions shall be provided where shown on the drawings.

10. Circuit breakers shall be selectively coordinated with all upstream and downstream breakers associated with the equipment branch, critical branch and life safety branch to meet NEC article 517 requirements. Shop drawings shall indicate the breakers are selectively coordinated through use of a spreadsheet and manufacturer tables.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.

B. Locate panelboards so that the present and future conduits can be conveniently connected.

C. Install a printed schedule of circuits in each panelboard after approval by the Project Engineer. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards

D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).

E. Provide blank cover for each unused circuit breaker mounting space.

F. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

G. Label each panelboard with the system voltage, and feeder sizes as shown on the riser diagram in 1/2 inch block lettering on the inside cover of the cabinet door. Include the words "LIFE SAFETY BRANCH", "CRITICAL BRANCH", or "EQUIPMENT SYSTEM" as applicable and the panel designation in 1/2 inch block letters on the inside of the cabinet doors.

H. Provide ARC flash identification per NFPA 70E and the existing labeling system at the VAMC Fargo. Exact orientation and information required on the labels will be provided to the contractor. Coordinate label requirements with the Project Engineer prior to printing labels.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with specifications and approved shop drawings.

b. Inspect physical, electrical, and mechanical condition.

c. Verify appropriate anchorage and required area clearances.

d. Verify that circuit breaker sizes and types correspond to approved shop drawings.

e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.

f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

---END---

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.

B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
2. Manuals:
   a. Submit, two weeks to final inspection, two companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

99-12.....Health Care Facilities

C. National Electrical Manufacturers Association (NEMA):

WD 1-10.....General Color Requirements for Wiring Devices

WD 6-08 .....Wiring Devices – Dimensional Specifications

D. Underwriter's Laboratories, Inc. (UL):

20-10.....General-Use Snap Switches

231-07.....Power Outlets

467-07.....Grounding and Bonding Equipment

498-07.....Attachment Plugs and Receptacles

943-11.....Ground-Fault Circuit-Interrupters

1449-07.....Surge Protective Devices

1472-96.....Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.

1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
3. All receptacles shall be labeled with the panel name and circuit number. Example: 12S1-5. The labels shall be self-adhesive type with clear background and black lettering, 3/16 inch high text.

B. Duplex Receptacles: Hospital-grade with green dot, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.

1. Bodies shall be ivory in color.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.

3. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, hospital-grade with green dot, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring.
   a. Ground fault interrupter shall be consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.

C. Receptacles; 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.

2.2 TOGGLE SWITCHES

A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be ivory in color unless otherwise specified or shown on the drawings.
   1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.
   2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
   3. Switches shall be rated 20 amperes at 120-277 Volts AC.

2.3 MANUAL DIMMING CONTROL

A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.

B. Manual dimming controls shall be fully compatible with LED dimming driver and be approved by the driver manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.

C. Provide single-pole or three-way, as shown on the drawings.

D. Manual dimming control faceplates shall be ivory with stainless cover plate unless otherwise specified.

2.4 WALL PLATES

A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.

B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

C. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.

D. Duplex Receptacles on Emergency Circuit: Wall plates shall be red nylon with the word "EMERGENCY" engraved in 6 mm (1/4 inch) white letters

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC and as shown as on the drawings.

B. Install wiring devices after wall construction and painting is complete.

C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.

D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.

E. Provide barriers in multigang outlet boxes to comply with the NEC.

F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with equipment.

G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.

H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.

I. Install wall dimmers 1.2 M (48 inches) above floor.

J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install at 48” above floor where indicated on the drawings. Install specific-use receptacles at heights shown on the drawings.

K. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

L. Label all receptacles and switch plates with the panel name and circuit number serving it. Example: 10S1-5. Labels to be self adhesive type with clear background and black letters, 3/16 inch high letters.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform manufacturer’s required field checks in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Inspect physical and electrical condition.

b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.

c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

d. Test GFCI receptacles.

---END---

SECTION 26 29 11
MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of motor controllers, including all low- and medium-voltage motor controllers and manual motor controllers, indicated as motor controllers in this section, and low-voltage variable speed motor controllers.

B. Motor controllers, whether furnished with the equipment specified in other sections or, shall meet this specification and all related specifications.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium-voltage cables and terminations.

C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

a. Submit sufficient information to demonstrate compliance with drawings and specifications.

b. Include electrical ratings, dimensions, weights, mounting details, materials, overcurrent protection devices, overload relays, sizes of enclosures, wiring diagrams, starting characteristics, interlocking, and accessories.

2. Manuals:
   a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
      1) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
      2) Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.
      3) Elementary schematic diagrams shall be provided for clarity of operation.
      4) Include the catalog numbers for the correct sizes of overload relays for the motor controllers.
   b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
   a. Certification by the manufacturer that the motor controllers conform to the requirements of the drawings and specifications.
   b. Certification by the Contractor that the motor controllers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

519-92.....Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

C37.90.1-02.....Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

C. International Code Council (ICC):

IBC-12.....International Building Code

D. National Electrical Manufacturers Association (NEMA):

ICS 1-08.....Industrial Control and Systems: General Requirements
ICS 1.1-09.....Safety Guidelines for the Application, Installation and Maintenance of Solid State Control
ICS 2-05.....Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts
ICS 4-05.....Industrial Control and Systems: Terminal Blocks
ICS 6-06.....Industrial Control and Systems: Enclosures
ICS 7-06.....Industrial Control and Systems: Adjustable-Speed Drives
ICS 7.1-06.....Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems
MG 1 Part 31.....Inverter Fed Polyphase Motor Standards

E. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)

F. Underwriters Laboratories Inc. (UL):
508A-07.....Industrial Control Panels
508C-07.....Power Conversion Equipment
UL 1449-06.....Surge Protective Devices

PART 2 - PRODUCTS

2.1 MOTOR CONTROLLERS

A. Motor controllers shall comply with IEEE, NEMA, NFPA, UL, and as shown on the drawings.

B. Motor controllers shall be separately enclosed, unless part of another assembly. For installation in motor control centers, provide plug-in, draw-out type motor controllers up through NEMA size 4. NEMA size 5 and above require bolted connections.

C. Motor controllers shall be combination type, with magnetic controller per Paragraph 2.3 below and with circuit breaker disconnecting means, with external operating handle with lock-open padlocking positions and ON-OFF position indicator.

1. Circuit Breakers:
   a. Bolt-on thermal-magnetic type with a minimum interrupting rating as indicated on the drawings.

b. Equipped with automatic, trip free, non-adjustable, inverse-time, and instantaneous magnetic trips for less than 400A. The magnetic trip shall be adjustable from 5x to 10x for breakers 400A and greater.

c. Additional features shall be as follows:

1) A rugged, integral housing of molded insulating material.

2) Silver alloy contacts.

3) Arc quenchers and phase barriers for each pole.

4) Quick-make, quick-break, operating mechanisms.

5) A trip element for each pole, a common trip bar for all poles, and one operator for all poles.

D. Enclosures:

1. Enclosures shall be NEMA-type rated 1, 3R, or 12 as indicated on the drawings or as required per the installed environment.
2. Enclosure doors shall be interlocked to prevent opening unless the disconnecting means is open. A "defeater" mechanism shall allow for inspection by qualified personnel with the disconnect means closed. Provide padlocking provisions.
3. All metal surfaces shall be thoroughly cleaned, phosphatized, and factory primed prior to applying light gray baked enamel finish.

E. Motor control circuits:

1. Shall operate at not more than 120 Volts.
2. Shall be grounded, except where the equipment manufacturer recommends that the control circuits be isolated.
3. For each motor operating over 120 Volts, incorporate a separate, heavy duty, control transformer within each motor controller enclosure.
4. Incorporate primary and secondary overcurrent protection for the control power transformers.

F. Overload relays:

1. Electronic type. Devices shall be NEMA type.
2. One for each pole.
3. External overload relay reset pushbutton on the door of each motor controller enclosure.
4. Overload relays shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

5. Electronic overload relays shall utilize internal current transformers and electro-mechanical components. The relays shall have ambient temperature compensation, single-phase protection, manual or automatic reset, and trip classes of 10, 15, 20 and 30. The relay shall provide fault cause indication, including jam/stall, ground fault, phase loss, and overload.

G. Hand-Off-Automatic (H-O-A) switch is required unless specifically stated on the drawings as not required for a particular controller. H-O-A switch shall be operable without opening enclosure door. H-O-A switch is not required for manual motor controllers.

H. Incorporate into each control circuit a 120 Volt, electronic time-delay relay (ON delay), minimum adjustable range from 0.3 to 10 minutes, with transient protection. Time-delay relay is not required where H-O-A switch is not required.

I. Unless noted otherwise, equip each motor controller with not less than two normally open (N.O.) and two normally closed (N.C.) auxiliary contacts.

J. Provide green (RUN) and red (STOP) pilot lights.

K. Motor controllers incorporated within equipment assemblies shall also be designed for the specific requirements of the assemblies.

L. Additional requirements for specific motor controllers, as indicated in other specification sections, shall also apply.

2.2 MANUAL MOTOR CONTROLLERS

A. Fractional horsepower manual motor controllers shall have the following features:

1. Controllers shall be general-purpose Class A, manually operated type with full voltage controller for fractional horsepower induction motors.
2. Units shall include thermal overload relays, red pilot light, and toggle operator.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Shall be in accordance with applicable requirements of 2.1 above.

B. Controllers shall be general-purpose, Class A magnetic controllers for induction motors rated in horsepower. Minimum NEMA size 0.

C. Where combination motor controllers are used, combine controller with protective or disconnect device in a common enclosure.

D. Provide phase loss protection for each controller, with contacts to de-energize the controller upon loss of any phase.

E. Unless otherwise indicated, provide full voltage non-reversing across-the-line mechanisms for motors less than 75 HP, closed by coil action and opened by gravity.

2.4 LOW-VOLTAGE VARIABLE SPEED MOTOR CONTROLLERS (VSMC)

A. VSMC shall be in accordance with applicable portions of 2.1 above.

B. VSMC shall be electronic, with adjustable frequency and voltage, three phase output, capable of driving standard NEMA B three-phase induction motors at full rated speed. The control technique shall be pulse width modulation (PWM), where the VSMC utilizes a full wave bridge design incorporating diode rectifier circuitry. Silicon controlled rectifiers or other control techniques are not acceptable.

C. VSMC shall be suitable for variable torque loads, and shall be capable of providing sufficient torque to allow the motor to break away from rest upon first application of power.

D. VSMC shall be capable of operating within voltage parameters of plus 10 to minus 15 percent of line voltage, and be suitably rated for the full load amps of the maximum watts (HP) within its class.

E. Minimum efficiency shall be 95 percent at 100 percent speed and 85 percent at 50 percent speed.

F. The displacement power factor of the VSMC shall not be less than 95 percent under any speed or load condition.

G. VSMC current and voltage harmonic distortion shall not exceed the values allowed by IEEE 519.

H. Operating and Design Conditions:

1. Elevation: 1000 feet Above Mean Sea Level (AMSL)
2. Temperatures: Maximum +90°F Minimum 0°F
3. Relative Humidity: 95%

I. VSMC shall have the following features:

1. Isolated power for control circuits.
2. Manually resettable overload protection for each phase.
3. Adjustable current limiting circuitry to provide soft motor starting. Maximum starting current shall not exceed 200 percent of motor full load current.
4. Independent acceleration and deceleration time adjustment, manually adjustable from 2 to 2000 seconds. Set timers to the equipment manufacturer's recommended time in the above range.
5. Control input circuitry that will accept 4 to 20 mA current or 0-10 VDC voltage control signals from an external source.

6. Automatic frequency adjustment from 1 Hz to 300 Hz.
7. Circuitry to initiate an orderly shutdown when any of the conditions listed below occur. The VSMC shall not be damaged by any of these electrical disturbances and shall automatically restart when the conditions are corrected. The VSMC shall be able to restart into a rotating motor operating in either the forward or reverse direction and matching that frequency.
   a. Incorrect phase sequence.
   b. Single phasing.
   c. Overvoltage in excess of 10 percent.
   d. Undervoltage in excess of 15 percent.
   e. Running overcurrent above 110 percent (VSMC shall not automatically reset for this condition.)
   f. Instantaneous overcurrent above 150 percent (VSMC shall not automatically reset for this condition).
   g. Short duration power outages of 12 cycles or less (i.e., distribution line switching, generator testing, and automatic transfer switch operations.)
8. Automatic Reset/Restart: Attempt three restarts after VSMC fault or on return of power after an interruption and before shutting down for manual reset or fault correction, with adjustable delay time between restart attempts.
9. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

J. VSMC shall include an input circuit breaker which will disconnect all input power, interlocked with the door so that the door cannot be opened with the circuit breaker in the closed position.
K. VSMC shall include a 5% line reactor and a RFI/EMI filter.
L. Surge Suppression: Provide three-phase protection against damage from supply voltage surges in accordance with UL 1449.
M. VSMC shall include front-accessible operator station, with sealed keypad and digital display, which allows complete programming, operating, monitoring, and diagnostic capabilities.
   1. Typical control functions shall include but not be limited to:
      a. HAND-OFF-AUTOMATIC-RESET, with manual speed control in HAND mode.
      b. NORMAL-TEST, which allows testing and adjusting of the VSMC while in bypass mode.

2. Typical monitoring functions shall include but not be limited to:
   a. Output frequency (Hz).
   b. Motor speed and status (run, stop, fault).
   c. Output voltage and current.
3. Typical fault and alarm functions shall include but not be limited to:
   a. Loss of input signal, under- and over-voltage, inverter overcurrent, motor overload, critical frequency rejection with selectable and adjustable deadbands, instantaneous line-to-line and line-to-ground overcurrent, loss-of-phase, reverse-phase, and short circuit.
   b. System protection indicators indicating that the system has shutdown and will not automatically restart.

N. VSMC shall include two N.O. and two N.C. dry contacts rated 120 Volts, 10 amperes, 60 Hz.

O. Hardware, software, network interfaces, gateways, and programming to control and monitor the VSMC by control systems specified in other specification sections, including but not limited to Divisions 22 and 23.

P. Network communications ports: As required for connectivity to control systems specified in other specification sections, including but not limited to Divisions 22 and 23.

Q. Communications protocols: As required for communications with control systems specified in other specification sections, including but not limited to Divisions 22 and 23.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor controllers in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.

B. Install manual motor controllers in flush enclosures in finished areas.

C. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and electronic overload relay pickup and trip ranges.

D. Program variable speed motor controllers per the manufacturer’s instructions and in coordination with other trades so that a complete and functional system is delivered.

E. Adjust trip settings of circuit breakers and motor circuit protectors with adjustable instantaneous trip elements. Initially adjust at six times the motor nameplate full-load ampere ratings and attempt to start

motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficiency motors if required). Where these maximum settings do not allow starting of a motor, notify Project Engineer before increasing settings.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
   a. Compare equipment nameplate data with specifications and approved shop drawings.
   b. Inspect physical, electrical, and mechanical condition.
   c. Verify appropriate anchorage, required area clearances, and correct alignment.
   d. Verify that circuit breaker, motor circuit protector, and fuse sizes and types correspond to approved shop drawings.
   e. Verify overload relay ratings are correct.
   f. Vacuum-clean enclosure interior. Clean enclosure exterior.
   g. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
   h. Test all control and safety features of the motor controllers.
   i. For low-voltage variable speed motor controllers, final programming and connections shall be by a factory-trained technician. Set all programmable functions of the variable speed motor controllers to meet the requirements and conditions of use.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the motor controllers are in good operating condition and properly performing the intended functions.

3.4 SPARE PARTS

A. Two weeks prior to the final inspection, provide one complete set of spare fuses for each motor controller.

3.5 INSTRUCTION

A. Furnish the services of a factory-trained technician for two 4-hour training periods for instructing personnel in the maintenance and

operation of the motor controllers, on the dates requested by the Project Engineer.

---END---

SECTION 26 29 21
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.

D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Submit sufficient information to demonstrate compliance with drawings and specifications.
   b. Submit the following data for approval:
      1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
2. Manuals:
   a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.

1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
2) Include information for testing, repair, troubleshooting, assembly, and disassembly.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. International Code Council (ICC):
IBC-12.....International Building Code

C. National Electrical Manufacturers Association (NEMA):
FU 1-07.....Low Voltage Cartridge Fuses
KS 1-06.....Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

D. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
98-07.....Enclosed and Dead-Front Switches
248-00.....Low Voltage Fuses
489-09.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.

B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.

C. Shall be horsepower (HP) rated.

D. Shall have the following features:
1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the open position.
3. An arc chute for each pole.

4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground lugs for each ground conductor.
9. Enclosures:
   a. Shall be the NEMA types shown on the drawings.
   b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
   c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as fused switches, but without provisions for fuses.

2.3 FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES

A. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).

2.4 MOTOR RATED TOGGLE SWITCHES

A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.

B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.5 CARTRIDGE FUSES

A. Shall be in accordance with NEMA FU 1.

B. Feeders: Class RK1, time delay.

C. Motor Branch Circuits: Class RK1,time delay.

D. Other Branch Circuits: Class RK1, time delay.

E. Control Circuits: Class CC, time delay.

2.6 SEPARATELY-ENCLOSED CIRCUIT BREAKERS

A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.

B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer’s instructions, the NEC, as shown on the drawings, and as specified.

B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with specifications and approved shop drawings.

b. Inspect physical, electrical, and mechanical condition.

c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

d. Vacuum-clean enclosure interior. Clean enclosure exterior.

---END---

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.

B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
   b. Material and construction details, include information on housing and optics system.
   c. Physical dimensions and description.
   d. Wiring schematic and connection diagram.
   e. Installation details.
   f. Energy efficiency data.
   g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.

h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).

i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).

j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

2. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American National Standards Institute (ANSI):

C78.1-91.....Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics

C78.376-01.....Chromaticity of Fluorescent Lamps

C. American Society for Testing and Materials (ASTM):

C635-07.....Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

D. Environmental Protection Agency (EPA):

40 CFR 261.....Identification and Listing of Hazardous Waste

E. Federal Communications Commission (FCC):

CFR Title 47, Part 15...Radio Frequency Devices

CFR Title 47, Part 18...Industrial, Scientific, and Medical Equipment

F. Illuminating Engineering Society (IES):

LM-79-08.....Electrical and Photometric Measurements of Solid-State Lighting Products

LM-80-08.....Measuring Lumen Maintenance of LED Light Sources

LM-82-12.....Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

G. Institute of Electrical and Electronic Engineers (IEEE):

C62.41-91.....Surge Voltages in Low Voltage AC Power Circuits

H. International Code Council (ICC):

IBC-12.....International Building Code

I. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

101-12.....Life Safety Code

J. National Electrical Manufacturer's Association (NEMA):

C82.1-04.....Lamp Ballasts – Line Frequency Fluorescent Lamp Ballasts

C82.2-02.....Method of Measurement of Fluorescent Lamp Ballasts

C82.4-02.....Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)

C82.11-11.....Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts

LL-9-09.....Dimming of T8 Fluorescent Lighting Systems

SSL-1-10.....Electronic Drivers for LED Devices, Arrays, or Systems

K. Underwriters Laboratories, Inc. (UL):

496-08.....Lampholders

542-0599.....Fluorescent Lamp Starters

844-12.....Luminaires for Use in Hazardous (Classified) Locations

924-12.....Emergency Lighting and Power Equipment

935-01.....Fluorescent-Lamp Ballasts

1029-94.....High-Intensity-Discharge Lamp Ballasts

1029A-06.....Ignitors and Related Auxiliaries for HID Lamp Ballasts

1598-08.....Luminaires

1574-04.....Track Lighting Systems

2108-04.....Low-Voltage Lighting Systems

8750-09.....Light Emitting Diode (LED) Light Sources for Use in Lighting Products

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.

B. Sheet Metal:

1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Lamp Sockets:

1. Fluorescent: Single slot entry type, requiring a one-quarter turn of the lamp after insertion. Lampholder contacts shall be the biting edge type.

E. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

F. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.

G. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

H. Light Transmitting Components for Fluorescent Fixtures:

1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.

2.2 BALLASTS

A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V), electronic instant-start or programmed-starttype, designed for type and quantity of lamps indicated. Ballasts shall be GE Ultramax with the capability to operate a low wattage 28 watt rated T8 lamp. Ballasts that are operated by occupancy sensors shall be provided with programmed start ballasts only. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated. Ballasts shall include the following features:

1. Automatic lamp starting after lamp replacement.
2. Sound Rating: Class A.
3. Total Harmonic Distortion (THD): 10 percent or less.
4. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
5. Operating Frequency: 20 kHz or higher.
6. Lamp Current Crest Factor: 1.7 or less.
7. Ballast Factor: 0.87 or higher unless otherwise indicated.
8. Power Factor: 0.98 or higher.
9. EMR/RFI Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

2.3 LAMPS

A. Linear T8 Fluorescent Lamps:

1. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between 3500° and 4100°K, a Color

Rendering Index (CRI) equal or greater than 80, average rated life equal to or greater than 24,000 hours when used with an instant start ballast and 30,000 hours when used with a programmed or rapid start ballast (based on 3 hour starts), and be suitable for use with dimming ballasts, unless otherwise indicated.

2. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.

2.4 LED EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA and UL.

B. Housing and door shall be die-cast aluminum.

C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.

D. Finish shall be satin or fine-grain brushed aluminum.

E. There shall be no radioactive material used in the fixtures.

F. Fixtures:

1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.

2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.

3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.

G. Voltage: Multi-voltage (120 – 277V).

2.5 LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.

2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.

3. LED drivers shall include the following features unless otherwise indicated:

a. Minimum efficiency: 85% at full load.

b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)

c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
d. Integral short circuit, open circuit, and overload protection.
e. Power Factor: ≥ 0.95.
f. Total Harmonic Distortion: ≤ 20%.
g. Comply with FCC 47 CFR Part 15.

4. LED modules shall include the following features unless otherwise indicated:
a. Comply with IES LM-79 and LM-80 requirements.
b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
c. Minimum Rated Life: 50,000 hours per IES L70.
d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
B. Align, mount, and level the lighting fixtures uniformly.
C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
D. Lighting Fixture Supports:
1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
4. Hardware for surface mounting fluorescent fixtures to suspended ceilings:
a. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 6 mm (1/4 inch) secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid

members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.

b. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 6 mm (1/4 inch) studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 6 mm (1/4 inch) toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.

c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.

1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.

2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.

d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

7. Surface mounted lighting fixtures:

a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.

b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.

1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.

2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.

3) The outlet box is supported vertically from the building structure.

d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.

8. Single or double pendant-mounted lighting fixtures:

a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.

9. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.

E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.

F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.

G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform the following:

1. Visual Inspection:

a. Verify proper operation by operating the lighting controls.

b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.

2. Electrical tests:

a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the Project Engineer. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.

b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END---

SECTION 26 55 71
MEDICAL AND SURGICAL LIGHTING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of medical and surgical lighting fixtures. The terms “lighting fixtures”, “fixture” and “luminaire” are used interchangeably.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:
   a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
   b. Material and construction details, include information on housing and optics system.
   c. Physical dimensions and description.
   d. Wiring schematic and connection diagram.
   e. Installation and mounting details.
   f. Energy efficiency data.
   g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
   h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
   i. For LED lighting fixtures, submit IES L70 rated life.
2. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the Contractor that the luminaires have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. Illuminating Engineering Society of North America (IESNA):

RP-29-06.....Lighting for Hospitals and Health Care Facilities

HB-10-11.....Lighting Handbook Reference and Application

C. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

99-12.....Health Care Facilities

D. Underwriters Laboratories, Inc. (UL):

60601-03.....Medical Electrical Equipment, Part 1: General Requirements for Safety

1598-08.....Luminaires

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Luminaires shall be in accordance with UL 1598, NEC, NFPA 99, and IESNA RP-29, as shown on the drawings and as specified.

B. Luminaires shall be complete, grounded, fungi-proof, adequately enclosed for asepsis, and designed for use in human operating rooms by a manufacturer that regularly produces such fixtures.

C. Luminaires shall be supplied complete with suspension systems, light heads, transformers, and controls. Components shall be products of a single manufacturer.

D. Suspension components shall not flex during normal use. Articulation of the suspension to any position in its range shall maintain the light head at that point without drift.

E. All exposed surfaces shall be free of burrs and sharp edges. Finishes on all exposed surfaces shall be specifically designed to resist scuffing and deleterious effects of the use of hospital cleaning materials.

F. Except for finished aluminum, stainless steel, chrome, nickel and brass surfaces, all metal surfaces shall be thoroughly cleaned and painted at the factory with a corrosion-resistant primer and not fewer than two coats of lacquer or baked enamel finish and provided with an anti-microbial finish.

G. Maximum leakage current of each light head and its respective control shall not exceed 100 microamperes as measured in accordance with UL 60601-1-03.

2.2 EXAM LIGHTING FIXTURE TYPES

A. Single Ligh thead and Pivot Arm, Single Point Suspension: Shall be an exam light system of the single point suspension type with a single light head unit, mounted from a pivotal arm assembly. Light head shall rotate within a clearance circle of 3624 mm (142.67 inches) to 6544 mm (257.63 inches), depending on light head site horizontal arm selection. Center of light head adjusted vertically from 1190 mm (46.85 inches) to 2250 mm (88.58 inches) above the floor.

2.3 LIGHT HEAD

A. Light head Housing: The light head housing shall be not greater than 760 mm (30 inches) in diameter.

B. Light Source:

1. Light source shall be light-emitting diode (LED) Light-emitting diodes consist of multiple LEDs within a single head.
2. Light source shall have the following characteristics and shall comply with IESNA RP-29:
   a. Minimum illuminance of 4000 foot-candles, measured at 1016 mm (40 inches) from the light source.
   b. Correlated Color Temperature (CCT) of between 4000 and 4500 degrees Kelvin.
   c. Color Rendering Index (CRI) shall be a minimum of 92, as measured on the ASTM E308 chromaticity diagram.

C. Focus and pattern size shall be adjustable either by raising and lowering the unit, and/or through operation of focus controls which change the pattern size without movement of the unit. D. Shadow Reduction: The unit shall provide minimum of 10% of its intended illumination inside and at the bottom of a tube 50 mm (2 inches) in diameter and 75 mm (3 inches) long, finished flat black inside from a distance of 1000 mm (39 inches) when the beam is obstructed by a disc 250 mm (10 inches) in diameter, 580 mm (23 inches) above the operating table and normal to the axis of the tube.

E. Control Handle: The control handle shall be located beneath each light head and shall be easily removable for sterilization. Handle shall accommodate third-party disposable handle adapters.

2.4 LIGHT CONTROLS

A. Provide a wall-mounted intensity control unit for each light head and the required backbox for the intensity control unit as required by the manufacturer.

B. The control unit shall provide either a continuously variable range from the maximum foot-candle rating of the light source down to no greater than 5% of this value, or shall be adjustable within this range with a minimum of five discrete steps. LED dimming range shall be a minimum of 100% to 30%.

C. The minimum wall control box functions shall include an on-off switch, intensity adjustment, and endoscopic light actuation located outside the sterile field. Controls shall move in a free, smooth, and silent manner without drifting, regardless of position.

D. The controls shall have adequate radio frequency suppression appropriate for applications where sensitive electronic medical equipment is used.

E. Each unit shall be readily removable from its wall box for servicing or replacement, utilizing electrical plug connections.

F. In the event of a control unit fault, the unit shall default to maximum intensity of illumination.

G. Where light source is a single primary lamp with automatic secondary lamp, controls shall include a “reserve lamp in use” indicator or similar.

2.5 LIGHT SUSPENSION

A. Vertical arm members and suspension tubes: Shall be constructed of high-strength steel or heavy-gauge aluminum for rigidity. Coordinate

vertical lengths with the ceiling height of the room where each fixture will be installed to provide the proper positioning of the light head or light head arm assembly within the unit's range of vertical mobility as recommended by the manufacturer. Attach the suspension to structure with bolts and metal inserts (power-set fasteners will not be accepted) as required by the manufacturer and/or structural calculations.

B. Horizontal Arm Assemblies:

1. Each light head shall be mounted from a two-section, essentially horizontal, counter-balanced arm assembly which pivots in either direction 360 degrees continuously about the ceiling attachment tube axis, and a minimum of 350 degrees about its midpoint, permitting positioning of the light head assembly approximately under the ceiling axis or outside of the sterile area. In systems with multiple arms attached to the same mount, each individual arm and light head shall operate independently and be mounted such that they can be positioned outside the sterile area, bypass each other, and be raised, lowered, and rotated. In the multi-arm installation, at least one of the light heads shall be positionable directly under the ceiling axis.
2. The lower arm member shall pivot vertically to permit raising and lowering the light head. It shall be possible to limit the travel such that the electrical components of the lamp assembly (or assemblies) will not adjust below 1500 mm (59 inches) from the finished floor. When maintained in the horizontal position, the light head shall be adjustable to a minimum of 2200 mm (86.61 inches) above the finished floor, as measured to the lowest point of the optical assembly (lens or reflector) from which the final light beam is emitted. The component parts of the joint between the upper and lower support arms shall be at least 2000 mm (80 inches) above the floor.
3. The light head shall be attached to the lower arm assembly through a dual-bow pivot system that allows light head rotation in all directions without the need to rotate the suspension arms.
4. The clearance circle of each light head about its pivot center shall be at least 3550 mm (140 inches) in diameter.

C. Ceiling Mount Assembly, Single Point Suspension: The mounting assembly shall support the complete fixture unit by attachment to the structural ceiling. Vertical portions of the mount assembly between the

structural ceiling and a suspended ceiling shall be cross-braced as part of the installation to prevent lateral movement. The exposed portions of the attachment assembly, or the hole where the ceiling mount tube passes through the false ceiling, shall be covered by a gasketed spun aluminum or sturdy plastic trim canopy designed to make a tight seal with the ceiling. The mount assembly shall be installed in accordance with the manufacturer's recommendations, with required fasteners for a stable and rigid system. The assembly shall be capable of supporting the weight of the entire unit plus the weight of additional light head assemblies in the future, as calculated by standard manufacturer's modification.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with NEC, as shown on the drawings, and in accordance with the manufacturer's recommendations.

B. Coordinate the components electrically and mechanically with the ceiling heights and plenum depths and with other equipment, such as radiology equipment, ductwork, service drops, and like items, in the room where each fixture will be installed.

C. Mount the controls with the bottom of the control 15 mm (59 inches) above the finished floor.

D. For remote transformer installation, ensure that the wiring distance is not more than that allowed by the manufacturer.

E. Upon completion of the installation, conduct an operating test in the presence of the Project Engineer to demonstrate that each surgical lighting fixture meets the requirements of this specification. Perform all of manufacturer's recommended visual and physical performance checks.

3.2 SPARE LAMPS AND STERILIZABLE HANDLES

A. Furnish three sterilizable handles for each exam light unit.

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SECTION 27 10 05
COMPUTER NETWORK AND TELEPHONE WIRING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

This section includes the furnishing and installation of the following:

A. Raceway distribution system.

B. Computer and telephone wiring.

C. Workstation communications outlets.

D. Data rack and patch panels.

E. Backbone telephone and fiber optic cable for in building wiring.

F. Horizontal cabling patch panels.

G. Premise testing.

H. Equipment.

1.2 RELATED SECTIONS

A. Section 26 05 11 – Requirements for Electrical Installations

B. Section 26 05 33 – Raceway and Boxes for Electrical Systems

C. Section 26 27 26 – Wiring Devices.

1.3 REFERENCES

A. ANSI/TIA/EIA 568A - B.1, B.2, B3 Commercial Building Telecommunications Cabling Standard.

B. ANSI/TIA/EIA 569A Commercial Building Standard Telecommunications Pathways and Spaces.

C. ANSI/TIA/EIA 606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

D. NFPA 70 National Electrical Code.

E. BICSI TDMM (Building Industry Consulting Service International, Telecommunications Distribution Methods Manual and Telecommunications Cabling Installation Manual).

1.4 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 26 05 11.

B. As-built record drawings to be provided to Owner/Engineer before final payment.

1.5 SHOP DRAWINGS

A. Submit in accordance with Section 01 33 23.

B. Submit conductors, jacks, racks, and patch panels.

1.6 SYSTEM DESCRIPTION

A. Horizontal and workstation pathways conform to ANSI/EIA/TIA 569A, using raceway and patch panels as indicated.

B. Premise Wiring: Horizontal and workstation complete from communication room to each outlet, using conductors and other equipment as specified.

C. All premise wiring to be of one manufacturer.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with BICSI TDMM and ANSI/EIA/TIA standards.

1.8 QUALIFICATIONS

A. Installer: Company specializing in installing data communications wiring with minimum of three years project experience and BICSI certified as an installer at start of installation.

B. Installer: Must submit documentation of qualifications before start of installation.

1.9 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 and applicable building codes.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.10 MAINTENANCE/WARRANTY

A. Manufacturer shall warranty and provide maintenance service for 15 years minimum on the network system and a lifetime for products used in the system.

B. Submit documentation stating warranty at project closeout.

1.11 COPPER AND FIBER OPTIC CONDUCTOR CABLE TESTING

A. Contractor shall perform and document all conductor tests. Return one copy of testing report to the Engineer and one copy to the Owner.

B. All Category 6 Enhanced conductors, Category 3 backbone cables and fiber optic cables shall be tested and certified for ANSI/EIA/TIA, 568A, TSB-67 standards and ANSI/TIA/EIA-TSB-95.

C. All copper station runs must be tested after final installation and termination. All data cable runs shall be documented with a hard copy printout of the test results. This printout shall be bound and delivered to the Owner prior to final payment.

D. The Owner requires that the Scope/HP Wirescope 350 Level III, or approved equal tester be utilized for all copper data testing.

E. The Owner requires that the company/individual testing the cable be manufacturer certified for products provided.

PART 2 - PRODUCTS

2.1 CONDUIT AND OUTLETS

A. As specified in Section 26 05 33 – Conduit Systems.

B. Conduit Size: Minimum 3/4 inch with larger sizes where noted on Drawings.

C. Four-inch square box with single gang plaster ring.

2.2 OUTLET COVER PLATES

A. As specified in Section 26 27 26 – Wiring Devices.

B. Cover Plate: Ivory.

2.3 WORKSTATION COMMUNICATIONS OUTLETS

A. Connector modules shall be equal to Panduit CJ6X88TGEI to match existing Fargo VAMC standard.

1. ANSI/TIA/EIA-T568B wiring configuration.
2. Category 6 Enhanced (500 MHz) power sum connector. Modular faceplates shall be Panduit Mini-Com Executive Series faceplates.
   a. One, two, four and six-port single gang and 10-port double gang faceplates as required. Panduit part numbers CFPE1-IW, CFPE2-IW, CFPE4-IW, CFPE6-IW, and CFPE10IW-2G.
3. Standard Color: Orange for data connectors, ivory for telephone connectors.
4. See Drawings for quantity of connector modules and modular faceplates.
5. Modular Furniture Faceplates: Provide Panduit CFFPL4BL four module space modular furniture snap-in faceplate with labels for installation in modular furniture where shown on the drawings. Faceplate to be compatible with the brand of modular furniture.

2.4 COPPER CONDUCTOR

A. Manufacturer: Equal to General Genspeed 6000E.

1. Category 6 Enhanced.
2. Four twisted pair non-shielded.
3. 23 gauge solid copper conductors.
4. U.L. listed MPP/CMP.
5. Conductor Resistance: 9.38 ohms/100m nom. @ 20 degrees C.
6. Impedance:
   a. 100±15 ohms 1-100 MHz.
   b. 100±22 ohms 101-250 MHz.
   c. 100±32 ohms 250-500 MHz.
7. ACR based on Power Sum NEXT
   a. >= 15.8 dB/100m @ 200 MHz.
   b. >= 10.7 dB/100m @ 250 MHz.

8. Delay Skew <= 35 ns/100m.

9. NVP = 70% speed of light.

10. Plenum rated cable.

2.5 BACKBONE CABLES

A. Fiber Optic Cables

1. Manufacturer: Optical Cable Corporation (OCC) or equal.

a. Interior Cable: OCC DX series, distribution-style with 900um tight buffered fibers, Super/FDDI-grade, type OFNP nonconductive-plenum-rated cable, flame-retardant PVC jacket, 12-fiber, multimode 62.5/125 um, complying with TIA-492AAAA; covered with orange cable jacket and complying with relevant portions of and addenda to latest edition of TIA/EIA-568.

2.6 CROSS CONNECTION EQUIPMENT

1. Patch Panels for Copper Data Cabling: Sized to fit EIA standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.

a. Equal to Panduit CPP48WBLY 48-port all metal modular patch panel frames, populated with Panduit CJ6X88TGEI modular connectors (as listed in 2.3) Category 6 enhanced power sum connectors.

b. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.

c. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA/EIA-606 using encoded identifiers.

d. Provide incoming cable strain relief and routing guides on back of panel.

e. Equal to Chatsworth 30530-719, HORZ MGR DBL UNIV 2U 19 IN, horizontal wire management panels shall be provided between pairs of CPP48 patch panel frames for front and rear patch cable management and as necessary above and/or below network electronics.

f. Panduit type WMPV22E, VTR CBL MGT 4X FRT/REAR 22RU vertical wire management panels shall be provided on the left and right sides of each rack.

2. Patch Panels for Fiber Optic Cabling: Sized to fit EIA standard 19 inch wide equipment racks; 0.09 inch thick aluminum.
   a. Equal to Panduit FRME24BL 24-port rack mount fiber panel with FAP-6W ST multimode ST adapter plate. Provide Panduit FWME8 series wall mount enclosures for wall mount applications.
   b. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA/EIA-606 using encoded identifiers.
   c. Provide incoming cable strain relief and routing guides on back of panel.
   d. Provide rear cable management tray at least 8 inches deep with removable cover.
   e. Provide dust covers for unused adaptors.
   f. Patch Cords: Provide one patch cord for each pair of patch panel ports.

2.7 ENCLOSURES

A. Equipment Racks and Cabinets: CEA-310 standard 19 inch wide component racks.
   1. Floor Standing Racks: 16 gauge steel construction with corrosion resistant finish, fixed 19" EIA threaded equipment rails, vertical and horizontal cable management and grounding lug.
      a. Manufacturer: Equal to Hoffman E4DR19FM Series.
      b. 84” high, standard 19” two post data rack meeting EIA-310-D standards. Aluminum construction, 45 Rack Spaces.
      c. Wire Management: Provide matching horizontal and vertical cable management for rack and all installed components.
      d. Provide UL listed horizontal power strip, single input, 120V single phase, 20 amp rated, (8) NEMA 5-20R outlets and an integral circuit breaker and 10 foot cord with NEMA 5-20P plug equal to Chatsworth 12816 Series in all data racks.
      e. Provide cable drop out or cable exit accessories for connecting rack to cable tray. Secure cable try to each rack.

B. Plywood Termination Board: ¾ inch thick, fire rated CDX plywood with smooth finish on one side, painted with gray intumescent paint. A minimum of one fire rating label on the plywood to remain visible.

2.8 FIRESTOP

A. Provide a firestop system with an "F" rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

1. For penetrations by non-combustible items including steel pipe, copper pipe, rigid steel conduit, and electrical metallic tubing (EMT), the following are acceptable:
   a. Hilti FS 601 elastomeric firestop sealant or Fs 605 HP firestop sealant.
   b. 3M fire barrier CP25.
   c. Nelson CLK firestop sealant.
   d. Approved equal.
2. For fire-rated construction joints and other gaps, the following may be used:
   a. Hilti FS 601.
   b. 3M fire barrier CP25.
   c. Nelson CLK firestop sealant.
   d. Approved Equal.
3. For penetrations by combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable, or cable bundles, and plastic pipe (closed piping systems), the following are acceptable:
   a. Hilti FS 611A intumescent firestop sealant.
   b. 3M fire barrier CP 25.
   c. 3M fire barrier FS-195 wrap strip.
   d. Nelson FSP firestop putty, PCS pipe choke system.
   e. Approved Equal.
4. For large complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways or raceways, the following are acceptable:
   a. Hilti FS 635, trowelable firestop compound.
   b. 3M fire barrier CS-195 composite sheet.
   c. Nelson CPS composite sheet, CMP firestop compound.
   d. Approved equal.

2.9 COMPUTER CABLE SUPPORT HANGERS

A. J-hooks shall be equal to Erico Caddy Fastener type CableCat.

1. Erico Caddy Fastener type CableCat Cat21 J-hook shall be used for up to 50 4-pair communication cables.

2. Manufacturer guidelines shall be used for supporting/mounting CableCats.
3. Cable shall be supported at no greater than four-foot intervals.
4. Utilize cable hooks only to span across corridors or rooms to route cables to cable tray as shown on the plans.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support raceways under the provisions of Section 26 05 11.
B. Install cable from all computer and telephone outlets to rack or backboard.
C. Install modular outlets at all locations shown on the Drawings. Terminate wiring at both ends.
D. Provide cable supports as required in a neat workmanlike manner.
E. Color coding of wiring is to be consistent between connector modules and connector blocks.
F. All cabling shall consist of 4 pair, 1 cable per jack.
G. Install cable in accordance with manufacturer's instructions and in accordance with ANSI/EIA/TIA 568A standards. Cable maximum bend radius shall not exceed four (4) times the outside cable diameter.
H. Bridged taps/splices are not allowed as part of the horizontal wiring system.
I. Each workstation jack shall be provided with its own UTP cable continuous (without splice) from jack to computer rack or telephone backboard.
J. All penetrations through fire barrier walls or floors shall consist of a conduit sleeve and shall be sealed with an industry approved fire barrier caulk or compound reamed and bushed.
K. All vertical/horizontal sleeves shall be sized according to station count passing through each. Sized for maximum 60 percent fill.
L. Install cable support hooks a maximum of 4'-0" on center above ceiling.
M. All vertical/horizontal raceways shall be sized according to station count passing through each. Sized for maximum 60 percent fill.
N. Install a 3/4 inch conduit, minimum from each workstation outlet continuous to the nearest cable tray location in the corridor ceiling.
O. Terminate all data cabling on data rack patch panels and all telephone cables on 110 blocks on the telephone backboard.
P. Terminate all backbone cables in both the new and existing data rack locations Coordinate termination requirement with the VA Project

Engineer. The fiber optic backbone cables shall be terminated in new fiber optic patch panels.

3.2 GANGING WORKSTATION JACKS

A. Where indicated, workstation jacks may be ganged under a common one gang wall plate. Where the plans show multiple outlets at one location they may be ganged into one wall plate.

3.3 LABELING

A. All horizontal cabling shall be labeled at both ends with permanent tag indication from which jack the cable originated.

B. Machine labels shall be installed on each workstation jack faceplate and at the patch panels.

C. All labels shall be a machine label in conformance with ANSI/EIA/TIA 606.

D. Numbering of workstation jacks shall be consistent and match existing Veterans Administration standard.

E. Labeling to be verified with Engineer and Owner.

3.4 CUTTING, PATCHING AND FINISHING

A. Perform all cutting, patching and finishing required for installation of electrical work. Restore surfaces to original condition.

B. Cutting, patching and finishing work is subject to the direction and approval of the Engineer.

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SECTION 27 41 32
TELEVISION WIRING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Television distribution equipment.

B. Cable and accessories.

1.2 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2011.

1.4 SYSTEM DESCRIPTION

A. Premises wiring for broadband distribution of television signal, including individual outlets.

B. Provide a broadband television distribution system as described herein. The system shall support the distribution of broadband signals from various sources including but not limited to programming from local cable provider, city offices, satellite receivers as well as programming generated locally.

C. The contractor shall provide all necessary amplifiers, cables, connectors and hardware for a complete and functional broadband television distribution system.

D. Signal at each outlet: 3 dBmV across 75 ohms, minimum, plus 5 dB, minus 0 dB.

1.5 PERFORMANCE REQUIREMENTS

A. The broadband television distribution system shall be installed to meet the following requirements:

1. Carrier to noise ratio must be greater than 55dB.
2. Cross-modulation no less than -57dB.
3. Operating band width on all passive devices shall be between 5 MHz and 1000 MHz.
4. Composite second order distortion less than -60dB.
5. Composite triple beat distortion less than -60dB.
6. The amplitude difference between two adjacent channels shall be no greater than 2dB.
7. The system shall be free of any signal leakage.
8. The RF signal level at any outlet shall be no greater than +15dB and no less than +5dB.

9. Isolation between any two outlets shall be a minimum of +20dB for any frequencies between 5MHz and 1000 MHz.

1.6 SUBMITTALS

A. See Section 01 33 23 - for submittal procedures.

B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show installation details, cable routing, and system configuration.

C. Product Data: Provide showing electrical characteristics and connection requirements for each component.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Project Record Documents: Record actual locations of outlets, devices, and cable routing.

F. Maintenance Data: Basic trouble-shooting procedures.

1.7 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70 and cable television utility company.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of project.

C. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.

D. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 100 miles of the project.

E. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of television system for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 AMPLIFIERS AND CONVERTERS

A. Manufacturers:

1. Equal to Blonder Tongue Laboratories, Inc: www.blondertongue.com.
2. VHF Amplifier: Provide broadband amplifier, wall mounted.
    a. Impedance: 75 ohm.
    b. 50 to 750 MHZ Bandwidth.
    c. 30 dB gain.

d. 120 volt input power.

2.1 ACCESSORIES

A. Splitter:

1. Equal to Blonder Tongue SXRS series.
2. Frequency Response: 5 - 1000 MHZ.
3. Isolation: 21 dB minimum.
4. Return Loss: 16 dB minimum.
5. Insertion Loss: 6.8 dB maximum.
6. RFI shielding: 120 dB minimum.
7. Quantity as required for television locations as shown on drawings. Provide a cable from each outlet to the new electrical room and connect to the existing television cable signal in the area.

B. Receptacles:

1. Manufacturer: Equal to Panduit CMFSR series.
2. Mini-com self-terminating F connector.
3. Provide with matching Panduit Mini-Com faceplate, color to match devices specified in Section 27 10 05.

C. Main Distribution Cable:

1. Description: RG 11/F. Plenum rated.
2. Product: Commscope or equal.

D. Branch Distribution Cable:

1. Description: RG 6/F. Plenum rated.
2. Product: Commscope or equal.

E. Conduit

1. As specified in Section 26 05 34 - Conduit.
2. Size: Minimum 3/4 inch with larger sizes where noted on drawings.

F. Outlets

1. As specified in Section 26 05 37 - Boxes.
2. Four-inch square box with single gang plaster ring.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide proper grounding of television system components and wiring.

C. Provide raceway system or utilize cable tray system for all cable.

D. Provide cable continuous from the outlets to the electrical room splitter locations. Provide a trunk cable from the incoming signal cable to the electrical room. Install a new amplifier in the electrical room and connect to the nearest trunk cable on second floor.

E. System connections will be made to provide the features described and specified herein.

F. Additional connections and cabling may be required to provide a complete system.

G. System connections will be made to provide the features described and specified herein. Additional connections and cabling may be required to provide a complete system.

H. Cabling terminated at each piece of equipment shall be cut to length and terminated with the appropriate connector. The use of tie wraps is necessary to maintain the cabling in a neat manner.

I. Equipment utilizing screw terminals shall have the conductors tinned prior to tightening into the terminals.

J. Cable should be run in one piece without splices made. In the event a splice is absolutely necessary it shall be done to provide proper impedance. Video cable shall use a female to female BNC type barrel with crimped BNC connectors on each end. Splices must be accessible and not internal to conduit as per code regulations

K. All National, State and Local Electrical, Fire and Building Codes apply to this project. The contractor must be aware of and adhere to these codes. The Owner shall not be liable for failure of the contractor in the following code. Any portion of the installation that does not meet code shall be removed and re-installed up to code shall be removed and re-installed up to code by the contractor at their own expense.

L. All cables and T.V. outlet plates shall be labeled by number or origination and termination designation. Labels must be permanent and legible. Peel off numbers is not acceptable unless clear heat shrink is used over the numbers.

M. Provide firestop for all penetrations in accordance with section 26 05 33 and 27 10 05.

3.2 MANUFACTURER'S FIELD SERVICES

A. Provide services of manufacturer's technical representative to prepare and start systems and supervise final adjustments and tuning of system.

3.3 ADJUSTING

A. Adjust work under supervision of manufacturer's field service personnel.

B. Measure signal level at each outlet. Adjust amplifier gain and make other system adjustments to achieve specified output levels at each outlet.

3.4 DEMONSTRATION

A. Conduct walking tour of project and briefly describe function, operation,

and maintenance of each component.

B. Include demonstration of color television operation specified signal level at two outlets selected by Owner.

- - - END - - -

SECTION 27 51 25

PUBLIC ADDRESS SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Provide a complete and functional paging system as shown on the drawings and specifications. All material including installation material shall be provided in its entirety whether or not enumerated on the drawings including relays, isolation transformers and termination materials.

1.2 RELATED WORK

A. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

1.3 DESCRIPTION OF SYSTEM

A. The paging system is to provide audio reproduction of voice announcements via the telephone system. The new reproduction devices shown on the drawings shall be connected to the existing system as indicated on the drawings.

1.4 SHOP DRAWINGS

A. Submit in accordance with Section 01 33 23.

B. Clearly indicate dimensions, schematic diagrams, electrical characteristics, electrical connections, power requirements, cabling and conduit size requirements.

C. Submit a detailed manufacturer's data sheet on all equipment and components to be provided.

1.5 QUALITY ASSURANCE

A. U.L. listed components.

B. All components and the system will conform to the minimum applicable standards issued by EIA. All work in conjunction with this installation will meet the provisions of the National Electrical Code and other applicable codes.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver to the job site in standard shipping containers. Leave labels intact.

B. Store in dry area, protected from the weather. Maintain temperature above freezing.

1.7 INSTALLATION

A. All system components and cables must be electronically balanced in nature.

B. All cable must be arranged in a neat and orderly fashion using trimmed tie wraps and must be fasten securely to prevent them from physical damage and to minimize visibility.

C. Speaker mounting hardware used should be installed as per the manufacturer's recommendations.

D. The systems should be connected to the paging system and configured to allow paging override for massaging.

E. Adjust the transformer taps on all new speakers to provide even sound pressure levels in all spaces indicated as having paging coverage.

PART 2 PRODUCTS

2.1 PAGING SYSTEM COMPONENTS

A. Ceiling Mount Distributed Speaker - Recessed Mounted

1. Manufacturer: Atlas Sound C803A or equal compatible with existing Fargo VA public address systems.
    a. 2-way coaxial mounted, 120 degree coverage, 8 inch LF driver with 3 inch HF driver, with 70 Volt, 16 watt multi-tap transformer. 70 Hz to 15 kHz frequency response. Sensitivity of 98 dB at 1 watt, 1 meter.
    b. Back box - Atlas Sound 191-78-8 with 164-8 baffle or equal. Baffle to me white in color to match ceiling.
2. Provide where shown on the drawings with required tile bridges and mounting hardware.

2.2 OUTLETS

A. As specified in Section 26 05 33 – Raceway and Boxes for Electrical Systems.

B. 4-inch square box, 2 1/8 inch deep with single gang ring for mic/aux. jacks.

2.3 CABLE

A. 70 Volt Distributed Speaker Cable: 18 AWG two conductor speaker cable with 100% overall aluminum shield and drain wire. Cable shall be equal to West Penn 293. In plenum spaces use West Penn 25293 or equal.

PART 3 EXECUTION

3.1 GENERAL

A. All conductors will be installed in conduit, 3/4 inch minimum.

B. Terminations will be made using screw type terminals, push-on terminal boards, multi-pin connectors or solder lugs with good, clean solder joints. Under no circumstances are any terminations to be taped.

C. All incoming cables will be clearly marked as to origin with printed heat shrink tubing. All mic level cables to be labeled with white tubing and black print, line level cables with blue tubing and black print, and speaker level with yellow tubing and black print.

D. Equalize sound system and adjust transformer taps for adequate paging coverage in all areas.

E. All non-speaker level audio lines must be continuous, shielded cable. All termination of such lines must be made in accordance with manufacturer's specifications for the given electronic devise. All terminations made at wall plates or cable connectors must be solder type.

F. All equipment power and signal wiring shall conform to NEC and all state and local codes.

- - - **END** - - -

SECTION 27 52 23

NURSE CALL SYSTEM

PART 1 - GENERAL

1. 1 SUMMARY

A. Work covered by this document includes design, engineering, labor, material and products, equipment warranty and system guarantee, training and services for, and incidental to, the complete installation of new and fully operating National Fire Protection Association (NFPA) – Life Safety Code 101.3-2 (a) Labeled and (b) Listed, Emergency Service Nurse-Call and/or Life Safety listed Code Blue Communication System and associated equipment (here-in-after referred to as the System) provided in approved locations indicated on the contract drawings. These items shall be tested and certified capable of receiving, distributing, interconnecting and supporting Nurse-Call and/or Code Blue communications signals generated local and remotely as detailed herein.

B. Provide a complete working Nurse Call System based upon the specification outlined here to include all necessary devices that provide the functions listed in this specification. This facility will be referenced as the OWNER in this specification.

C. The Contractor for this project will be required to coordinate with concurrent construction projects in progress at the Fargo VAMC site. Coordinate closely with other Contractors and trades where work areas may overlap.

D. If an operational function is specified that requires hardware or software to complete that specific function, then consider that software or hardware part of this specification. The cost of any omissions of software or hardware necessary to complete all operational functions outlined in this specification shall be borne by the contractor providing this system.

E. The term “provide”, as used herein, shall be defined as: designed, engineered, furnished, installed, certified, tested, and guaranteed by the Contractor.

F. Specification Order of Precedence: In the event of a conflict between the text of this document and the Project’s Contract Drawings outlined and/or cited herein; THE TEXT OF THIS DOCUMENT TAKES PRECEDENCE. HOWEVER, NOTHING IN THIS DOCUMENT WILL SUPERSEDE

APPLICABLE EMERGENCY LAWS AND REGULATIONS, SPECIFICALLY NATIONAL AND/OR LOCAL LIFE AND PUBLIC SAFETY CODES. The VA Public Safety Officer is the only authority that may modify this document's EMERGENCY CODE COMPLIANCE REQUIREMENTS, on a case by case basis, in writing and confirmed by VA's Project Engineer. The VA Contracting Officer is the only approving authority for other amendments to this document that may be granted, on a case by case basis, in writing with technical concurrencies by VA's identified Facility Project Personnel.

G. All Nurse Call System devices shall be UL-1069 listed. This includes routers, hubs, switches, and room control devices. The nurse call network shall be an FDA Registered Class II (or higher) medical device and the system's manufacturer shall be an FDA Registered Operator. Field wiring shall be CAT 6e cable, control wiring for power distributions and very long runs, and utilize an optional fiber backbone (when distances exceed normal Ethernet limitations). All station equipment shall use plug on connectors and all switches, routers and controllers shall utilize standard RJ-45 modular connections. All remote devices utilizing standard structured cabling shall be capable of PoE (Power over Ethernet) or power supplied within the CAT 6e cable jacket. Systems which require separate DC power to devices, remote power supplies, or heavy DC wiring to each individual room shall not be accepted. Wiring shall be capable of either being installed in conduit or cable trays, where shown on the plans. Nurse Communications cabling may be run along with other low voltage and data cables where permitted by code. Nurse Communications cabling to be separated out from any high voltage AC or DC wiring that exceeds 90 volts, or which violates any national or local electrical code.

H. If an operational function is specified that requires hardware or software to complete that specific function, then consider that software or hardware part of this specification. The cost of any omissions of software or hardware necessary to complete all operational functions outlined in this specification shall be borne by the contractor providing this system.

I. The system must be UL 1069 listed as a Nurse Communications Network. Systems listed by other nationally recognized testing laboratory may not be accepted. The system shall be capable of interconnecting with

the hospital’s LAN (Local Area Network). This connection shall be minimal and utilize only one Ethernet 100 Mbps (or optionally 1 Gb) connection to accomplish all ADT, hospital information, reporting software and information exchange. The HL-7 standard shall be utilized for receipt of patient information..

J. All software applications shall be HIPAA and PIPEDA compliant and shall allow for patient name aliases and alternative display methods. Complex user names, expiring passwords, granular permission settings and role based security shall be standard. All databases shall be ODBC compliant, equal to MS SQL 2005.

K. The Nurse Call Communications Network shall utilize VoIP communications between all major components: nurse consoles, staff terminals, telephones and controllers. Any nurse call console and staff terminal must be able to answer any patient call placed in the network. Systems not utilizing the VoIP standard will not be acceptable. The OWNER will not be providing any analog ports to the nurse call network. As part of this contract, the Contractor will supply an interface to the existing telephony system to allow communications between the existing telephone system and the new wireless telephone network being furnished as part of the Nurse Call System and as described in this specification. The capability to assign patients to staff shall be via a networked software infrastructure on new Contractor provided workstations. It shall also be possible to have multiple users logging onto system via barcode or other standard human interface devices. Log on process identifies user and the current device used that day.

L. Ethernet ports will be provided by the Contractor for HL-7 integration to the entire network. Those nurse call systems requiring more than one interface to the live environment will not be acceptable. Additional servers will be provided by the Contractor on an as needed basis for those specific nurse call options that are selected. All servers will be installed in the facilities data center. The Network shall be expandable to any combination of bed, duty, or staff stations and sub-stations connected as a contiguous interconnected system. Multiple buildings and intra-building connections may be linked together utilizing a fiber or copper connection. Audio communications between devices

shall be digital and virtually non-blocking, so as to provide fast, instantaneous communications without queuing or delay.

1. 2 REFERENCES

A. Underwriter's Laboratories UL-1069 current release
B. Canadian Standards Association
C. National Electrical Code
D. NFPA 70 and 99
E. U.S. Dept. of Labor / Occupational Safety and Health Administration
F. State Hospital Code / Joint Commission of Hospitals – Nurse Call Requirements
G. NEMA installation standards

1. 3 RELATED SECTIONS

A. 26 05 19 – Low Voltage Electrical Power Conductors and Cables
B. 26 05 11 – Requirements for Electrical Installations
C. 26 05 26 – Grounding and Bonding for Electrical Systems
D. 26 05 33 – Raceways and Boxes
E. 27 10 05 – Computer Network and Telephone Wiring

1. 4 QUALIFICATIONS

A. Authorized Distributor for product supplied. Authorized Distributor Letter from manufacturer required upon request of specifying authority.
B. The OEM shall have had experience with three (3) or more installations of Nurse Call systems of comparable size and interfacing complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least one (1) year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
C. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.

D. The Contractor's Communications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.

E. Applicable state licenses. Copy available upon request.

F. Certificate of successful completion of manufacturer's installation/training school for installing technicians of the equipment being proposed. Letter from manufacturer stating technician qualifications on request.

G. Certificate of completion of network certifications (i.e. Cisco or Microsoft). Copy available upon request.

1. 5 SYSTEM DESCRIPTION

A. System hardware shall consist of a nurse call network comprised of VoIP nurse consoles, PC consoles, nurse call network controllers, patient stations, power supplies, battery back-up, dome lights, call cords, pull cord stations, emergency push button stations, wiring and other options such as bed side-rail interfaces, VoIP staff terminals, and network adapter module as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network.

B. System hardware and firmware shall be the product of a single, reputable manufacturer with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of one year from date of installation for any product feature enhancements. Manufacturer shall provide a 5 year warranty on all manufactured hardware. All communications shall be full duplex audio to all loud speaking devices, including patient, staff, duty, staff terminals, and pillow speakers.

C. All wall mounted stations shall be flush mounted.

D. All flush mount station buttons shall use a bio-seal cover to facilitate the use of disinfectant cleaners.

E. Entire Network shall be supervised, including all sub-stations. Reporting of station failure shall be to any designated console, PC,

e-mail, or wireless device. Remote diagnostics shall be utilized to quickly locate the source of the problem.

F. Nurse call network shall support a VLAN configuration to separate activity in the nurse call network from other hospital LAN traffic.

G. The nurse call network shall support a GUI interface that sits on the nurse call LAN. This interface consists of multiple modules such as staff assignment, PC call display, call detail recording, exception reporting, etc.

H. The nurse call network shall support call processes to facilitate work flow and call escalations to various staff and or groups.

I. Nurse call network shall support a wireless telephone device via an open architectural interface.

J. Nurse call network shall support any data backup system.

1. 6 SUBMITTALS

A. Each submittal shall consist of the following:

1. Name of supplying contractor and project name.
2. In the following order, a listing of: component quantities, equipment manufacturer, model number, and description of each component being supplied.
3. Recently dated (within one year from submittal date) support letter from manufacturer stating that the supplying contractor is an Authorized Distributor of the product being supplied.
4. Statement that warranty hardware from manufacturer for 5 years or statement of vendor extending manufacturer’s original warranty to 5 years.
5. Copy of the installing technician(s) certificate of completion from the manufacturer’s training school for the equipment being proposed.
6. Provide a list of recommended spare parts to maintain all systems specified after the warranty period.
7. One catalog sheet per product of equipment. Each catalog sheet shall describe mechanical, electrical and functional equipment specifications. The catalog sheet must also include a photograph of the product.

8. Provide all inter-equipment wiring diagrams and drawings necessary to install the equipment being supplied. These drawings will show all wiring types by wire gauge, conductors and wire manufacturer. These drawings must be updated prior to completion of any work to reflect changes that may have been made during actual installation. Drawings shall include the floor plan, all device locations and all wiring requirements and conduit sizes. Drawings to be submitted in ACAD version compatible with Autocad software currently is use at the Fargo VA.

1. 7 SCHEDULING

A. It is the responsibility of the contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The OWNER will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1. 8 WARRANTY

A. The supplying contractor shall provide a warranty on the complete system which shall include all necessary labor and equipment to maintain the system(s) in full operation for a period of one year from the date of complete system acceptance.

B. In addition, the equipment (parts) warranty for the complete system including all core system components, control / switching equipment, power supplies, patient stations, sub-stations, and nurse consoles shall extend to a total of at least five (5) years. Warranty for ancillary devices such as pillow speakers and call cords shall extend to a total of at least two (2) years.

C. Manufacturer shall provide, free of charge, product firmware upgrades throughout the 1 year warranty period for any product feature fixes.

D. The contractor shall respond and correct on-site trouble calls:

1. A routine trouble call within one (1) working day of its report. A routine trouble is considered a trouble which causes a pillow speaker or cord set, one (1) master nurse control station, patient station, emergency station, or dome light to be inoperable.

2. Routine trouble calls within 4 hours in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The Contracting Officer shall notify the Contractor of this type of trouble call.
3. An emergency trouble call within four hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, or code one system to be inoperable at any time.
4. If a Nurse Call and/or Code Blue/ component failure cannot be corrected within four (4) hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate nurse call equipment. The alternate equipment/system shall be operational within a maximum of 20 hours after the four (4) hour trouble shooting time and restore the effected location operation to meet the System performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the System or sub-system to full operational capability, as described herein, until repairs are complete.

E. After the acceptance of the system(s) service shall be provided for emergency service and routine service. Emergency service shall be provided 24 hours a day. When a total or catastrophic failure of equipment is reported to contractor, within 2 hours of notification, a service person will be on site. Routine service shall be provided within 4 business hours (9 a.m. to 5 p.m., Monday through Friday, excluding holidays) of notification. When a minor failure of equipment is reported to contractor, a service person will be on site within 24 hours of notification.

1. 9 MAINTENANCE

A. Provide necessary spare parts after commissioning of system(s) and prior to final payment.

1. 10 PROJECT CLOSE-OUT

A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.

B. Before the project closeout date, the Contractor shall submit:

1. OEM Equipment Warranty Certificates.
2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
3. Project record documents.
4. Instruction manuals and software that is a part of the system.
5. System Guaranty Certificate.

C. Contractor shall submit written notice that:

1. Contract Documents have been reviewed.
2. Project has been inspected for compliance with contract.
3. Work has been completed in accordance with the contract.

PART 2 PRODUCTS

2. 1 MANUFACTURERS

A. The products specified shall be new and of the standard manufacture of a single reputable manufacturer.

B. Ascom Telligence Series or equal. The system provided in this project shall interface with the existing Ascom Telligence system currently installed in the adjacent Operating Suite, and shall communicate to existing and new nurse call master stations shown on the drawings.

2. 2 GENERAL REQUIREMENTS

A. Coordinate features and select interface components to form an integrated Nurse Call system. Match components and interconnections between the systems for optimum performance of specified functions.

B. Expansion Capability: The Nurse Call equipment interfaces and cables shall be able to increase number of enunciation points in the future by a minimum of 50 percent (%) above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Active electronic type shall use solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied between 110 to 130 VAC, 60 Hz supplied from the Facility's Emergency Electrical Power System.

D. Meet all FCC requirements regarding equipment listing, low radiation and/or interference of RF signal(s). The system shall be designed to prevent direct pickup of signals from within and outside the building.

E. Each Code Blue System shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. dome light bulbs [each light will be considered supervised if they use any one or a combination of (UL) approved electrical supervision alternates, as identified in UL-1069, 1992 revision], wires, contact switch connections, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the nurse control station and all remote locations.

F. The Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system.

2. 3 NURSE CALL NETWORK WIRING

A. All Nurse Call Network wiring shall be CAT 6e. Plenum wire shall be used. System shall be capable of injecting DC power into a CAT 6e run, for additional rooms, or long runs, by running a separate DC cable pair to a remote location.

2. 4 NURSE CALL CONTROLLER(S)

A. Furnish as needed in each nursing unit a nurse call network controller. Each controller shall provide the following:
   1. Non-blocking, duplex communications between consoles and rooms, sub stations and duplex pillow speakers.
   2. CAT 6e wiring standard utilizing PoE (Power over Ethernet) between console and nurse call controllers and local wiring to power room station equipment and dome lights.
   3. VoIP audio to Nurse Call Network, VoIP Nurse console, VoIP staff terminal, wired or wireless phones via SIP protocol. VoIP digital audio stream out to rooms without IP overhead signaling.

B. Controller must be life safety grade meaning that it shall not require regular rebooting for continued basic functions of system and it shall be possible for controller to act as a stand alone controller should loss of network communication occur. Personal Computers may not be used for this purpose. PCs will only be allowed

outside of the UL-listed nurse call network on the customer supported LAN.

C. Nurse call controller(s) are connected to the nurse call LAN via Ethernet switches. The nurse call servers also connected to the nurse call LAN are running specialized software for using hospital data resources and telephone communications resources.

2. 5 VoIP NURSE CONSOLES MASTER STATION

A. Furnish as shown on plans, a UL-1069 listed VoIP nurse console capable of the following functions:

1. Full duplex audio
2. Color display
3. 12 or 24 hours time display and synchronization to hospital standard network time from the nurse call gateway server including any daylight savings time changes supported by the network.
4. Display up to 3 incoming calls each with an individual elapsed timer which increments time since call was placed. Also provide the ability to scroll to see all in coming calls.
5. Power over Ethernet powered connection to UL-1069 listed Ethernet controller. No local power supplies required.
6. Choice of hands-free duplex communications through built in speaker and separate microphone or private handset conversation.
7. Console shall be interactive with an associated PC workstation without the necessity of any interconnection to the PC. The work process relationship shall be software defined through the network connections.
8. Optional tone/mute of calls in progress.
9. Ability to block all nurse call loudspeaker paging to facilitate a low noise patient environment. Password protection can be enabled to only allow authorized access to audio paging.
10. Ability to swing an individual room or any group of rooms by touching one labeled touch point. Room(s) and consoles may be located anywhere within hospital nurse/patient communications network.
11. Console can be programmed to be the receiver of any call that is not answered by another console, or can be programmed to

receive any call from a console that has failed or has been unplugged, or otherwise not receiving the call (call orphaning).

12. Ability to dial through built in key pad.
13. Self-contained unit ,desk or wall-mountable.
14. Support manual Staff Follow functions. When Staff Follow is enabled, call-tones for a prescribed area will automatically be forwarded to the room station speaker where staff members are located. Staff location may be determined manually by entering the room number into the console or automatically using staff register stations. Pressing the call button on that station shall silence the tones. When a new call is placed, the tones shall automatically be restored.

2. 6 CAREGIVER ASSIGNMENTS AND SIGNING ON and OFF DUTY

A. Provide software to make caregiver to patient assignments from PC workstations within the hospital by easy user sign on. Assignment process shall be intuitive and indicate to that Supervisor making the assignment, each caregiver's patient load based on number of patients and patient difficulty. The following additional functions shall be provided:

1. Unlimited assignment of caregivers to patients, patients to caregivers.
2. Group assignments.
3. Assignments may be made up to 7 days in advance.
4. Easy display of prior day's assignment and easy click to accept if you want to keep assignment the same.
5. Display pertinent HL-7 fields for patient.
6. Allow for assigning advanced call escalation for un-answered calls.
7. User's assignment can print out to a local printer.
8. User shall have the ability to go ON and OFF break forwarding their device to another caregiver and reflecting this activity in the reporting software.

2. 7 PATIENT STATIONS

A. Provide single patient or dual patient station as shown on plans.

B. Each patient station shall be capable of the following functions:

1. Separate speaker and microphone for full duplex audio. Entertainment audio to be muted when intercom in use.

2. One DIN pillow speaker receptacle per bed that shall have a tilt design, with automatic release of pillow speaker plug when pillow speaker cord is pulled at any angle.
3. Station shall support an optional module to feature bed side rail control on station to indicate bed connection. LED on station shall indicate bed connection(s).
4. Built in lighting control that interfaces directly to low voltage controllers.
5. Universal 1/4” jack for auxiliary alarm input/call cord as indicated on the drawings. Call priority of these receptacles shall be independent of any other button or receptacle.
6. Cancel button shall cancel any call on this station and any other station in room that is programmed for universal room cancel.
7. Continuous supervision.
8. Ability to program on a per patient station basis, each bed and entertainment/call cord receptacle to custom call priorities.
9. Supply for the Enhanced Single Patient Station that includes all the features above, and additionally, two programmable buttons: code blue and staff assist. Optionally these two buttons may be changed to any call process that is selected by OWNER by changing the buttons.
10. Supply for the Enhanced Single Patient Station an optional Clear Button Cover to prevent accidental initiation of the additional programmable buttons. Cover is easy to install and has an easy to lift cover to access the buttons.

2. 8 DUTY STATION

A. Provide as shown on plans a duty station. Unit shall provide remote annunciation of assigned patient stations and sub-stations via LED visual indicators and audible call tones. Duty station faceplate LED’s shall mimic corridor light activity for the assigned nursing area. Also provides two-way duplex intercom to the assigned nurse console(s) through separate speaker and microphone. Call tones generated at duty station must be identical and repeat in synch with tones produced at closest nurse console. It shall be possible to mute the call in tone, without cancelling call. The next call in, assigned to this duty station, will un-mute the station. Muting

feature may be defeated in those jurisdictions that do not allow muting of duty station. The duty station shall be capable of being programmed for a specific time that a day/night mode takes place, allowing a volume change to the call-in tones. This feature is required to minimize noise for patients.

2. 9 SUB-STATIONS

A. Provide as shown on plans, sub-stations which shall be flush mounted in a single gang box. All sub station cancel buttons will follow the cancel policy as defined in the system configuration. Typically canceling a high priority call can only be accomplished by the station initiating a call, while lower priority calls may be cancelled by any associated station in the room.

B. Individual sub-stations shall be:

1. Pull cord station shall be water resistant with a replaceable PVC pull-cord, and easily cleaned surface. The pull-cord shall have a large, easy to pull plastic “bell” attached. This station may only be cancelable with the room and not cancelable from the nurse console. Provide with separate call-in button to indicate a different call process, and include built in speaker/microphone for duplex audio communications.
2. Provide where necessary a Logical Input Station which allows any dry contact closure from an external device to activate a call into the nurse communications network.
3. Provide where necessary a Logical Output Station that allows external devices to be controlled from the nurse call network. Either dry contacts or a driver voltage output shall be available.

2. 10 CORRIDOR LIGHTS

A. Provide as shown on plans, the proper type of corridor light or domeless controller. Corridor lights shall contain four sections, each lighted by a long life, RGB LED capable of producing 7 colors. Each section shall have a diffusion lens which allows for 180 degree horizontal visibility of call lights. The corridor lights shall be capable of the following:

1. All segments of corridor light can indicate a call in multiple color selections, such as: Blue, Red, White, Green, Orange, Yellow, or Pink.

2. Custom call patterns (any combination of light segments, such as all segments blue for code blue).
3. Flash any single color or strobe the sections of the light in any color pattern.

B. Intelligence in the corridor light and domeless controller shall support multiple room devices and allow for the ability of any room station to be associated with any other room in the system. This allows special functions where needed, such as associated call stations and cancelling options, (i.e. door monitoring).

C. Staff registration shall be indicated by a custom color associated with that staff level (i.e. Green = Nurse, Orange = LPN, Yellow = Aide).

D. In the unexpected event of communications loss with the nurse call controller, corridor lights shall enter a local room failsafe mode showing all calls in the hallway via the LED indicators.

E. Corridor lights may be hot-swapped on the room-to-room communication line without the loss of communications to other devices on the local network.

2. 11 DIGITAL MESSAGE SYSTEM

A. The nurse call system shall include inputs into the existing digital message system with a series of prerecorded announcements, customizable to Fargo VA room numbers and locations. Each Code Blue button shall generate a unique pre-recorded message which shall announce that a Code Blue Station has been activated, and the room number of the Code Blue Station in alarm. The digital message system shall be connected to the facility overhead paging system on a priority input, and shall announce these messages facility-wide.

2. 12 INITIATION, ANNUNCIATION AND RESPONSE

A. Light and Tones:

1. Calls may be initiated through:
2. Patient station.
3. Staff station.
4. Code Blue station.
5. Toilet Emergency Station pull cord / push button.
6. Push-button cordset.

B. Once a call is initiated, it must be annunciated at the following locations:

1. The corridor, intersectional and room dome light associated with the initiating device.
2. A local master control station indicating the call location and priority.
3. Each duty station.
4. Each staff station.
5. Each remote location.
6. All calls must be displayed until they are cleared by the nursing staff ONLY from the initiating device location.

2. 13 DATABASE MANAGEMENT

A. Provide standard ODBC (MS SQL 2005) compliant databases. Databases shall be able to be backed up using facilities standard backup processes and disaster recovery methods.

2. 14 REPORTING SOFTWARE

A. Provide software that may be accessed by any networked PC work station that gives management patient call details in clear readable format. HL-7 integration shall make all pertinent patient details available, including the ability to search by patient name and/or patient ID number for those nurse call records associated for that patient during their stay, regardless of room/bed occupied.

B. In addition, the reporting software shall provide the following functions:
   1. Standard, global reports.
   2. Individual user reports.
   3. Reports shall be viewed in Adobe Acrobat Reader.
   4. Any trained individual may utilize standard ODBC compliant reporting software to generate more enhanced reporting.

PART 3 - EXECUTION

3. 1 SUPERVISION

A. Only factory certified installers shall install, service and maintain the specified network system.

B. Manufacturer shall have the equipment manufacturer’s engineer or their designated agent inspects the installation and operation of this network to determine that the network complies with all standards listed in Part 1.3.

3. 2 INSTALLATION

A. Execute work in accordance with National, State and local codes, regulations and ordinances.

B. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.

C. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.

D. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc.

    1. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
    2. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
    3. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
    4. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.

E. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect and Owner.

F. Coordinate cover plate sizes and requirments with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommeted holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.

G. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone and data equipment, systems, and service.

H. Color code all distribution wiring to conform to the Nurse Call Industry Standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and

permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance.

I. Product Delivery, Storage and Handling:

1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The Project Engineer may inventory the cable, patch panels, and related equipment.
2. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the Project Engineer.

J. Equipment Racks/Cabinets:

1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks/cabinets.
2. Provide security covers for all devices not requiring routine operator control.
3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer’s recommendations regarding ventilation space between amplifiers.
4. Provide insulated connections of the electrical raceway to equipment racks.
5. Ensure a minimum of 36 inches around each cabinet and/or rack to comply with OSHA Safety Standards. Cabinets and/or Racks installed side by side – the 36” rule applies to around the entire assembly

3. 3 TRAINING

A. Contractor shall provide thorough training of all nursing staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses/staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows

this type of individualized training utilizing in-service training unit, prior to cut over of the new system.

B. Provide the following minimum training times and durations:
   1. 2 hours for nursing staff and supervisors coordinate schedule with Owner.
   2. 2 additional hours during the opening week for nursing staff and supervisors – both day and night shifts, coordinate schedule with Owner.
   3. 2 hours for Biomed, maintenance staff and system administrators, coordinate schedules with Owner.

3. 4 WIRING

A. Contractor shall terminate all wiring with manufacturer approved connectors. The use of wire nuts is prohibited.

B. All wiring shall be free from shorts and faults. Wiring shall be UL listed, NEC and NFPA 70, Article 25 approved.

C. Nurse patient communications network wiring shall not be run in the same conduit with other systems (i.e. Class 1 AC power distribution, fire alarm, entertainment systems, lighting controls, etc.).

D. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.

E. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.

F. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.

G. Use wire pulling lubricants and pulling tensions as recommended by the OEM.

H. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.

I. Do not use tape-based or glue-based cable anchors.

J. Ground shields and drain wires to the Facility’s signal ground system as indicated by the drawings.

K. Field wiring entering equipment racks shall be terminated as follows:
   1. Provide OEM directed service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to

allow plates, panels and equipment to be removed for service and inspection.

a. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products.") Provide 15% spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
b. If specified terminal blocks are not designed for rack mounting, utilize ¾" plywood or 1/8" thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
c. Employ permanent strain relief for any cable with an outside diameter of 1" or greater.

L. Make all connections as follows:

1. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
2. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
3. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
4. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
5. Run cabling parallel to walls and building structure.
6. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2'-0" clearance from all shielded electrical apparatus.
7. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
8. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.

3. 5 PROTECTION OF NETWORK DEVICES

A. Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved ESD wrist straps

tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

3. 6 CLEANING AND PATCHING

A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.

B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.

3. 7 DRAWINGS

A. Provide as built drawings of all installed network components and associated wiring on building plans. Final payment for work will not be authorized unless these drawings are supplied.

B. Provide as built drawings in Autocad, compatible with current version in use at Fargo VAMC.

C. Drawings shall include a complete, updated riser diagram showing all devices, nurse call panels, wiring, etc.

END OF SECTION

SECTION 28 13 16

ACCESS CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Access control devices.

B. Access control panels.

1.2 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 26 05 21 – Low Voltage Electric Power Conductors and Cables.

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2011.

1.4 SYSTEM DESCRIPTION

A. Extension of the existing door access control system to numerous doors as shown on the drawings. New access control panel is to be to accommodate the new card readers. All new system components shall be compatible with the existing facility access control system and system software.

1.5 SUBMITTALS

A. See Section 01 33 23 for submittal procedures.

B. Shop Drawings: Provide system wiring diagram showing each device and wiring connections required. Submit drawings in ACAD format showing all devices and wiring requirements.

C. Product Data: Provide electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Project Record Documents: Record actual locations of all system components.

F. Operation Data: Operating instructions.

G. Maintenance Data: Maintenance and repair procedures.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities and an authorized installer within

100 miles of project.

C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Access Control and Security System:

1. SimplexGrinnell Software House or equal.

2.2 COMPONENTS

A. Access Control Panel:

1. Product: Simplex Grinnell Software House i-Star Pro Controller or equal.
2. Description: 16 card reader capacity control panel with 64 MB of on board memory, battery backup, local area network compatible. Control panels shall accommodate 16 card readers, door position monitoring inputs for 16 doors and request to exit sensors for 16 doors.

B. Encoded Card Readers:

1. Product: HID RP40-6125CGN000DG30 for the 5” by 5” locations or the HID RP15-6145CGN000DG30 for the narrow mullion mount locations, or Equals.
2. Description: Proximity card reader, indoor/outdoor rated, 5”x 5” square polycarbonate housing with approximately a 8” read range. The card reader shall be fully compatible with the PIV badges being used at the VA hospital.

C. Encoded Card Readers with Keypad:

1. Product: HID 6136CGN000D00G30 with integral keypad, or Equal.
2. Description: Proximity card reader with integral 10 button keypad, indoor/outdoor rated, 5”x 5” square polycarbonate housing with approximately a 8” read range. The card reader shall be fully compatible with the PIV badges presently being used at the VA hospital.

D. Request to Exit Sensors:

1. Product: Bosch DS160 or equal.
2. Description: Surface mount with passive infrared sensor with a 8’ by 10’ coverage pattern. White plastic enclosure.

E. Door Position Switches:

1. Product: General Electric 1076D series or equal.
2. Description: 1 inch diameter steel door contact with DPDT contacts, white in color.

F. System Cable:

1. Product: Communications Supply Corporation or equal.

2. Plenum rated cable with aluminum foil shield , copper drain wire, yellow PVC jacket. Cable shall include integral #18-4/C unshielded, #22-3PR shielded, #22-2/C unshielded, and #22-4/C unshielded conductors for card reader, REX and door contact functions.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Use multi-conductor cable for connections to all of the access control components at each door. Install all wiring in conduit, ¾ inch minimum.

C. Make conduit and wiring connections to door hardware devices furnished and installed under Section 08 71 00.

D. Provide a connection from each control panel to the VA Hospital local area network system in the nearest IRM closet using category 6e plenum rated cable in accordance with section 27 10 05.

E. Provide a 120 volt power connections to each control panel and electric strike or latch power supply to the nearest emergency power (equipment branch) circuit connected to a transfer switch as shown on the drawings.

F. Power Door Operators: Where card readers are being installed on doors with power door operators, the access control system shall deactivate the push pad adjacent to the card reader normally. When a valid card is presented, the push pad shall be activated to the door can be operated with the push pad after the electric latch is operated. The interior or push pad on the opposite side of the door shall be wired to operate the both the door operator and latch bolt when the push pad is depressed. Provide all required relays.

3.2 FIELD QUALITY CONTROL

A. Manufacturer Services: Furnish services of technician to supervise installation, adjustments, final connections, system testing, and to train Owner personnel.

3.3 CLOSEOUT ACTIVITIES

A. Demonstrate normal and abnormal modes of operation for both the access control and security systems, and required response to each.

3.4 MAINTENANCE

A. Furnish service and maintenance of access control and security system for one year from Date of Substantial Completion.

- - - E N D - - -

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the specifications includes the furnishing, installation, and connection of new fire alarm equipment with connections to the existing facility fire alarm network equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units and wiring as shown on the drawings and specified.

B. Fire alarm systems shall comply with requirements of NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Contracting Officer or his authorized representative. Installers shall have a minimum of two years experience installing fire alarm systems.

C. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in Room 1D-01.

D. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

1.2 SCOPE

A. All existing fire alarm equipment, wiring, devices and sub-systems that are not shown to be reused shall be removed. All existing fire alarm conduit not reused shall be removed.

B. New fire alarm system components shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.

C. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.

D. Basic Performance:

1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.
3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.
4. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.
5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet of floor space or 3 floors whichever is less.
6. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

1.3 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements for items which are common to other Division 26 sections.

B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and boxes for cables/wiring.

C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW: Cables/wiring.

1.4 SUBMITTALS

A. General: Submit 4 copies and 1 reproducible in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Drawings:

1. Prepare drawings using AutoCAD release compatible with the version in use at the VAMC in Fargo and include all contractor’s information. Layering shall be by VA criteria. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.
2. Floor plans: Provide updated locations of all devices (with device number at each addressable device corresponding to control unit

programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.

3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Two weeks prior to final inspection, the Contractor shall deliver to the COTR one (1) set of reproducible, as-built drawings, two blueline copies and one (1) set of the as-built drawing computer files (using AutoCAD release compatible with that currently in use at the Fargo VA). As-built drawings (floor plans) shall show all new and existing conduit used for the fire alarm system. The as-builts shall be added to the overall fire alarm system as-builts for the facility and submitted as an update to the entire facility as-builts.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only.

B. National Fire Protection Association (NFPA):
70-2005.....National Electrical Code (NEC).
72-2002.....National Fire Alarm Code.

90A-2002.....Installation of Air Conditioning and Ventilating Systems.

101-2003.....Life Safety Code

C. Underwriters Laboratories, Inc. (UL):

2000-2000.....Fire Protection Equipment Directory

D. Factory Mutual Research Corp (FM): Approval Guide, 2005 Edition

E. American National Standards Institute (ANSI):

S3.41-1996.....Audible Emergency Evacuation Signal

F. International Code Council, International Building Code (IBC) 2003 Edition

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturer's requirements and that satisfactory total system operation has been achieved.

2.2 CONDUIT, BOXES, AND WIRE

A. Conduit shall be in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS and as follows:

1. All new and reused conduit shall be installed in accordance with NFPA 70.
2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduit shall be 19 mm (3/4 inch) minimum.

B. Wire:

1. All existing wiring shall be removed and new wiring installed in a conduit or raceway.
2. Wiring shall be in accordance with NEC article 760, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
3. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically excepted by the fire alarm equipment manufacturer in writing.

4. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
5. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

C. Terminal Boxes, Junction Boxes, and Cabinets:
1. Shall be galvanized steel in accordance with UL requirements.
2. All new and reused boxes shall be sized and installed in accordance with NFPA 70.
3. New and existing covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 19 mm (3/4 inch) high.
4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COTR.

2.3 FIRE ALARM CONTROL UNIT

A. General:
1. Each building shall be provided with a fire alarm control unit and shall operate as a supervised zoned fire alarm system.
2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.

B. Enclosure:
1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.

2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

C. Power Supply:

1. The control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
3. Power supply for smoke detectors shall be taken from the fire alarm control unit.
4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
5. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.

D. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

E. Trouble signals:

1. Arrange the trouble signals for automatic reset (non-latching).
2. System trouble switch off and on lamps shall be visible through the control unit door.

2.4 VOICE COMMUNICATION SYSTEM (VCS)

A. General:

1. An emergency voice communication system shall be installed throughout. 2. Upon receipt of an alarm signal from the building fire alarm system, the VCS shall automatically transmit a pre-recorded fire alarm message throughout the building .
3. A digitized voice module shall be used to store each prerecorded message.
5. The VCS shall supervise all speaker circuits, control equipment, remote audio control equipment, and amplifiers.

B. Speaker Circuit Control Unit:

1. The speaker circuit control unit shall include switches to manually activate or deactivate speaker circuits grouped by floor in the system.

C. Speaker Circuit Arrangement:

1. Speaker circuits shall be arranged such that there is one speaker circuit per smoke zone.
2. Audio amplifiers and control equipment shall be electrically supervised for normal and abnormal conditions.
3. Speaker circuits shall be either 25 VRMS or 70.7 VRMS with a minimum of 50% spare power available.
4. Speaker circuits and control equipment shall be arranged such that loss of any one speaker circuit will not cause the loss of any other speaker circuit in the system.

D. Audio Amplifiers:

1. Audio Amplifiers shall provide a minimum of 50 Watts at either 25 or 70.7 VRMS output voltage levels.
2. Amplifiers shall be continuously supervised for operational status.
3. Amplifiers shall be configured for either single or dual channel application.
4. Each audio output circuit connection shall be configurable for Style X.
5. A minimum of 50% spare output capacity shall be available for each amplifier.

2.5 ALARM NOTIFICATION APPLIANCES

A. Speakers:

1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the one-half watt tap. Speakers shall provide a minimum sound output of 80 dBA at ten feet with the one-half watt tap.
2. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
3. 100 mm (4 inches) or 200 mm (8 inches) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.

B. Strobes:

1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Backplate shall be red with 13 mm (1/2 inch) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
3. Each strobe circuit shall have a minimum of twenty (20) percent spare capacity.
4. Strobes may be combined with the audible notification appliances specified herein.

2.6 ALARM INITIATING DEVICES

A. Manual Fire Alarm Stations:

1. Shall be non-breakglass, address reporting type.
2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE".
4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills. The key shall be a Simplex 'B' key to match existing keys.
5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.

2.7 SUPERVISORY DEVICES

A. Duct Smoke Detectors:

1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.
2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".
3. Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.

2.8 ADDRESS REPORTING INTERFACE DEVICE

A. Shall have unique addresses that reports directly to the building fire alarm panel.

B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.

C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.

D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.

E. Shall be mounted in weatherproof housings if mounted exterior to a building.

2.9 UTILITY LOCKS AND KEYS:

A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key to match the existing Simplex 'B' key currently in use.

B. Key-operated manual fire alarm stations shall have a single standardized lock and key to match the existing keys presently in use at the facility.

C. All keys shall be delivered to the Project Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS , Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.

B. All new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. All existing accessible fire alarm conduit not reused shall be removed.

C. All new or reused exposed conduit shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas. All junction box covers shall be painted red and stenciled with 'FA' to match existing junction boxes.

D. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.

E. All fire detection and alarm system devices shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations to be approved by the Project Engineer.

F. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in

finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.

G. Strobes shall be flush wall mounted 2,000 mm (80 inches) above the floor or 150 mm (6 inches) below ceiling, whichever is lower. Locate and mount to maintain a minimum 900 mm (36 inches) clearance from side obstructions.

H. Manual pull stations shall be installed not less than 1050 mm (42 inches) or more than 1200 mm (48 inches) from finished floor to bottom of device and within 1500 mm (60 inches) of a stairway or an exit door.

3.2 TYPICAL OPERATION

A. Activation of any manual pull stationor smoke detector shall cause the following operations to occur:

1. Operate the emergency voice communication system . For sprinkler protected buildings, flash strobes continuously only in the zone of alarm.
2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control.
3. Release only the magnetic door holders in the smoke zone on the after the alert signal.
4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
5. Unlock the electrically locked exit doors within the zone of alarm.

B. Smoke detectors in the primary elevator lobbies of shall, in addition to the above functions, return all elevators in the bank to the secondary floor.

C. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders in that smoke zone.

3.3 TESTS

A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the Project Engineer.

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the Project Engineer. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and

been approved by the Project Engineer, the contractor may request a final inspection.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
4. Open each alarm initiating and notification circuit to see if trouble signal actuates.
5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

3.4 FINAL INSPECTION AND ACCEPTANCE

A. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

PART 4 - SCHEDULES

4.1 DIGITIZED VOICE MESSAGES:

A. The existing voice communication system shall be modified with the new zones as shown on the drawings. Re-program the voice communication system as required based on the zone naming shown in the drawings.

4.2 FIRE ALARM COMPUTER WORKSTATION GRAPHICAL USER INTERFACE:

A. The existing fire alarm computer workstation graphical user interface shall be modified with the new zones, zone names and building layout. Provide graphical floorplan drawing of new building and updated plan indicating new zoning and building layout.

- - - END - - -