# SECTION 16360--DISCONNECT SWITCHES 600 V AND LESS

## PART 1--GENERAL

### SUMMARY:

Section Includes: Work includes, but is not limited to:

The Subcontractor shall provide and install electrical disconnect switches of types, grades, and sizes as shown on the drawings. Provide complete assembly including, but not necessarily limited to hubs, fuses, and other components and accessories as needed for a complete system.

### REFERENCES:

### SYSTEM DESCRIPTION:

### DESIGN REQUIREMENTS:

### SUBMITTALS:

See Vendor Data Schedule.

## PART 2--PRODUCTS

### MANUFACTURERS:

Acceptable Manufacturers: Square D, General Electric and Westinghouse or approved equal.

### MATERIALS:

Disconnects: Disconnect switches shall be UL listed, NEMA type, heavy duty, single throw, fused or nonfused, and have current and voltage rating as shown on the drawings.

Switches shall be operated with external operating handle which is an integral part of the box--not the cover. The operating mechanism shall be quick-make, quick-break and shall not be capable of being restrained by the operating handle during the opening and closing operation.

Dual interlocks shall interlock the switch box cover with the switch mechanism and shall prevent opening or closing the box cover when the switch contacts are closed and the switch mechanism is in the "ON" position. An interlock release shall be provided to defeat the interlocking mechanism and to permit opening the box cover when the switch contacts are closed. To defeat the interlock release and permit opening the box cover shall require an external hand tool.

Switch handles shall be designed for padlocking in the "OFF" position, locking the door closed to inhibit access to the switch. All current-carrying metal parts of the switch shall be enclosed.

PART 3--EXECUTION

INSTALLATION:

Install disconnect switches as indicated on the drawings and in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation," and comply with recognized industry practices to ensure that products serve intended functions.

Install disconnecting devices associated with motors within sight of the motor driven device where practical. In all cases the disconnecting device shall be clearly labeled to distinguish which motor/piece of equipment it disconnects.

LABELING:

For labeling requirements See Section 16195--Electrical Identification.

FIELD QUALITY CONTROL:

Site Tests: Visual inspection to determine that equipment installation conforms to NEC, these specifications and the drawings.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16360

# SECTION 16450--GROUNDING

## PART 1--GENERAL

### SUMMARY:

Section Includes: Work includes, but is not limited to:

Subcontractor shall provide and install grounding of sizes, ratings, materials and types as shown on the drawings and as recommended by the NEC and the NESC.

Section Does Not Include: For grounding requirements for the following systems, see the Section listed:

Communication Systems:

| | |
|---|---|
| 16610 | Telephone System |
| 16721 | Fire Alarm and Supervisory (FA) System |
| 16725 | Emergency Notification System |
| 16123 | Fiber Optic Cable Installation |

Cathodic Protection Systems:

| | |
|---|---|
| 16640 | Cathodic Protection |

Lightning Protection Systems:

| | |
|---|---|
| 16650 | Lightning Protection |

Related Sections:

| | |
|---|---|
| 02444 | Chainlink Fencing |
| 05100 | Structural Steel and Miscellaneous Metals |
| 05310 | Steel Decking |
| 13120 | Pre-Engineered Building |
| 15400 | Piping and Plumbing Systems |
| 15501 | Wet Pipe Fire Protection Systems |
| 15503 | Deluge Fire Protection System |
| 15504 | Preaction Fire Protection System |
| 15506 | On-Off Multicycle Preaction Fire Suppression System |
| 15507 | Dry Pipe Fire Protection System |
| 16000 | Electrical Sections |

REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein. Unless otherwise indicated use the latest edition in effect as of the date of these specifications.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 National Electrical Code (NEC)

AMERICAN NATIONAL STANDARDS ASSOCIATION (ANSI)

ANSI C2 National Electrical Safety Code (NESC)

SUBMITTALS:

See Vendor Data Schedule.

PART 2--PRODUCTS

MATERIALS:

Equipment grounding conductors shall be green insulated or bare copper, sized and located as shown on the drawings.

Building grounding grid wire shall be a minimum of No. 2 AWG bare stranded copper sized and located as shown on the drawings.

Grounding rods shall be a minimum of 5/8 in. diameter and 10 ft long copper clad steel.

Grounding grid connections below grade shall be made by the exothermic welding process or listed nonreversible compression fittings.

Exothermic welds shall be Cadweld or approved equal.

Nonreversible compression fittings shall be Burndy HyGround or approved equal.

Ground bus bar shall be 1/4" thick x 4" W x 24" L with mounting insulators and brackets. VFC, Inc., GBI Series or Approved Equal.

PART 3--EXECUTION

INSTALLATION:

Install a complete grounding system as indicated on the drawings in accordance with applicable requirements of the NEC, the NESC, and complying with recognized industry practices to ensure that products serve intended functions and comply with requirements.

All exposed noncurrent-carrying metallic parts of electrical equipment, raceway systems (including manholes), cable trays, air ducts, building steel, and the neutral conductor of the wiring system shall be grounded. The riser of all firewater systems and all in-building, non-firewater, metallic piping shall be grounded.

In addition to the equipment grounding conductor routed with the branch circuit, the metal frame of large equipment (i.e., firewater risers, fuel tanks, electric fire pump controller and motor, etc.) shall be grounded via a No. 2 stranded, bare copper grounding conductor to a grounding bus bar (separate from the service panel grounding bus). The grounding bus bar shall be bonded to the building grounding grid as shown on the drawings.

Building Grounding Grid: A grounding grid shall be sized and provided around the periphery of the building as shown on the drawings. The grounding grid shall be a minimum of 30 in. below finished grade.

All in-building metallic water piping, all metallic air ducts, all building structural steel (in particular building corner columns), rebar, and underground metallic conduit and grounding cables shall be connected to the building grounding grid. These connections to the grounding grid shall be exothermically welded or by utilizing nonreversible compression fittings.

Beam or compression type grounding clamps shall be used for all above grade grounding attachments to building steel. Exothermic welds to structural steel shall not be allowed.

Cathodically protected piping or conduit shall not be connected to the grounding grid.

All conduit (except spares) shall contain a dedicated grounding conductor.

Conduit shall not be used as the grounding conductor.

Grounding Rods: Grounding rods shall be driven around the building adjacent to the grounding grid and connected thereto. The grounding rods shall be driven so that the top of the rod is 1 ft below finished grade.

Nonreversible Compression Connections: Connections shall be made in accordance with manufacturer's written recommendation.

Exothermic Welds: Exothermic welds shall be made in accordance with the manufacturer's written recommendations.

FIELD QUALITY CONTROL:

Site Tests: The Subcontractor or his agents shall perform visual inspections to determine that the grounding installation conforms to the NEC, these specifications, and the drawings.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16450

# SECTION 16460--TRANSFORMERS, GENERAL LIGHTING AND DISTRIBUTION DRY TYPE, INDOOR AND OUTDOOR, UNDER 600 VOLTS

## PART 1--GENERAL

### SUMMARY:

The Subcontractor shall provide and install transformers of sizes, ratings, and types as shown on the drawings.

Section Includes: Work includes, but is not limited to:

The Subcontractor shall install the transformers in the approximate locations shown and comply with all provisions of the NEC and NESC as to clearances, grounding, location, local disconnects, and NEMA ratings.

### REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI-C57 12.01 | General Requirements for Dry Type Distribution and Power Transformers |
| ANSI-C57 12.70 | Terminal Markings and Connections for Distribution and Power Transformers |
| ANSI-C57 12.80 | Terminology for Power and Distribution Transformers |
| ANSI-C57 12.91 | Test Code for Dry-Type Distribution and Power Transformers |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | National Electrical Code (NEC) |

NATIONAL ELECTRIC MANUFACTURER'S ASSOCIATION (NEMA)

UNDERWRITERS' LABORATORIES, INC. (UL)

### SUBMITTALS:

See Vendor Data Schedule.

PART 2--PRODUCTS

MATERIALS:

Single-phase transformers shall be 480 volt primary and 120/240 volt, 3-wire secondary. Three-phase transformers shall be 480 volt delta primary and 208Y/120 volt Wye secondary. Transformers 25 kVA and larger shall have a minimum of four 2 1/2% full capacity primary taps, two above and two below rated voltage. Exact voltages to be as designated on the drawings.

Transformers 15 kVA and above shall be 150•C temperature rise above 40•C ambient. All insulating materials to be in accordance with NEMA ST20 Standard for a 220•C UL component recognized insulation system.

Transformer coils shall be of the continuous wound construction and shall be impregnated with non-hygroscopic, thermosetting varnish.

All cores to be constructed of high grade, M-6, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with structural steel angles. The completed core and coil shall then be bolted to the base of the enclosure but isolated therefrom by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. On transformers 500 kVA and smaller, the vibration isolating system shall be designed to provide a permanent fastening of the core and coil to the enclosure.

Transformers 15 kVA and larger shall be in a ventilated sheet steel enclosure of a heavy gauge as described in the NEMA Standards. The ventilating openings shall be designed to prevent accidental access to live parts in accordance with UL, NEMA, and National Electrical Code standards for ventilated enclosures. Single-phase transformers through 75 kVA, and 3-phase transformers through 45 kVA shall be designed so they can be either floor or wall mounted. Above 75 kVA and 45 kVA transformers shall be floor mounted design.

The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed, and finished with a gray, baked enamel.

The maximum temperature of the top of the enclosure shall not exceed 50•C rise above a 40•C ambient.

The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.

Sound levels shall be guaranteed by the manufacturer not to exceed the following:

15 to 50 kVA - 45DB; 51 to 150 kVA - 50DB; 151 to 300 kVA - 55DB; 301 to 500 kVA -60DB

The transformer shall be listed by Underwriters' Laboratory for the specified temperature rise.

PART 3--EXECUTION

INSTALLATION:

Install transformers as indicated on the drawings and in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation," and complying with recognized industry practices to ensure that products serve intended functions.

Labeling: For Labeling Requirements see Section 16195--Electrical Identification.

FIELD QUALITY CONTROL:

Subcontractor Inspection: Visual inspection to determine that equipment installation conforms to NEC, these specifications and the drawings.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16460

# SECTION 16500--LIGHTING

## PART 1--GENERAL

### SUMMARY:

Section Includes: Work includes, but is not limited to:

The Subcontractor shall provide, install and terminate lighting fixtures of sizes, types, and ratings as shown on the drawings; comprised of, but not necessarily limited to, lamps, lampholders, reflectors, ballasts, starters, wiring and anchor systems.

### REFERENCES:

### SYSTEM DESCRIPTION:

### DESIGN REQUIREMENTS:

### SUBMITTALS:

See Vendor Data Schedule.

## PART 2--PRODUCTS

### FIXTURES:

Ballast shall be electro-magnetic, discrete electronic or 1C Electronic as called for on the drawing lighting fixture schedule.

Electro-magnetic ballast shall be of high power factor, high efficiency, Class P type, and their design and construction shall conform to Certified Ballast Manufacturer (CBM) Standards. Ballast shall be rated for starting and operating at a minimum of 60•F (-20•F for cold weather) and be bonded with non-asphaltic thermo-setting compound compatible with any contained fluid. Ballast shall not contain polychlorenated biphenyls (PCB's) and shall be maximum sound Level B.

Discrete electronic ballast (with no laminated electromagnetic components) shall have a minimum power factor of .95, UL Class P, rapid start, rated for starting and operating at a minimum of 60•F. Ballast total harmonic distortion shall be less than 20%. Lamps current crest factor shall not exceed 1.5, with a sound Level "A".

Integrated Circuit (IC) electronic ballast shall have a minimum power factor of .98, UL Class P, rapid start, rated for starting and operating at a minimum of 60•F. Ballast total harmonic distortion shall be less than 10%. Lamp current crest factor shall not exceed 1.5, with a sound Level "A". Ballast shall have a frequency of operation of 20K Hz or greater, and operate without a visible flicker.

Ballast Sound Levels:

Sound Level A - 20 to 24 dB
Sound Level B - 25 to 30 dB

Acceptable Manufacture: Motorola, OSRAM Sylvania, Advance Mark V and Advance Mark VII (for dimming) or approved equal.

Provide and install all fixtures, lamps, and tubes of the types and wattages indicated on the drawings.

All fixtures shall be wired from outlet boxes with minimum size No. 12 AWG, type THHN wire for through wiring of fluorescent fixtures.

Provide and install the necessary equipment for supporting or coordinating the hanging of all light fixtures.

PART 3--EXECUTION

INSTALLATION:

Install lighting fixtures of types indicated, where shown and at indicated heights; in accordance with lighting fixture manufacturer's written instructions and with recognized industry practices; to ensure that fixtures comply with requirements and serve intended purposes.

Fasten fixtures securely to indicate structural support members of building per UBC Seismic Zone 2b requirements. Minimum horizontal seismic forces shall be 15% of fixture weight for normal lighting and 23% of weight of fixture for emergency lighting. Check to ensure that solid pendent fixtures are plumb.

ADJUST AND CLEAN:
Clean lighting fixtures of dirt and debris upon completion of installation.

Protect installed fixtures from damage during remainder of construction period.

FIELD QUALITY CONTROL:

Site Tests: The subcontractor or his agents shall perform the following tests:

Upon completion of installation of lighting fixtures, apply electrical energy to demonstrate capability and compliance with requirements. Replace bulbs or tubes that are noticeably dim, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

Contractor Inspection: Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16500

# SECTION 16610--TELEPHONE SYSTEM

## PART 1--GENERAL

### WORK DESCRIPTION:

The Subcontractor shall furnish and install all materials and labor to implement and complete the installation of telephone systems as described on the drawings and these specifications.

WORK INCLUDED: Work includes, but not limited to, installation of telephone/data raceways, enclosures, telephone and data cable, data racks, outlet modules, and other associated devices as shown on the drawings.

### WORK NOT INCLUDED:

The work not included shall consist of but not be limited to the following:

Final connection to the telephone equipment and devices. This shall be done by others.

### RELATED SECTIONS:

16110--Electrical Raceways
16120--Cable, Wire, Connectors, and other Miscellaneous Devices
16123--Fiber Optic Cable Installation
16195--Electrical Identification
16450--Grounding.

### CODES AND STANDARDS:

All components shall comply with NEC Article 800 for telephone systems and service.

All components shall be UL approved.

### SUBMITTALS:

See Vendor Data Schedule for submittals.

## PART 2--PRODUCTS

### MATERIALS:

Backboards: Backboards covering less than 16 $ft^2$ of total area shall be 3/4 in. AD plywood painted with two coats of fire retardant paint. The paint color shall be off-white.

Backboards covering more than 16 $ft^2$ of total shall be 3/4 in. AD plywood covered with 5/8 in. sheetrock. Sheetrock and plywood edges shall be painted with two coats of fire retardant paint. The paint color shall be off-white.

Ground Bar: Ground bars shall be Newton 1/4 × 4 × 10 in. copper insulated ground bar. Anixter No. 108830 or approved equal.

Voice/Data Outlet Boxes: Voice/data outlet boxes shall be extra deep 4 in. square steel conduit boxes with a single gang raised ring to allow installation of a single gang cover.

Conductors: Direct buried telephone cable shall be Type REA-PE-89 Gopher Resistant Cable or approved equal. Cable shall be of the size and number of pairs as shown on the drawings.

Telephone cable installed in underground conduits or duct systems shall be AT&T Type AFMW or approved equal. Cable shall be of the size and number of pairs as shown on the drawings.

Telephone cable installed from the backboard to the voice/data outlet boxes shall be plenum rated premises cable. The cable shall be capable of high-speed LAN applications (• 100 Mb/s), 100 ohm unshielded. The cable shall be 4 pair No. 24 AWG Anixter Type Plenum Premises Cable Category 5 CMP-00424MAX-5 or approved equal.

Data Racks and Equipment: Data rack assembly shall be as shown on the drawings or approved equal.

Racks and equipment shall be furnished complete with all associated hardware required for installation.

Manholes: Manholes shall be standard precast concrete of the sizes shown on the drawings. Manholes shall meet the requirements of Section 03400--Precast Concrete.

Manholes shall be furnished complete with a metal ladder, pulling eyes, bonding ribbon, inserts cast in the walls for mounting cable racks, and the cable racks or supports. Ladders shall be permanently affixed and so installed as to avoid contact with cables and cable racks.

Manhole covers and frames shall be 30 in. diameter and shall be marked "TELEPHONE" or "COMMUNICATIONS". Covers shall be accessed by use of a standard manhole hook. Covers in permanent nontraffic areas shall be aluminum. Covers in traffic areas shall be capable of supporting an AASHTO H20 truck axle load.

Conduits shall enter the manholes via precast inserts installed in the upper left or right corners of the manhole walls or as shown on the drawing. Conduit shall not be installed in the lower half of the manhole walls.

A 12 x 12 x 12-in. sump hole shall be cast in the bottom of each manhole.

PART 3--EXECUTION

CONDUIT:

Install 3/4-in. rigid conduit between telephone outlets. Install 1-in. rigid conduit between outlets and the main telephone board or cable tray.

BACKBOARDS:

Backboards shall be installed in the telephone/communication room at locations shown on the drawings. Backboards shall cover the entire wall from 24 in. above the finished floor to a height of eight 8 ft above the finished floor.

CONDUIT STUBS:

Stub telephone feeder conduits to the left side of the terminal boards and branch conduits to the right side of the terminal board, unless otherwise noted.

120 VAC:
Install a 120 Vac quadraplex receptacle at the lower right side of the backboard and a minimum of one on each wall of the remaining telephone/communication room walls.

VOICE/DATA OUTLET BOXES:

Voice/data outlet boxes shall be installed at the following heights above finished floors and countertops/backsplashes:

| | |
|---|---|
| Offices and other finished areas | 18 in. |
| Wall phones and unfinished areas | 50 in. |
| Countertops | 5 in. |

All heights are to the center of the outlet box.

All outlet boxes shall have a blank cover installed after wiring is installed and labeled.

CONDUCTORS:

Fiber optic cable shall be installed in accordance with Section 16123--Fiber Optic Cable Installation.

Two 4 pair No. 24 AWG cables shall be installed to each voice/data outlet box and one 4 pair No. 24 AWG shall be installed to each wall phone outlet box. Leave 18 in. of each cable

neatly coiled at the outlet box for terminations and 20 ft neatly coiled at the backboard. Each cable shall be labeled with an unique identifying number containing the room number in which the outlet box is located. Labels shall be installed within 1 ft of each end of the cable and where in enters or exits conduit and pullboxes.

Cable installed in underground conduits or duct systems shall be labeled at each pull point. The label shall identify the cable size and the buildings they feed and area fed from. Each cables shall be tagged within 1 ft of where it exits the manhole.

Cables installed in manholes shall be racked in a neat and orderly manner.

GROUND:

Encase a No. 1/0 bare copper ground wire in each concrete ductbank. Bond all exposed conducting materials to this ground conductor. Bond this conductor to the building ground system.

Install a No. 1/0 bare copper ground wire at each backboard and bond it directly to the building ground system.

Install a ground bar at each backboard and connect to the building ground system.

QUALITY CONTROL TESTING:

Subcontractor Supplied Testing: The 4 pair No. 24 AWG voice/data cables shall be tested for electrical continuity in accordance with Section 16120--Cable, Wire, Connectors, and Miscellaneous Devices.

FIELD QUALITY CONTROL:

Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications.

END OF SECTION 16610

# SECTION 16721--FIRE ALARM AND SUPERVISORY (FA) SYSTEM

## PART 1--GENERAL

### SUMMARY

Section Includes: Work includes, but is not limited to:

Provide a complete fire alarm system as described herein. Provide Control panel, initiation devices (manual fire alarm stations), induct smoke detection devices, occupant notification devices (audible horns (standard fire alarm sound) and visual strobe (ADA)), fire sprinkler system waterflow switch monitoring, fire sprinkler control valve supervisory monitoring switch, wiring, conduit, DACT and all other parts and labor to provide a complete and workable system. Provide design, installation and testing of the systems.

### REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | National Electrical Code |
| NFPA 72 | National Fire Alarm Code |
| NFPA 90A | Installation of Air Conditioning and Ventilation Systems |
| NFPA 101 | Life Safety Code |
| NFPA 170 | Fire Safety Symbols |

UNDERWRITERS LABORATORIES (UL)

Fire Protection Equipment Directory
Electrical Construction Materials Directory
Building Materials Directory

DEPARTMENT OF ENERGY

DOE-ID Architectural Engineering Standards

### SUBMITTALS:

Submittals include, but are not limited to the following:

Record drawings

Wire label list
Owners manual
Wire and cable tests including opens, shorts, and impedance
Battery backup design calculations
Notification appliance design calculations
A copy of the proposed system acceptance test after approved design and prior to construction
The completed Inspection and Testing form as required by NFPA 72
A copy of the installer's certification and experience

Design: The fire alarm system shall be submitted as a complete package for review. Partial submittals will be considered as incomplete and will not be reviewed. The design must be approved by the Contractor prior to beginning of installation and shall comply with NFPA 72 requirements.

Proof of certification per Qualification requirements shall be provided with the design package.

Design drawings shall comply with the requirements of Section 01300 Submittals

Equipment: Catalog data and other information necessary to show compliance with this specification shall be submitted for approval for the following equipment:

Procedures: The Subcontractor shall submit an acceptance test procedure that will be used to verify proper operation of all new fire alarm equipment.

Test Reports: Completed acceptance test document shall be submitted to the Contractor's Representative (LSS) after the test. System certification, System Operations test, and System Test documentation shall be provided as a package.

See Section 01300, Submittals and the Vendor Data Schedule for additional submittal requirements.

QUALITY CONTROL:

Qualifications: The Subcontractor for the fire alarm system shall have a factory Certified installation Technician. This person shall be required to certify that the drawings are in accordance with this specification and all referenced regulatory requirements and that the system is installed in accordance with the drawings and specifications.

Experience: The Subcontractor shall have a minimum of three (3) years experience in the installation of the Fire Alarm System(s).

Codes and Standards: All equipment provided and the installation of the fire alarm and supervisory system shall comply with the applicable sections of the following codes and standards:

NFPA 70
NFPA 72
NFPA 90A
NFPA 170

MAINTENANCE:

Training:

Factory training shall be provided at the INEEL for maintenance and operation for building occupants and LSS personnel. This training shall include factory certification for the LSS personnel to perform corrective and preventive maintenance.

PART 2--PRODUCTS

MATERIALS:

All materials, appliances, equipment or devices shall be new, UL listed for use in the intended application. All individual components and composite systems shall be designed for continuous operation without undue heating or change in rated values.

Circuit Breakers: Circuit breakers protecting fire alarm equipment shall be marked with red engraved phenolic resin tags with white lettering stating FIRE ALARM EQUIPMENT. A protective device shall be installed on these breakers to prevent inadvertent operation.

Batteries: All batteries shall be sealed, lead acid batteries.

Devices: Provide all devices required for a working system. Provide all new equipment including but not limited to terminal boxes, terminal strips, terminal lugs, conduit and wire.

Conduit: All wiring shall be in conduit. Conduit for the fire alarm system shall be dedicated for fire alarm circuits. Initiation and notification circuits shall not share the same conduit. See Section 16110 of this specification for conduit requirements.

Cable and Wire: Wire/cable shall not be spliced except on a terminal strip and shall be continuous up to termination points. New fire alarm cable shall be twisted shielded pair, 18 AWG or larger, stranded with seven strands per conductor, 300 volt. Fire alarm cable shall be power limited as described in NEC 760-51 (a) through (c).

Wire Labels: Brady type B-322, Self-Extinguishing Heat-Shrink Polyolefin or approved equal.

Spade Terminal Lugs: Spade lugs shall be used on all terminals when compatible. AMP stud size 6, for wire size 16 AWG or approved equal.

Terminal Strip: Terminal strips shall be compatible with spade terminal lugs. Any wiring not using lugs shall be tinned with solder prior to connecting to equipment. Terminal strips shall be rated 300 volts minimum, 15 Amps minimum. All terminal strips shall have barriers between terminals.

NOTE: Connecting un-lugged wires to terminals designed for lugs is prohibited.

Pressure Type Terminal Connections: Any wiring terminated to pressure type terminal connectors shall be tinned with solder prior to connection to equipment.

Manual Fire Alarm Pull Boxes: Manual fire alarm pull boxes shall be double action type with single pole double throw contacts mounted on a back box. "Break Glass" types are not acceptable.

Manual Fire Alarm Pull Box Weather-Resistant Enclosure: New manual fire alarm pull boxes shall be installed in a "Weather Stopper" II enclosure from Detection Tech, Redmond, WA or approved equal when located outdoors or in wet or damp locations.

## PART 3--EXECUTION

### INSTALLATION:

Horns shall be mounted in accordance with NPFA 72. Strobes shall be mounted with the horn. Mounting in suspended ceilings is permitted

Cable shields shall be terminated to the terminal point marked for terminating the shield. Cable shields not terminated shall be cut back to cable jacket and shall be insulated using heat shrink tubing (the only shield not connected will be the most remote location from the single ground connection). Cable shields shall not be connected in manner that creates a ground loop.

Fire alarm control panel and terminal boxes shall be mounted 6 feet above finished floor to top of enclosure unless specified otherwise.

Manual fire alarm pull boxes shall be mounted not less than 4 feet and no more than 4 1/2 feet above finished floor unless specified otherwise.

installing conduits or any other penetration is to be minimized in the top of any fire alarm control panel, or terminal box.

Notification: The fire alarm Subcontractor shall notify the Contractor in writing two weeks prior to beginning work. The Subcontractor shall not connect into or modify any part of the fire alarm system unless authorized by the Operating Contractor's Representative.

WORKMANSHIP

All work shall be done in a skillful and workmanlike manner. The Subcontractor shall do all construction work associated with the installation of equipment. No modifications or rearrangements, not shown on the drawings, shall be made without prior approval from the Contractor. After the equipment is installed, all wiring in enclosures shall be neatly secured in place by cable ties. Conductors in cabinets shall be carefully formed and harnessed.

Terminal lugs shall be crimped to conductors with a calibrated crimping tool. The crimping tool shall be compatible with lugs being crimped.

Wiring Styles: Initiating appliances and indicating appliances shall be wired so they are supervised by a direct current supervised system (see NFPA 72. Fire alarms shall be wired class B, style "B" two wire. Supervisory alarms circuit shall be wired class B, style "B" two wire. Wiring for supervisory and fire alarm circuits shall be to the normally opened contact (non-alarm condition) of the device or relay contact. Class B, Style "D" wiring shall have one twisted shielded pair with one twisted shielded pair in and one twisted shielded pair out. Wire connections shall be made up to the alarm device. Strobes and horns shall be wired Class B, style "W" two wire.

WIRE LABELING:

Twisted shielded pair conductors shall be labeled at each termination point for all circuits with heat shrink labels giving destination location. All wire labels shall be pre-typed, heat shrink labels and shall be heated for uniform shrinkage. Wire labels shall be installed such that the typed information is readily identifiable. To identify each type of device, an abbreviated ID has been assigned for wire label purposes (see E drawings for wire termination connections and abbreviation). The abbreviations shall be used for wire labels. The following list does not intend to be all-inclusive but shall be used as a standard for abbreviated labels.

| | |
|---|---|
| IT-1646-01-01-03 - | Junction terminal box - building 1646 - terminal box 1 - terminal strip 1 - terminal point 3. |
| 124XXXX - | Event number corresponding to hardware address within multiplex panel 24. |
| MFA - | Manual Fire Alarm |

| | |
|---|---|
| SD - | Smoke Detector |
| WF - | Sprinkler Waterflow |
| TS - | Fire Sprinkler Control Valve Tamper Switch |
| FACP-BA-01-02 - | Fire alarm control panel, row B, column A, terminal strip 1, terminal point 2. |

Spare cables shall be labeled. Spare cables shall be labeled giving building to building, enclosure to enclosure, or circuit type. Examples: SPARE 617/660, JA1604-01, PIV-1001.

Labeling Cable or Cable Bundles Between Enclosures: Cables or cable bundles from one enclosure to another enclosure shall be labeled.

Labeling shall include an abbreviated destination address identifying the terminal box or fire alarm panel and building number. The label shall also include the words "POWER LIMITED FIRE ALARM". Cables sharing the same raceway with the same destination may use a single cable label if cables are dressed and harnessed separate from other cables in the same enclosure.

The following is a list of abbreviations for enclosures and shall be used as standard when applicable.

| | |
|---|---|
| MIP | Multiplex Interface Panel |
| MP | Miniplex Panel (50 or 100) |
| JA | Surge Suppresser Terminal Box |
| JT | Junction Terminal Box |
| LP | Lighting Panel |
| ELP | Emergency Lighting Panel |
| FOSB | Fiber Optic Splice Box |
| TB | Terminal Box |
| MFA JT | Manual Fire Alarm Junction Terminal Box |

EQUIPMENT LABELING:

All terminal box numbers, panel numbers, and alarm device event numbers shall be labeled.

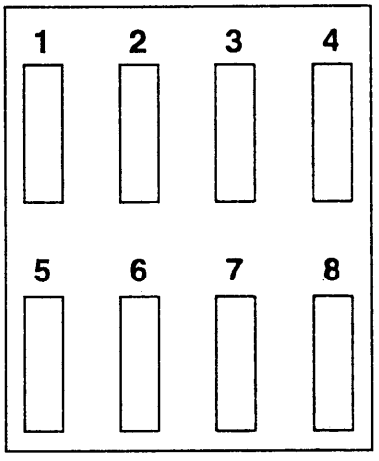
Labels shall be made upon red engraved laminated phenolic resin nameplates with white lettering. Lettering for event numbers shall be one half inch high. Lettering for terminal boxes and panels shall be 1 in. high. Labels for equipment shall be permanently installed by gluing, chaining, or screwing them to the equipment.

Labeling Modules Within An Enclosure: Modules shall be laid out in rows and columns for identification purposes. Modules shall be identified using a permanent marker identifying

their row and column location within an enclosure. The following is an example of how rows and columns should be laid out using a 6 row 4 column array.

| | | | |
|---|---|---|---|
| AA | AB | AC | AD |
| BA | BB | BC | BD |
| CA | CB | CC | CD |
| DA | DB | DC | DD |
| EA | EB | EC | ED |
| FA | FB | FC | FD |

The following is a standard of how a terminal strips would be laid out with two rows and four columns.




Label List: The Subcontractor shall provide a list of labels associated with each fire alarm panel for approval prior to installation. The list shall include labels for fire alarm panels, terminal boxes, and alarm devices. The label lists shall be submitted for review and approval prior to installation specifying where they will be used.

FIELD QUALITY CONTROL:

Subcontractor Supplied Testing: Upon completion of the fire alarm system installation, the individual with the factory certification shall conduct the final inspection of the installation in accordance with the working drawings and meets the design requirements of this specification.

Acceptance test procedure: The acceptance test procedure shall comply with NFPA 72 Inspection and Testing Form. The Subcontractor shall conduct the acceptance using an approved acceptance test procedure document. The acceptance test will verify that all equipment has been installed properly and is operable before connecting it to the INEEL proprietary fire alarm system. Adjustments and settings to achieve correct operation will be made as necessary during the acceptance test. Completed acceptance test document shall be submitted to the Contractor's Representative after the test.

All Subcontractor supplied equipment shall test satisfactory or be repaired or replaced at no additional cost to the Contractor

Test Report: Provide a test report for each terminal box enclosure. The test report shall measure resistance and stray voltages on all alarm wiring.

Resistance Measurements: Resistance measurements shall be made with an analog meter with an input impedance of 20K ohm per volt or greater. A digital meter SHALL NOT be used to make resistance measurements.

Meggering Testing: Prior to terminating, the cable or wire of 25 ft or longer shall be tested for insulation resistance with a megger (500 V megger for 300 V insulation). Any conductor with less than 10 megohms to ground shall be replaced before proceeding with the terminating. List the conductors tested on a test data submittal sheet. No meggering test shall be performed with wiring connected to modules or panels.

Contractor supplied surveillance:

Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications. The Contractor's Representative shall be present during system testing and at the time that final connections to existing systems are made

END OF SECTION 16721

# SECTION 16725--EMERGENCY NOTIFICATION SYSTEM

## PART 1 GENERAL

### SUMMARY:

This specification describes the work required to provide an emergency notification audio system which is to be used for distribution of voice messages of an emergency nature.

Section Includes: Work includes, but it not limited to:

1. Provide Control Panel and Microphone input.
2. Provide and install speakers throughout the facility.
3. Provide and install wiring and conduit to provide a complete and operational system

### REFERENCES:

The following documents, including others referenced therein, form part of this Section to the extent designated herein.

**[DELETE UNUSED REFERENCES]**

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | National Electrical Code |
| NFPA 72 | National Fire Alarm Code |
| NFPA 101 | Life Safety Code |

### DESIGN REQUIREMENTS:

The emergency communication system described herein shall provide the capability of emergency notification using voice and tone messages over speakers.

The design shall comply with NFPA 72 requirements.

### SUBMITTALS:

Submittals include, but are not limited to the following:

Manufacturer's specification
Equipment label list

Wire label list
Record of completion as required by NFPA 72
Owners manual
Wire and cable tests including opens, shorts, and impedance
Fiber optic cable power test results for light loss end to end
Battery backup design calculations
Notification appliance design calculations
A copy of the proposed system acceptance test after approved design and prior to construction
One copy of the completed As-built drawings for the emergency notification system
A copy of the installer's certification and experience

Design: The system design shall be submitted as a complete package for review. Partial submittals will be considered as incomplete and will not be reviewed. The Contractor prior to beginning of installation must approve the design.

Proof of certification per Qualification requirements shall be provided with the design package.

Design drawings shall comply with the requirements of Section 01300, Submittals. All design drawings shall be prepared by factory Certified Engineering Technician

.Procedures: An acceptance test procedure shall be submitted by the subcontractor and approved prior to testing.

Test Reports: Completed acceptance test documents shall be submitted to the Contractor's Representative (LSS) after the test.

See Section 01300, Submittals and the Vendor Data Schedule for additional submittal requirements.

QUALITY CONTROL:

Standards: Comply with requirements of the current revision of the following codes and standard, as specified in these specifications:

NFPA 70
NFPA 72

PART 2--PRODUCTS

MATERIAL:

Listing or Approval: All emergency communications systems materials, components and assemblies shall be UL listed or FM approved for fire alarm occupant notification system

All individual components and composite systems shall be designed for continuous operation without undue heating or change in rated values.

Circuit Breakers: Circuit breakers protecting emergency communications equipment shall be marked with red engraved phenolic resin tags with white lettering stating EMERGENCY COMMUNICATIONS EQUIPMENT

Batteries: All batteries shall be sealed, lead acid batteries.

Devices: Provide all devices required for a working system. Provide all new equipment including but not limited to terminal boxes, transient eliminators, terminal strips, terminal lugs, conduit and wire.

Conduit: All wiring shall be in conduit. Conduit for the emergency communication system shall be dedicated for the emergency communication system circuits. See Section 16110 of this specification for conduit requirements.

Speakers: Speakers shall be 25 vdc, multiple tap, for ceiling or wall mounting System sensor model SP101W, model SP100W or approved equal.

Cable and Wire: Wire/cable shall not be spliced except on a terminal strip and shall be continuous up to termination points. The cable shall be twisted shielded pair, 18 AWG minimum, stranded with seven strands per conductor, 300 volt. The cable shall be power limited as described in NEC.

Wire Labels: Brady types B-322, Self-Extinguishing Heat-Shrink Polyolefin of approved equal.

Spade Terminal Lugs: Spade lugs shall be used on all terminals when compatible. AMP stud sizes 6, for wire sizes 16 AWG or approved equal.

Terminal Strip: Terminal strips shall be compatible with spade terminal lugs. Any wiring not using lugs shall be tinned with solder prior to connecting to equipment. Terminal strips shall be rated 300 volts minimum, 15 Amps minimum. All terminal strips shall have barriers between terminals.

NOTE: Connecting un-lugged wires to terminals designed for lugs is prohibited.

Pressure Type Terminal Connections: Any wiring terminated to pressure type terminal connectors shall be tinned with solder prior to connection to equipment.

Transient eliminator: A JA (Junction Arrestor) box shall be installed on all metallic wire circuits entering a building from the outside and connected to a control panel. Transient eliminators shall be used to protect existing panels from lightning. Transient eliminators, shall be provided for, and be compatible with emergency notification circuits, control panel communications, and 25 or 70 volt audio circuits. . If transient eliminators shall be installed in a NEMA 1 enclosure with hinged cover that can latch closed. Transient eliminators shall be compatible with notification appliances from 24 vdc to 70-volts. Transient eliminator shall be wired and bonded to building grounding system

PART 3EXECUTION

INSTALLATION:

Install all emergency communications systems equipment, components, materials, including conduit and wire to provide a complete and workable system. The speakers shall be as indicated on the speaker installation table.

Conduit: Conduit for the voice paging system shall be dedicated for emergency communication system circuits. Notification appliance circuits shall not share conduit with other circuits. All wiring shall be in conduit.

Speaker Mounting: Speakers shall be mounted in accordance with NPFA 72. Mounting in a false ceiling is permitted.

LABELING:

Tags: Tags shall be made up on engraved laminated phenolic resin nameplates (color black) with white lettering. Unit tags shall be made with one half-inch high lettering. A tag shall be permanently attached at each device. The tag shall contain the information given in the notification appliance device table.

Labeling Twisted Shielded Cable: TSP cable(s) shall be labeled at each termination point with typed heat shrink labels. Heat shrink labels shall be heat shrunk for uniform shrinkage. Labels shall state the circuit type (Emergency Communications circuit ECSPK).

Wiring Styles: The emergency communications speaker circuits shall be wired so they are supervised by a direct current supervisory system. The wiring shall be class B, style W. See NFPA 72 Table 3-7.

(1-TSPCircuits, which leave building shall be connected to a transient eliminator.

FIELD QUALITY CONTROL:

Subcontractor Supplied Testing: The Subcontractor shall set all speakers taps at the tap setting shown in the speaker installation table to meet sound pressure levels as required in NFPA 72.

The complete system shall be tested to insure that the system performs the required functions. As a minimum the tests shall include the manufacturer's start up procedures, acceptance procedures, requirements listed in NFPA 72 and the following mandatory test list.

Mandatory Tests: Mandatory tests include:

Minimum and maximum dbA level tests with the sound pressure meter placed 5 feet above the floor and 10 feet away from the speaker.

Contractor Supplied Surveillance:

Surveillance will be performed by the Contractor's Representative to verify compliance of the work to the drawings and specifications. Inspection of equipment, installation and witnessing of all tests shall be accomplished by the Contractor's Representative.

END OF SECTION 16725

# SECTION 16918--UNIT SUBSTATION

## PART 1--GENERAL

### SUMMARY:

The Subcontractor shall provide, install, and test all the components of the Unit substation as described in this specification and shown on the drawings.

Section includes but is not limited to:

Requirements for and installation of a Unit Substation consisting of fused interrupter switches, transformers and sections of distribution switchgear.

Related Sections:

03300 Cast-In-Place Concrete

### REFERENCES:

The following documents, including others referenced therein, form part of this section to the extent designated herein:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI C37.13 | Low-Voltage AC Power Circuit Breakers Used in Enclosures |
| ANSI C37.16 | Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors. Preferred Ratings, Related Requirements and Application Recommendations |
| ANSI C37.20.3 | Standard for Metal Enclosed Interrupter Switchgear |
| ANSI C37.47 | Specification for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current Limiting Fuses |
| ANSI C37.50 | Test Procedures for Low-Voltage AC Power Circuit Breakers Used in Enclosures |
| ANSI C57.12.01 | General requirements for Dry Type Distribution and Power Transformers |
| ANSI C57.51 | Conformance Testing of Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies |
| ANSI C57.12.70 | Terminal Markings and Connections for Distribution and Power Transformers |
| **ANSI C57.12.80** | **Standard Terminology for Power and Distribution Transformers** |
| ANSI C57.12.91 | Test Code for Dry-Type Distribution and Power Transformers |

| | |
|---|---|
| ANSI C57.94 | Recommended Practice for Installation, Application, Operation and Maintenance of Dry Type General Purpose Distribution and Power Transformers |
| ANSI C57.96 | Loading Dry-Type Distribution and Power Transformers |
| ANSI C57.98 | Guide for Transformer Impulse Tests |
| ANSI C62.1 | Standard for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Power Circuits |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| **NEMA SG-3** | **Low-Voltage Power Circuit Breakers** |
| NEMA SG-5 | Power Switchgear Assemblies |

UNDERWRITERS LABORATORIES INC. (UL)

| | |
|---|---|
| **UL 1558** | **Metal Enclosed Low Voltage Power Circuit Breaker Switchgear** |
| UL 1066 | Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures |

SUBMITTALS:

Submittals include, but are not limited to the following:

- Wiring Diagrams
- Operation & Maintenance Manuals
- Recommended Spare Parts List
- Shop Drawings
- Factory Test Procedures for Load Interrupter Switch Transformer Circuit Breakers
- Factory Test Reports for Load Interrupter Switch Transformer Circuit Breakers
- Handling and Storage Instructions
- CC Test Procedures
- CC Test Report

See Vendor Data Schedule for additional submittal requirements.

QUALITY CONTROL:

Qualifications:

The unit substation assembly shall be suitable for and certified to meet all applicable seismic requirements of the Uniform building Code for zone 2B application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment.

DELIVERY, STORAGE AND HANDLING:

Equipment shall be handled and stored in accordance with the manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at the time of shipment.

Accessories shall be packaged and shipped separately. Each piece of gear shall be equipped with lifting eyes for handling solely by crane.

PART 2--PRODUCTS

MANUFACTURERS

The design was based on the use of Cutler-Hammer, however, Square D or General Electric may be used provided that: (1) all such equipment meets these specifications, (2) any form or fit related design changes from the selection of a supplier other than that used for the bases for design shall be made by the Construction Subcontractor at his cost and responsibility, and (3) red-lined drawings provided by the Construction Subcontractor shall include these design changes.

Unit Substation Assembly:

The entire assembly shall be rated to withstand mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage.

The assembly shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. The assembly shall be rated NEMA-3R suitable for outdoor use.

The ground busses in each section shall be bonded together.

The assembly shall be shall be provided with adequate lifting means.

The switchgear shall be suitable for use as service entrance and be labeled in accordance with UL requirements.

LOAD INTERRUPTER SWITCH (LOAD BREAK):

Ratings:

Load Interrupter Switchgear Ratings shall be as follows:

| | | |
|---|---|---|
| Nominal System Voltage | | |
| | 3.8 kV three-phase three wire System Grounding | Low |
| Resistance | | |
| | Maximum Design Voltage | 15 kV |
| | Basic Impulse Level | 95 kV |
| | Bus Continuous Current | 600 |
| Amperes | | |
| | Momentary Current | 80 kA |
| | Two Second Current | 38 kA |

Construction:

The metal enclosed load interrupter switchgear shall consist of dead front, completely metal enclosed vertical section, containing load-interrupted switch.

The following features shall be supplied on the vertical section containing a three-pole, two-position open-closed switch:

A high impact viewing window that permits full view of the position of all three-switch blades through the closet door.

The door shall be interlocked with the switch so that:

The switch must be opened before the door can be opened.

The door must be closed before the switch can be closed.

A grounded metal barrier in front of every switch to prevent inadvertent contact with any live part, yet allow for a full-view inspection on the switch blade position.

Provision for padlocking the switch in the open or closed position.

Permanent "Open-Closed" switch position indicators.

Vertical section construction shall be of the universal frame type using die formed and bolted parts. All enclosing covers and doors shall be fabricated from not less than 11-

gauge steel. To facilitate installation and maintenance of cables and bus in the vertical section, and a removable rear cover shall be provided.

The vertical section containing a switch shall have a single, full length, flanged front door and shall be equipped with two rotary latch type padlockable handles. Provisions shall be made for operating the switch and storing the removable handle without opening the full-length door.

Each load interrupter switch shall have the following features:

1. Three-pole gang operated.
2. Manual quick-make quick-break over toggle type mechanism that does not require the use of a chain or a cable for operation, and utilizing a heavy duty coil spring to provide opening and closing energy.
3. The speed of opening and closing the switch shall be independent of the operator and it shall be impossible to tease the switch into any intermediate position under normal operation.
4. Separate make and break contacts to provide maximum endurance for fault close and load interrupting duty.
5. Insulating barriers between each phase and between the outer phases and the enclosure.
6. A maintenance provision for slow closing the switch to check switch blade engagement and slow opening the switch to check operation of the arc interrupting contacts.
7. Each switch shall be provided with 2NO and 2NC auxiliary contacts for monitoring. Contacts to be rated 10 amps @ 125 Vac/1 amp @ 125 Vdc.
8. Switches shall be provided with 120 V heaters and adjustable thermostats per the manufacturer's recommendations.

Bus:

All phase bus conductors shall be copper and mounted on indoor NEMA class insulators.

Ground bus conductors shall be copper and directly fastened to a bare metal surface of the vertical section, and be of a size sufficient to carry the rated 2-second current of the switchgear assembly.

Wiring/Terminations:

One terminal pad per phase shall be provided for attaching subcontractor supplied cable terminal lugs for a maximum of two conductors per phase of the sizes indicated on the drawings. Sufficient space shall be supplied for subcontractor supplied electrical stress relief termination devices. Wire NO and NC and heaters to a TB in the LV Switchgear. Connect heater to same source as heater in LV Switchgear.

Fuses:

Fault protection shall be furnished by fuses rated as shown on the contract documents. The fuses shall have a minimum interrupting rating of 85K amperes symmetrical at 13.8 kV and shall be current limiting type. Three (3) spare fuses shall be provided. Fuses shall be sized in accordance with nameplate and recommendations from the transformer's manufacturer and concurrence with the fuse manufacturer.

Accessories:

15 kV class surge arresters shall be provided and connected at the incoming terminations and securely grounded to the metal structure. The arresters shall not be rated less than 125% of maximum phase to phase voltage at the point of application. The conductor between surge arrester and ground shall be #6 AWG minimum.

TRANSFORMER:

Ratings:

| | |
|---|---|
| KVA | 750/1000 AA/FA |
| Primary Voltage | 13800 Delta |
| Secondary Voltage | 480/277 Wye |
| Phase | 3 |
| Hertz | 60 |
| Impedance | 5.75% |
| Temperature Rise | 100 °C |
| Ambient (Avg/Max) | 30°C/40°C |
| HV BIL | 60 kV |
| LV BIL | 10 kV |
| Taps | FCAN 2 @ 2.5% (above)<br>FCBN 2 @ 2.5% (below) |

Construction:

The unit shall contain all necessary components and wiring, including fans, for automatically increasing the kVA rating by 33%. The forced air package shall include an electronic temperature monitor and fan control unit. The temperature monitor and fan control shall include digital readout, GREEN-power on, YELLOW-fan on, RED-high temperature indicating lights; audible high temperature alarm with alarm silence pushbutton; maximum temperature memory with read and reset switch; auto/manual fan control switch system test switch; temperature sensing in all three (3) low voltage coils. Auxiliary alarm contact and means for remote control and temperature monitoring shall be provided. Control power shall be provided from a control power transformer in the secondary equipment compartment.

The electrical insulation system shall utilize a 185°C-class material. The transformer design temperature rise shall be based on a 30°C average ambient temperature over a 24-hour period with a maximum of 40°C. Solid insulation in the transformer shall consist of inorganic material such as glass fiber, electrical grade epoxy and Nomex. All insulating material must be rated for continuous 185°C duty.

The primary coil assemblies shall be cast coil design and the secondary coil assembly shall be a Dynicast design. Each cast coil shall be cast under vacuum to assure complete, void-free epoxy resin impregnation throughout the entire insulation system.

The high and low-voltage windings shall be aluminum.

The transformer shall be designed to meet the sound level standards for dry-type transformers as defined in NEMA TR-1.

The transformer compartment shall include thermostatically controlled space heaters energized from a fused control power transformer connected to the primary side of the substation transformer.

The transformer shall include a diagram instruction plate, a removable panel for access to the high voltage taps for de-energized tap changing, and two ground pads.

LOW-VOLTAGE SWITCHGEAR:

Ratings:

| | |
|---|---|
| Voltage: | 480Y/277 Volts-3 phase, 4 wire |
| Amperage: | 1200 Amperes |
| Interrupting Rating: | 65,000 Amperes Symmetrical |

Construction:

The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 ° C over a 40° C ambient.

Provide a full capacity neutral bus.

A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbutton, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on the manufacturer's wiring diagrams.

Mechanical type terminals shall be provided for all load terminations and shall be suitable for copper cables rated for 75°C for the size as indicated on the drawings.

All control wiring shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. Provide wire markers at each end of all control wiring.

The switchgear compartments shall include thermostatically controlled space heaters energized from a fused control power transformer connected to the primary side of the substation transformer.

The main protective device shall be a fixed mounted low-voltage power air circuit breaker. Cutler-Hammer type Magnum DS or approved equal. Frame rating shall be 1600 amperes. The circuit breaker shall be UL listed for the application in its intended enclosures for 100% of its continuous rating.

The trip unit shall include long delay protection, short delay protection, instantaneous protection and ground fault protection.

Feeder protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes.

Feeder protective devices shall be equipped with an undervoltage release mechanism as shown on drawings.

Circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000 amperes.

Circuit breakers shall be provided as shown on the one line diagram.

PART 3--EXECUTION:

Preparation for Delivery:

After testing, the unit substation shall be broken down into shippable units. Each unit shall be adequately protected during shipment to prevent physical damage and entrance of moisture and foreign matter.

All boxes and crates shall be clearly labeled containing part number, serial number, purchase order number and any other pertinent information that may be required by the purchase order. The supplier shall identify and prepare required documentation such as unloading and storage instructions, which are to accompany the equipment during shipment:

Quality Control:

Inspection: The Contractor and his designated representatives shall have access to supplier's facilities during the fabrication and testing of the equipment for the purpose of inspecting the equipment.

Unit Substation Testing (Factory): The Unit Substation shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear shall be tested for operation under simulated service conditions to assure the accuracy of the wiring and operation of all equipment. Tests of circuit breakers shall include testing of all circuit breakers over 200 amperes and 10% of all circuit breakers under 200 amperes, and testing of all undervoltage release mechanisms. All testing shall be in accordance with ANSI C57 and C37. Subcontractor shall submit a factory test procedure for review by the Contractor prior to testing.

Witnessing Tests: The supplier shall be responsible for the performance of all tests. The Contractor reserves the right to witness all tests. The Contractor shall be notified in writing at least three weeks prior to conducting the factory tests. Provide test reports.

Field Quality Control:

The Subcontractor shall inspect all components upon arrival and before installation to insure damage was not inflicted during shipment and storage.

The Subcontractor shall perform field testing in accordance with NETA to determine that the components were not damaged or became out of adjustment during shipping, storage and re-assembly.

The following NETA sections shall apply:

| | |
|---|---|
| 7.1 | Switchgear |
| 7.2.1.2 | Transformer |
| 7.5.1.2 | MV Switch |
| 7.6.1.1 | Molded Case Circuit Breaker |

Prior to any testing, factory or field, the Subcontractor shall submit detailed test procedures for review and approval.

END OF SECTION 16918