

## **SECTION 16300 - MEDIUM VOLTAGE POWER SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 SCOPE OF SECTION:**

This section contains the requirements for equipment and installation (including manholes, switch vaults and pull boxes) relating to the Sub-transmission, Distribution, and Control of electric power ranging from 601-Volts to 25,000-Volts, such as substations, switchgear, circuit breakers, and transformers.

#### **1.2 GENERAL:**

- A. The medium voltage power system at the University of Florida is composed of two distinct systems: the Sub-transmission system at 22.9 kV (25kV Nominal) and the Distribution system at lower voltages (15 & 5kV Nominal). Verify voltages based upon location on campus. The Sub-transmission system is used to maintain service to large loads and to electrical substations, which step down Sub-transmission voltages to Distribution voltages. Substations are located around campus and form the nodes of the Distribution system, which supplies power to campus facilities.
- B. For reliability, single unit redundancy shall be provided on both the Sub-transmission and the Distribution System.
- C. System design shall ensure that the failure of any single component of the Sub-transmission or Distribution system shall not prevent the system from carrying the full sectional Campus load. Projects adding load to the system shall include, upgrades or expansion of the system to maintain this redundancy.
- D. New facilities are normally to be powered only from the Distribution system, but large projects may be powered from the Sub-transmission system with the approval of PPD (such as with the addition of very large, new loads, e.g., over 1,500 kVA). All new facilities shall be provided with the appropriate redundancy noted above. Over-current protection and switchgear shall be provided to maintain noted redundancy.
- E. Underground Transmission and Distribution are the preferred methods of new electrical infrastructure construction on campus. Underground construction methods shall include ancillary support equipment, such as switchgear, etc. where visible. Above ground equipment, such as MV switchgear, shall be concealed from view. Additions to existing overhead line construction will be allowable in order to extend service or to upgrade existing system's reliability.
- F. Additions to existing overhead line construction will be allowable in order to extend service or to upgrade existing system's reliability. All poles to be concrete unless approved by PPD, with vertical construction. All cut outs shall be installed outside of the phases.

#### **1.3 UNDERGROUND CABLE:**

##### **A. MATERIAL:**

1. Existing Primary cables on Campus include PILC, EPRLC and EPR. New cables may

be matched to existing when repairs or splicing occurs. New cabling shall be designed with Ethylene Propylene Rubber (EPR) insulation and PVC jacket.

2. Jacket shall be imprinted with size of conductor, manufacturer's name, type of insulation material, and date of manufacture.
3. All medium Voltage cabling on the 5, 15, and 25kV systems shall have 133% insulation and circuiting shall be comprised of three phases of single conductor, copper tape shielded power cables plus a 600V insulated ground wire sized per circuit ampacity. The ground wire shall not be less than a No. 2 copper wire.

**B. EXECUTION:**

1. "High pot" all cable and splices as a system. Provide copy of test to PPD at the time of Substantial Completion.
2. Splicing shall only be performed by certified cable splicers.
3. Cables shall be identified at their point of termination and where they enter and exit a manhole, switch vault, etc. with a tag. Minimum size shall be 1" x 2" with 3/4" letters, identifying the circuit number and source. Tags shall be attached with non-metallic, fungus-resistant, heat stabilized, self-extinguishing cable ties made of nylon.
4. Voltage phasing shall be maintained and guaranteed by the Constructor (or Electrical Subcontractor) on all feeders spliced or terminated prior to energizing electrical service to the building. Phasing shall be witnessed by PPD Systems. Contact PPD a minimum of 24 hours in advance to arrange for PPD witnessing.
5. All splices shall be individually grounded to the manhole grounding system.

**1.4 MEDIUM VOLTAGE SWITCHES:**

**A. EXISTING SWITCHGEAR:** If oil is used to refill an existing oil switch, it shall be tested per ASTM D877 testing procedures to 30k V prior to energizing.

**B. NEW SWITCHGEAR:** New underground installations, which require interface with an existing oil switch, shall be responsible for replacement of the oil switch with a new SF6 switch. SF6 shall incorporate: vacuum bottle fault interruption, visible blade source switching and gas insulation to minimize the profile (size) of the gear. SF-6 switches shall also have the following attributes:

1. Switching shall have "make before break" operation.
2. Switching shall have the "anti-tease" feature.
3. Feeder protection by electronically selectable over current ratings. These ratings are to be pre-set, prior to energization, for all calculated operating load conditions.
4. Underground switchgear shall be the required design for new projects. The placement of above ground switches may be allowed where concealed and immediately adjacent to a building and/or its transformer or for Chilled Water Plants, Substations, etc. All new Medium Voltage padmounted switchgear

intended for use underground shall have waterproof, stainless steel tanks and control boxes.

5. The vaults shall have operable, hinged doors (covers), an open bottom for drainage and adequate room for primary cabling to circle the vault prior to termination. The bottom of vault shall include a minimum of 8-inches of ¾ inch gravel to promote drainage.
6. All new Medium Voltage padmounted switchgear shall come System Control And Data Acquisition (SCADA) ready, with the following features:
  - a) Auxiliary Switches: Indication of Fault Interrupter position and Load Interrupter position. Dry contacts to be terminated in a low-voltage enclosure with terminal blocks.
  - b) Remote Low Pressure Alarm: Provisions only (plugged pressure gage dog) for a future low pressure warning device.
  - c) Motor Operator Package: Provisions only to allow retrofit of motor operator to achieve remote control without replacement of the switch or the switch enclosure.
  - d) External Trip: Provisions to allow an external signal to open a fault interrupter.

C. MAINTENANCE SUPPLY: Provide one tank of extra SF6 gas at the time of Substantial Completion.

D. ACCEPTABLE MANUFACTURERS: G&W or S&C or approved equal.

## 1.5 TRANSFORMERS:

### A. GENERAL:

1. Transformers shall have all-copper windings.
2. Electric panels shall not be mounted inside transformer enclosures.
3. Dry-type transformers are not to be used on the exterior of buildings, unless approved by PPD. Oil-type transformers are preferred.
4. All transformers are to be new. Rebuilt transformers are allowed under emergency conditions only when performing maintenance.
5. Transformers shall be Radially fed only, with an upstream SF-6 switch to de-energize the transformer. New transformers shall be configured with load break elbows (separable connectors), with internal wiring of either the loop or radial feed design. The Loop feed design shall only be utilized for simplifying the wiring congestion within the High Voltage compartment. All unused connections shall be plugged "safe". The preferred design is to use a loop fed transformer with the surge lighting arrester inserted into the second set of loop bushings. When the transformer is internally wired as a Radial feed transformer, the surge arrester may be plugged into the back of the separable connector, or into special feed through inserts. Surge arresters shall be of the Metal Oxide Varistor Elbow

(M.O.V.E) style. NOTE: All transformers shall configure with external, visible, separable connector type lighting/surge arresters. The lighting/surge arrester Basic Impulse Level (BIL) ratings shall be selected based upon actual design operating voltage and electrical system configuration (Wye/Delta).

6. Acceptable Manufactures: ABB, Cutler Hammer, GE, Square D or approved equal from an Original Equipment Manufacturer.
7. All conduits shall enter & exit transformer from beneath the pad.

B. TESTING: All transformers 300kVA and above shall be tested for winding resistance, Transformer Turns Ratio (TTR) and oil dielectric per the latest ANSI C57 and ASTM D877 industry standards. The test results shall be given to PPD Systems department prior to energization.

C. OIL TYPE, PAD MOUNT:

1. Specify the following features: replaceable MOV Elbow surge arresters, internally wired Loop feed transformers types may have source on/off switching for energizing surge arrester, oil sampler; spare fuses (one set minimum); lifting hooks; externally operated tap changer with two taps at 2.5% above and two taps at 2.5 % below nominal voltage.
2. New transformers shall be of the Load Break Elbow (separable connector) design. Allow side bushings shall be configured with NEMA two hole spade type bushings for three phase transformers. On/Off switching on the primary side may be included as a feature to ease the operation of the local transformer.
3. All three-phase oil filled transformers above 150kVA shall have a pressure/vacuum gauge, thermometer with re-settable maximum reading indicator, Schraeder valve, oil drain gate valve and a pressure relief device installed. Configure secondary conduit placement in a manner consistent with the Manufacturer's shop drawing information on the drain oil sampling valve location, and configure wiring to assure the sampling operation can occur without having to disconnect secondary cabling.
4. Oil shall have a minimum dielectric rating of 30 kV, per ANSI test.
5. High voltage compartment shall be separated from low voltage compartment by a protective grounded metal barrier.
6. Transformer shall be located to be visually unobtrusive. Provide a reinforced, cast in place (or pre-cast) transformer pad (minimum 6-inches in height) to protect the cabling and bottom of the transformer.
7. Transformers shall be turned over to PPD Systems with a positive pressure of a 2-psi of Nitrogen Gas Blanket above the transformer oil. PPD Systems may require retesting of the transformer if the oil pressure stays at zero psi regardless of ambient temperature and various transformer loadings.

D. OIL TYPE, POLE MOUNT: Specify two-bushing type. High side shall have "eyelet" connectors; low side shall have "eyelet" connectors up to 167 kVA and above 167kVA shall be NEMA Standard two hole spade-type bushings on low side. Provide the bushings with the number of holes and spade length appropriate to connect the quantity of secondary conductors specified. Placement of cabling lugs on both sides of the spade is acceptable.

The intent is to prevent obtaining a spade so short that attaching (lugging) on both sides and double lugging on one side of the spade is required to connect all of the design wiring conductors.

## 1.6 **ELECTRICAL MANHOLES:**

**General:** Covers shall be of the double door, spring assist, traffic rated design.

- A. Minimum size shall be 10'X 10' with a standard height of 96-inches minimum ceiling height. For shallow installations and only when avoiding conflicting conditions or utilities, a 78-inches minimum ceiling height is acceptable.
- B. Construction shall be pre-cast reinforced concrete or cast-in-place. Entire structure shall be traffic rated per Florida DOT standards.
- C. Provide a 12" X 12" X 12" sump with grate located directly beneath inner concentric cover (pumping ring) or below one of the double doors.
- D. Entire exterior shall be coated with bituminous waterproofing mastic.
- E. Locate pulling eyes opposite raceways.
- F. Manhole Covers:
  - 1. All manhole covers shall be traffic bearing regardless of location. Square, or rectangular, covers shall be hinged for safety and spring-assisted for ease of opening. All covers shall be fastened with steel penta-head bolts. Lids shall be marked "ELECTRIC" and have permanent marking of Manhole identification with ID Number. Welded or brass.
  - 2. New Manholes/Switch/Vaults: Provide with hinged, operable covers
- G. All manholes shall have a driven ground rod,  $\frac{3}{4}$  inch by 10 foot in length, with a maximum resistance reading of 25 Ohms. Ground rod shall be cad-welded to grounding conductor. Ground rod shall be connected to a fully closed loop of grounding conductor, which is used to bond all splices and non-current carrying electrical equipment in manhole. Connections shall be made to racks with listed connectors suitable for the purpose. Loop of conductor shall be between 12 inches and 24 inches above floor and shall be securely attached to wall of manhole.
- H. Cables in manholes shall be placed on porcelain insulators on suitable racks. Cables shall be secured by cable ties which are fungus resistant, ultra-violet, heat stabilized and made of self-extinguishing nylon material.

Each cable shall be fireproofed, individually by phase, with a tape listed for the purpose, equivalent to Scotch Brand #7700. Fire proofing tape shall be overlapped with a half turn and shall be installed into the conduit 1inch or more. Fireproofing tape shall be binder wrapped with a glass cloth tape also listed for the purpose equivalent to Scotch Brand #27.

The length of any cable in manhole shall be not less than half the circumference of the interior of the manhole. This dimension shall be determined for a contiguous, unspliced length of cable, from the point where the cable enters the manhole to the point where it exits the manhole.

If the newly installed cable is to be connected to an existing cable within the manhole, the newly installed cable shall have a length of not less than one half circumference of the manhole from the point where the cable enters or exits the manhole, to the point of connection to the existing cable. The existing cable shall not be required to be one half manhole circumference if that amount of length does not exist. However, the existing cable shall not be shortened without written permission from the Systems Department Assistant Director.

- I. Maximum distance between primary wiring manholes shall be 450 feet. Distance between secondary wiring manholes shall not exceed 450 feet, and shall not exceed distances, which would cause tensions to exceed (any of) the wiring manufacturer's recommended maximum pulling requirements.
- J. All cable racks, mounting equipment, etc. shall be hot dipped galvanized, stainless steel, or industrial grade fiberglass/plastic. Porcelain insulators shall be utilized for cable supports when attaching cables to the racks. Provide tie wraps to attach cables to insulators, and then to racks.

#### 1.7 **SWITCH VAULTS:**

- A. Switch Vaults shall be coordinated with the actual switchgear intended for proper clearance for cabling and operation of the switchgear.
- B. Switch Vaults shall be provided with hinged, operable covers of the re-enforced aluminum door design, with tread plates and a DOT 3 traffic rating for the entire structure. Doors shall be spring or hydraulically assisted and shall include a lockable penta-head device with stainless steel bolt.
- C. Hinged doors shall be sized to accommodate replacement of the switch and the function of the structure.
- D. Switch Vaults shall have a driven ground rod,  $\frac{3}{4}$  inches by 10 foot in length, with a maximum rating of 25 ohms.
- E. Switch Vaults with double door type design shall have an open bottom manhole with a minimum of eight inches of  $\frac{3}{4}$  inch (nominal) gravel.

#### 1.8 **PULL BOXES:**

General: Pull boxes on the primary system are discouraged unless necessitated by the site conditions.

- A. MINIMUM SIZE: The minimum size for pull boxes shall be 6' x 6' x 6' deep. Larger size may be required for installed conductors.
- B. CONSTRUCTION:
  - 1. Construction shall be pre-cast reinforced concrete only.
  - 2. Entire structure shall be traffic rated per Florida DOT standards.

- C. MAXIMUM SPACING: Maximum distance between pull boxes shall be 475 feet.
- D. COVERS: Pull box covers shall be of double door reinforced aluminum with a locking and opening mechanism which incorporates a penta-head stainless steel bolt. Covers shall be fastened with stainless steel penta-head bolts.
- E. GROUND ROD: All primary wiring Pull boxes shall have a  $\frac{3}{4}$  inch by 10 foot long ground rod with a maximum resistance reading of 25 ohms. Ground rod shall be cad-welded to grounding conductor. Ground rod shall be connected to a fully closed loop of grounding conductor, which is used to bond all splices and non-current carrying electrical equipment in pull box. Connections shall be made to racks with listed connectors suitable for the purpose. Loop of conductor shall be between 12 inches and 24 inches above floor and shall be securely attached to wall of pull box.

END OF SECTION