PART 1: GENERAL

1.01 WORK INCLUDED
A. Most new loads will be served from the underground electric distribution system. This system is a primary open loop configuration served by an effectively grounded source operating at 13.2 kV. Primary switching and over-current devices shall be designed for 500 MVA of available fault current.

1.02 SUBMITTALS
A. Products described in this section shall be submitted for review to Cornell University’s Electrical Utility Engineer, before ordering equipment.

PART 2: PRODUCTS

2.01 MEDIUM VOLTAGE CABLE
A. 13.2 kV System
   1. Single conductor.
   2. Copper conductor, standard sizes: #2/0, 350 kcmil.
   3. 15 kV EPR insulation, 220-mil (133%), 105 degrees C.
   4. Copper tape shield, 5-mil.
   5. Extruded conductor screen and insulation screen.
   6. PVC jacket, 80-mil minimum, rated for cable tray use.

B. 2.4 kV System
   1. Single conductor.
   2. Copper conductor, standard sizes: #2, 350 kcmil.
   3. 5 kV EPR insulation, 125 mils minimum (100%).
   5. PVC jacket, 80-mil minimum, rated for cable tray use.
2.02 DUCT BANKS

A. No less than two - 5" schedule 40 PVC ducts per duct bank.

B. The duct bank shall be encased in reinforced concrete.

C. A minimum of five feet of clearance shall be maintained from steam and condensate lines.

D. Contractor shall verify duct bank continuity by pulling a 4-1/2" mandrel through each duct.

E. Plastic bell ends and plugs shall be used in the manhole and building.

F. Install a 3/16" diameter nylon fish in all ducts.

G. Minimum 48" bending radius.

2.03 MANHOLES

A. Reinforcing bars shall extend from each duct bank into the manhole wall to prevent movement.

B. Pulling irons shall be located on the opposite wall and one foot below the horizontal projection of the lowest duct for each duct bank entering the manhole.

C. A manhole ground lug shall be connected to two driven 8' electrodes in corners of the manhole.

D. The manhole shall have a concrete floor sloping toward an effective gravity drain located 18" up the side of a 30" deep sump. The sump must be 18" on a side and have a cast iron grate with 1/2" holes.

E. A 36" non-vented round manhole cover with drop rings is required.

F. The minimum size is: 8' Long x 6' Wide x 7' High. Larger manholes may be required at the discretion of the Cornell Utilities Department.

G. Vaults shall be rated H.25.

2.04 PRIMARY SWITCHGEAR AND TRANSFORMERS

A. DISTRIBUTION LOOP SWITCH

1. Taps into building 13.2 KV distribution system are accomplished using pad-mounted or vault-mounted switches. In applications where a convenient tapping point is not available, a distribution switch is required. The switch requires two switched ways for the incoming and outgoing loop feeders, one switched way for the building load, and at least one spare switched way. Distribution switchgear is not permitted to be located in manholes. Rooms containing distribution switches shall have emergency lighting and power.
2. Vault-Style SF6 Switch Ratings:
   a. Voltage: 15.5 kV
   b. Continuous Current & Loadbreak: 600 amps
   c. BIL: 110 kV
   d. Momentary Current Withstand: 40,000 amps
   e. One Second Withstand: 25,000 amps
   f. Close & Latch: 40,000 amps
   g. Operations at 600 amps: 1,000 minimum
   h. Bushings: 600 amp apparatus
   i. Acceptable Manufacturers: Canada Power Products SG6-__-27/40/SV, G&W RAM__-376M-40PI.

3. Pad-mounted Switch Ratings:
   a. Voltage: 14.4 kV
   b. Continuous Current & Loadbreak: 600 amps
   c. BIL: 95 kV
   d. Momentary Current Withstand: 22,400 amps
   e. One Second Withstand: 14,000 amps
   f. Close & Latch: 22,400 amps
   g. Acceptable Manufacturers: S&C PMH with Mini-Rupter Switch

B. TRANSFORMERS

1. Indoor transformer rooms must be accessible from both inside and outside of the building. The outside entrance must be large enough to allow installation and removal of the primary switchgear, transformer, and secondary switchgear. Dry-transformer unit substations are preferred over separate equipment. Transformer rooms shall be ventilated to the outside and shall have emergency lighting and power. Transformers shall carry a primary BIL of 95 kV. Design temperature rise of 150˚C is acceptable. Transformer sizing based on forced-air ratings is not permitted.

2. Pad-mounted Transformers:
   a. Pad-mounted transformer installations, where permitted, shall include the following design considerations:
      1) Concrete pads shall be provided with footers to prevent pad movement.
      2) Concrete pads shall be designed with a pit under the primary cable compartment to provide a minimum of 36” of exposed cable under the primary bushing.
3) Concrete pads shall contain a grounding electrode consisting of a minimum of two ground rods and a length of bare copper conductor encased in concrete.

4) Transformer primary over-current protection shall consist of drywell, load-break, current limiting, fuses on transformers 500 KVA and smaller. A separate, fused primary interrupter switch (as detailed below) shall be used with larger transformers. A complete set of spare fuses shall be supplied.

5) Primary bushings shall consist of 200 amp load-break bushing inserts.

6) Primary and secondary compartments shall be separated by a steel bulkhead.

3. All transformers shall be protected with surge arresters. Arrester rating shall be 10 KV for the 13.2 KV system.

C. PRIMARY OVERCURRENT PROTECTION

1. The primary switchgear protecting an indoor (or outdoor greater than 500 KVA) transformer bank shall consist of a fused, air-insulated, load-break switch. The switch shall be an S&C Mini-Rupter. The fuses and fuse holders shall be S & C SM-5S. One set of spare power fuses shall be provided.

D. METERING

1. Metering shall be on the secondary side of the building transformer bank. Metering shall consist of panelboard style, revenue grade digital power meter/analyzer with the following requirements.

   a. Measurements: True RMS 3-phase voltage, current and power, harmonics, K-factor, symmetrical components, and sag/swell data;

   b. Communications: ION/Modbus/DNP 3.0 protocols, RS-485 port with built-in modem, one front panel optical port, GPS synchronized meter clock, and remote alarm notification;

   c. Data Logging: Sequence of events and min./max. logging, scheduled event-driven logging of up to 32 parameters concurrently on-board data logging features;

   d. Set Points: Setpoint on any parameter or condition for 1 second;

   e. Outputs: Serial port communications connection;

   f. Security: Multi-user, multilevel security, customizable up to 16 users with multiple levels of access;
g. **Acceptable manufacturers:** Power Measurements 8300 ION Series, or equal ION Series by ABB or Siemens.

2. Instrument transformers used for metering shall meet ANSI accuracy class 0.6 or better.

E. **GROUNDING**

1. A continuous grounding system shall be provided for grounding of primary cable shields, switchgear and transformer frames and transformer secondary neutrals. The grounding system shall meet the requirements of the NEC Article 250. In addition, a #4/0 copper grid shall be installed in the vault floor and be bonded to the building grounding electrode system.

PART 3: **EXECUTION**

3.01 **INSTALLATION**

A. All medium voltage cable pulling, splicing, and terminating for building services shall be done by Cornell Shops personnel.

B. In cases where a contractor must work on medium voltage systems, the following shall apply:

   1. **Operation of Switching Equipment:**

      Contractors shall not operate medium voltage circuit breakers, distribution switches, and other switching equipment except to de-energize a circuit in the event of an emergency. **Cornell linemen will perform all live switching operations.**

   2. **Work on New Systems:**

      Contractors may perform all necessary work on new systems installed by the Contractor, without the necessity for supervision or assistance of Cornell personnel. The Contractor is expected to follow standard de-energizing, locking-out, testing, grounding, and tagging procedures before handling any medium or low voltage equipment. Any connection to existing equipment shall require the contractor and Cornell personnel to adhere to the following procedure. Once a system has been energized and put into service, it shall be considered to be “existing equipment.”
3. Work on Existing Systems:

Any time a Contractor must make a connection to or work on an existing system, the following procedures shall be used to ensure the safety of all personnel involved:

a. Cornell linemen will operate all switching equipment as required to de-energize a circuit in preparation for work. A representative of the Contractor shall be present during all switching and both the Contractor’s electrician and a Cornell lineman shall install locks on all switches as required to prevent accidental switch operation. Each switch shall be tagged to inform others of the work being done. **Manhole switches are never operated with personnel in the manhole.** Cornell linemen have and use remote switching devices.

b. Cornell lineman will test a circuit to ensure that it is “dead” before any contact is made with the circuit. After testing, grounds will be installed by Cornell linemen to ensure the circuit is dead and cannot become energized. The Contractor may also install grounding equipment.

c. A Contractor shall not work on any existing cable without first having a Cornell lineman verify that the correct cable has been selected and the cable is de-energized. **Cornell linemen will make the first cut into any existing cable system prior to Contractor splicing or terminating.** This is to ensure that the Contractor does not select and cut into an energized cable. A cable terminated on each end into a G&W switch with a pothead cannot remain grounded at all times during splicing. Cornell linemen will perform the switching, locking, tagging, and testing procedure before cutting into the cable and grounding each phase. The Contractor may then proceed with work.