

SECTION 16300
MEDIUM VOLTAGE EQUIPMENT

A. Medium Voltage Distribution System

1. General Requirements

- a. The following medium voltage distribution systems are present on the Indiana University Campuses:
1. IU Bloomington: 4,160 volt and 12,470 volt
 2. IU Purdue University Indianapolis: 13,800 volt
 3. IU Northwest: 12,470 volt
 4. IU South Bend: 12,470 volt

These utility systems are operated and maintained by University personnel. Operations include switching to isolate portions of circuits and live-line paralleling (closed-transition switching) of circuits to move loads for maintenance work or during conditions caused by system problems. The requirements of the medium voltage system have been developed over years of operating the system. The consultant shall work with Engineering Services or CFS to determine the quantities and type of switchgear to be provided.

- b. The University is concerned with proper access to and clearances around all medium voltage equipment. The requirements of the National Electrical Code will be viewed as an absolute minimum and the consultant must consider how replacement of transformers, cables, and switchgear will be accomplished after the building has been constructed. The consultant shall provide equipment layout, with access, accordingly on the bid documents.
- c. Medium voltage switchgear should be located at grade level wherever possible. Such equipment should only be located in penthouses with permission of Engineering Services or CFS.
- d. All lighting in medium-voltage equipment rooms shall be on emergency power if available. Provide some fixtures with emergency ballasts or wall-mounted, battery operated emergency lighting.
- e. All 120V receptacles in medium-voltage equipment rooms shall be on emergency power if available.
- f. Double doors (6'-0" W X 7'-0" H) should be provided into switchgear rooms. Access to room shall allow for removal of largest equipment item.
- g. Assume a Type 2 condition in NEC Table 110.34(A) for minimum clearances.

- h. Where directed by Engineering Services or CFS, provide electrical metering by Power Measurement, LTD. with the following features:
 - 1. Meter shall have 10BaseT and/or 10BaseFL Ethernet option as specified by engineering.
 - 2. Provide ANSI accuracy Class 0.3 current transformers. CT range shall be selected appropriately for the load and shall not exceed the load by more than 50%.
 - 3. Provide CT shorting block and/or test switches.
 - 4. Provide voltage transformers as necessary.
 - 5. Meters shall have fuse protection for voltage and power supply inputs.
 - 6. For each meter, supply a data jack in the metering enclosure, connected to the campus Ethernet.
- i. There shall be no foreign systems installed in medium voltage electrical rooms unless they are associated with the room function.

2. 15KV Switchgear

- a. Switchgear shall be fusible for overcurrent protection of transformers or feeder cables. Fuses shall be Class E rated and shall utilize an S & C Electric Corporation SM-5 or SM-4 fuseholder (consult Engineering Services or CFS). Fuse size shall be per ANSI C37 & C57 recommendations for transformer or cable protection. The "SM" fuseholder may be special order equipment for some switchgear manufacturers but can be provided if specified. Non-fused interrupter switches shall be used for loop circuit entrance and exit into switchgear lineups. One set of spare fuses shall be provided for each switch.
- b. Equipment shall meet or exceed all requirements of ANSI/NFPA 70, ANSI/IEEE C2, and ANSI/IEEE C37.
- c. Switchgear shall be rated 15 KV nominal, 600 amp or 1200 amp main bus, 600 MVA or 910 MVA 3-phase symmetrical short circuit interrupting, 95 KV BIL. Fused switches shall be rated 200 amp or 400 amp depending on fuse requirement.
- d. Switchgear shall be deadfront type completely metal enclosed with freestanding, self supporting enclosure. Switchgear assemblies comprised of numerous cubicles shall be group mounted with an 11-gauge steel full length barrier between adjacent sections. The enclosure shall be completely front accessible allowing the rear of the equipment to be placed against walls.
- e. Switchgear shall be key interlocked to prevent doors from being opened when the switch is in the closed position.
- f. Fused switch cubicles shall have an inner door secured by bolts to prevent access to the fuses with only the outer door opened.

- g. Switchgear shall have copper bus with silver to silver connections at main-bus sections, main bus to tap bus, and between ground bus sections. Bus, connections and supports shall be braced for a minimum of 40,000 amps asymmetrical fault current. A copper ground bus shall be installed the full length of switchgear.
- h. Phasing of incoming cables shall be such that circuits may be paralleled within the switchgear.
- i. Where directed by Engineering, provide electrical metering by Power Measurement, LTD. with the following features:
 - 1. Meter shall have 10BaseT and/or 10BaseFL Ethernet option as specified by engineering.
 - 2. Provide ANSI accuracy Class 0.3 current transformers. CT range shall be selected appropriately for the load and shall not exceed the load by more than 50%.
 - 3. Provide CT shorting block and/or test switches.
 - 4. Provide voltage transformers as necessary.
 - 5. Meters shall have fuse protection for voltage and power supply inputs.
 - 6. For each meter, supply a data jack in the metering enclosure, connected to the campus Ethernet.
- j. Provide analog voltmeters on medium voltage switches which are not part of the building's main switchgear lineup.
- k. Preferred manufacturer shall be S & C Electric Co.

3. 5 KV Switchgear

- a. 5 KV switchgear shall meet all requirements of 12.47 KV switchgear except as modified hereafter.
- b. Switchgear shall be rated 5 KV nominal, 600 amp main bus, 125 MVA 3-phase symmetrical short circuit interrupting, 60 KV BIL.
- c. Switchgear shall be completely front accessible when located with rear against walls however equipment may be located in room so as to provide rear access. The consultant is cautioned to review NEC clearance requirements when arranging equipment in this manner.
- d. Preferred manufacturers are S & C Electric Co. and Square D Electric Company.

B. Unit Substations and Transformers

1. General Requirements

- a. Dry type transformers 1000 KVA and smaller shall be vacuum-pressure impregnated type with copper windings, 80 degree C rise.
- b. Dry type transformers larger than 1000 KVA shall be cast coil type with either copper or aluminum windings, 80 degree C rise. Both primary and secondary windings shall be cast in a stabilized epoxy resin or totally encapsulated in epoxy resin.
- c. Liquid filled transformers shall have Envirotemp FR-3 coolant. Coordinate outdoor locations with Engineering Services or CFS.
- d. Dry type transformers shall be installed in environmentally conditioned spaces. The transformer room shall not use outside air for the sole source of cooling or heating. Provide temperature sensors connected to the campus energy management system when requested by Engineering. These sensors will be used to monitor room conditions.
- e. In buildings with major research programs the electrical substation shall be of double ended construction with transformers sized so that either unit could carry most of the building load in the event of a failure. IUPUI Switchgear shall be designed to automatically open main and close tie on secondary side in the event of primary voltage loss. Switchgear shall also have a manual mode to allow operator to manually close tie, temporarily paralleling both transformers, and manually select main to be opened to isolate transformer and incoming circuit for maintenance, etc. Circuits shall be phased in the Owner's presence during startup. Gear shall include an indicating light to show circuits are in phase. Transformers shall have a winding temperature monitor powered from unit sub control circuit. Over temperature alarm and trip functions shall be supplied.
- f. The incoming line section of unit substations shall consist of either a fused switch cubicle or an air filled terminal compartment if switchgear is separate from substation but located in same room. Section shall be complete with bushings for terminating cables. One additional set of spare fuses shall be supplied per switch.
- g. Transformers shall have provisions for forced air fan cooling. Transformer core and coils shall meet the requirements of ANSI C57.
- h. Preferred vendors for unit substations are Cutler-Hammer, Siemens, Square D, General Electric, or Asea Brown Boveri. Only transformers manufactured by a preferred vendor shall be acceptable.
- i. It is anticipated that transformers will be installed inside buildings. Where

equipment is to be located outdoors see paragraph 5, Pad Mounted Transformers.

- j. Transformers shall meet NEMA TP-1 efficiency requirements.
- k. Manufacturer's representative shall be required for checkout, startup, and training of University personnel prior to energization of unit substations.
- l. Factory test results shall be provided as part of the record documents.

2. Transformer Ratings

- a. The following ratings are minimum requirements for transformers installed on the Bloomington Campus:

Temperature: 80 degree C rise with an insulation system hot spot capability of 140 degrees C for dry type and 65 degree C rise over 40 degree C ambient for liquid filled type.

BIL: Units with 12.47 or 13.8 KV primary voltage shall have 95 KV BIL; 4.16 KV primary units shall have 60 KV BIL; secondary BIL rating shall be 10 KV unless noted otherwise.

Taps: 2-2.5% above and below normal primary voltage (unless directed otherwise by Engineering Services or CFS) suitable for operation when de-energized.

3. Transformer Accessories

- a. Transformers shall have the following accessories as applicable:

- 1. Coolant temperature (liquid type) or winding temperature (dry type) with indicating gauge to show highest reading.
- 2. Distribution class lightning arresters; 3 KV on 4.16 KV system, 9 KV on 12.47 KV system, and 10 KV on 13.8 KV system. Locate lightning arresters in switchgear or air terminal compartment.
- 3. Liquid level indicator gauge.
- 4. Pressure-vacuum gauge with pressure relief and valved fill port, and gas sampling port for liquid type.
- 5. Bottom drain with sampling valve for liquid type.
- 6. Upper and lower filter press connections on liquid type units larger than 333 KVA.
- 7. Fan cooling or provision for fan cooling per Engineering Services or CFS directions.
- 8. Transformer accessories requiring power shall be powered from the transformer and not external panelboards.

4. Outgoing Termination Equipment

- a. See Section 16400.
- b. The enclosure for outgoing termination equipment shall consist of a dead-front metal type matching the transformer enclosure.

5. Pad Mounted Transformers

- a. Where approval has been obtained from Engineering Services or CFS, pad mounted transformers may be installed. Location of transformers shall meet FM recommendations for liquid used and building construction rating. Protective and/or decorative screening will be needed at outdoor equipment locations.
- b. Pad mounted transformers shall have applicable accessories as detailed in previous sections and the following additional features:
 1. Dead front construction with 200A bushing wells for 200 amp one piece molded loadbreak elbows. On the IUPUI Campus, supply 600A bushing well for 600A dead break elbows. Include parking standoff plugs for mounting of elbows when disconnected from bushings.
 2. Bay-o-net, oil-immersed, current-limiting fuses for overload and short-circuit protection. Fuses shall be accessible from the front of the high-voltage compartment.
 3. Arrangement for loop feed with 3 of the terminations used for incoming cable terminations and 3 of the terminations used for connecting to deadfront M.O.V. elbow arresters.
 4. Oil-immersed OFF-ON loadbreak, gang operated switch rated 600A. Switch shall allow paralleling (closed transition switching) of 2 different circuits(same source) at each transformer. 2 switches are acceptable to allow paralleling provided both may be closed and/or open at the same time. Switch shall have a handle with eye suitable for operation with a hot stick. Locate switch in the high voltage compartment.
 5. Compartmental type construction with metal barrier between high voltage and low voltage sections. Sealed tank construction with sufficient strength to withstand 7 psi without permanent distortion.
 6. Preferred manufacturers for pad mounted transformers are RTE (Cooper Industries), General Electric, and Asea Brown Boveri.
 7. Where directed by Engineering, provide electrical metering by Power Measurement, LTD. with the following features:
 - a. Meter shall have 10BaseT and/or 10BaseFL Ethernet option as specified by engineering.
 - b. Provide ANSI accuracy Class 0.3 current transformers. CT range shall be selected appropriately for the load and shall not exceed the load by more than 50%.
 - c. Provide CT shorting block and/or test switches.

- d. Provide voltage transformers as necessary.
 - e. Meters shall have fuse protection for voltage and power supply inputs.
 - f. For each meter, supply a data jack in the metering enclosure, connected to the campus Ethernet.
8. Provide baseline oil sample analysis.

C. Equipment Rooms Below Grade

1. Provide access to equipment rooms for future maintenance and removal of equipment.
2. Provide water detection alarms in each equipment room below grade. System to notify campus control Operations Center. Water detection alarms shall be the responsibility of the building controls installation contractor.