

## SECTION 16001C -- ELECTRICAL DESIGN CRITERIA

### 1. Background

- a. Four Narragansett Electric feeders supply the University electrical distribution system at 11.2 kiloVolts (kV). The feeders terminate at a substation located in the Prince Engineering building. Two of the three feeders are normally operated in parallel. The remaining two feeders are operated as radial feeders. Electricity is in turn distributed throughout the campus from three local distribution substations via an underground network of electrical ductbanks. Electricity is presently distributed on the campus at two operating voltages: 11.2 KV and 4.16 KV. Both systems are configured as three phase, three wire, grounded wye. In the future, the campus will also be installing a third distribution system operating at 34 KV.
- b. Brown University also has a cogeneration unit installed at the Central Heat Plant (CHP). The CHP was built in 1967 and was later retrofitted with a 3.2 MegaWatt (MW) steam turbine-driven generator that supplements the University electrical distribution system.
- c. The Campus Utility Metering System consists of digital electric meters connected to the campus Ethernet. Submetering of major systems is required in new buildings, and in most renovations to existing buildings. Metering and consumption data is stored and archived in servers located in the Facilities Management Building.

### 2. Design Calculations

- a. The following basic electrical system design calculations and information shall be performed by the Engineer of Record for all projects, prior to the completion of design. Copies of this information shall be submitted as a part of the overall project design documentation to Brown University for review. Basic electrical system information required for the preparation of these studies shall be provided by the Brown University Project Manager as required.
  - i. Fault current availability, to determine the worst-case fault current at each major equipment location. This study is required for proper selection and verification of equipment fault current withstand and interrupting ratings, and protective device sizing.
  - ii. Voltage drop (on primary feeders and/or long low voltage runs)
  - iii. Load calculations and building power requirements for sizing of electrical distribution equipment, transformers and feeders. For modifications to existing building systems, verify existing system loads and perform analysis to evaluate impact of new loads on existing building and/or campus distribution systems.

- iv. Emergency and legally required standby power requirements and equipment sizing. For additional loads to be added to existing Emergency systems, coordinate with the Brown University Project Manager to determine existing system loading and spare capacity.
- b. For larger and /or more specialized electrical system design projects, and when so directed by the Brown University Project Manager, the following electrical system design calculations shall be performed by the Engineer of Record for all projects, prior to the completion of design. Copies of this information shall be submitted as a part of the overall project design documentation to Brown University for review. If the Engineer of Record is unable or unwilling to perform these studies, then the project will be responsible for the preparation and coordination of the studies by others.
  - i. Short circuit and coordination studies for fuse sizing and selection, determination of setpoints for adjustable trip circuit breakers, relays and other circuit protective devices.
  - ii. Arc-flash protection studies, for determination of the level of personnel hazard protection and relevant required marking and signage, at each piece of major electrical utilization equipment being installed in the project that is likely to require examination, adjustment, maintenance or service while energized.
  - iii. Power system harmonic analysis study: required for all applications involving loads with high concentrations of harmonic content, such as personal computers, data processing equipment and variable speed drives for motors over 25 HP. Analysis shall include proposed mitigation measures to maintain total harmonic distortion at the building service within the requirements of IEEE 519, and the proper selection of equipment required to withstand anticipated harmonic distortion levels, ie. K-rated transformers. Harmonics analysis studies shall also be provided as required to comply with Narragansett Electric Company rebate program requirements.

### 3. General

- a. Electrical equipment shall be configured to allow other Brown University Standards' requirements to be met.
- b. Buildings located in areas served by the Brown University electrical grids shall be powered from the grid, except as directed in writing by the Brown University Project Manager.
- c. It is Brown University's intent to coordinate and limit the loads added onto the distribution systems based on the size of the new loads and their location on the campus. In general, new building loads of 300 KVA and below shall be served from the 4.16 KV distribution system. Loads larger 300 KVA shall be served from the 11.2 KV distribution system. Loads larger than 1 MVA will be served from the 34 KV system. Actual

distribution system connection locations and service voltages shall be coordinated with the Brown University Project Manager.

- d. All high voltage switches and gear shall be compatible with established and planned future campus metering, automatic control, loadshedding, and SCADA plans.
- e. All HV feeders shall be routed underground in 5" minimum schedule 40 PVC concrete encased ductbank. There shall be at least one spare duct per run.
- f. All new installations requiring switchboards, switchgear, panelboards, disconnect switches, and other power related components shall all be from the same manufacturer.
- g. For critical buildings, electrical supply redundancy shall be provided if directed by Brown University Project Manager. This shall be accomplished by double ended switchgear. Critical buildings are generally considered to be research facilities and data centers.
- h. For important buildings, electrical supply redundancy shall be provided if directed by Brown University Project Manager. This shall be accomplished either by installation of an emergency generator or by the installation of permanent provisions for temporary connection of a roll-up generator. Important buildings are those buildings which require a limited continuity of power due to building use, such as assembly areas, server farms or specialized campus support facilities.
- i. Connections of equipment to standby power shall be as directed by the Brown University Project Manager, and shall be specified in design documents at all project stages. If connecting to an existing generator, analysis shall be made on the loading to verify the added load will not jeopardize operation of life safety emergency loads. This may require load bank testing to verify full load output.
- j. Energy Rebate requirements shall be incorporated into all work. Engineer shall complete application form and forward it to project manager upon completion. Reference 01351CP-Brown University Standard for Narragansett Electric Company Rebate Program for additional requirements and information on energy efficient rebate program.

#### 4. Electric Meters

- a. All projects that interface with electrical components shall provide a digital electric meter if not already present.
- b. Refer to section 16002C – Campus Central Metering System Design Criteria for additional details on electrical metering.

## 5. Cable and Conduit

- a. Branch Circuit: The minimum size shall be 20 Amps. All branch wiring shall be stranded copper. There shall be no sharing of neutral wires, except under special circumstances with MC cable.
  - b. MC Cable: Not allowed except under special retrofit conditions making conduit impractical. When two or more circuits use the same neutral, the neutral wire will be oversized to meet the amperage. This is typically done for light fixtures. Using this requires approval from the Project Manager.
  - c. Roof unit will have 110 Volt GFI receptacles with plastic cover for plug cords. Receptacles to be spaced at no more than fifty feet apart. Gas unit needs one receptacle per unit. Lighting to be designed for emergency repairs.
  - d. Roof unit service disconnects to be supported by galvanized uni-strut and fittings.
  - e. The minimum size for conduit shall be  $\frac{3}{4}$ ".
  - f. When sizing conduit, rigid, EMT, and PVC is acceptable. Aluminum or IMC is not allowed on campus.
  - g. PVC shall be a minimum schedule #40.
6. Operating, maintenance and testing procedures for electrical shall be provided in Owner-approved format compatible with FAMIS software and shall include detailed PM schedules, PM procedures, and baseline performance measurements for use in troubleshooting, re-commissioning or retrocommissioning, engineering, and cost analyses.

END OF SECTION