

## SECTION 26 00 10- ELECTRICAL DESIGN CRITERIA

### PART 1 - GENERAL

1. SUMMARY:
  - A. This section details the general design requirements for Electrical systems, for both new and retrofit applications.
2. BACKGROUND:
  - A. Brown University maintains its own campus electrical distribution system which serves the majority of the buildings and facilities on the main campus. Electricity is distributed on the campus at two operating voltages: 11.2 KV and 4.16 KV. Both distribution systems are configured as three phase, three wire, grounded wye. National Grid feeders supply the University electrical distribution system at 11.2 kilovolts (kV). Electricity is in turn distributed to facilities throughout the campus via local distribution substations and underground electrical ductbanks and circuits. Building distribution transformers in turn step the distribution voltage down to a utilization voltage of 120/208 volts, three phase 4 wire and/or 480/277 volts three phase four wire.
  - B. Brown University facilities located in the downtown area (Jewelry District) are typically directly served by National Grid, the local utility company. Buildings in this area are typically fed from the “downtown network”, which is an underground network distribution system operating at 11.2 KV. Buildings are served either from outdoor padmount style transformers or indoor electrical vaults which directly feed the building secondary services at a utilization voltage of 120/208 volts, three phase 4 wire and/or 480/277 volts three phase four wire.
3. RELATED SECTIONS:
  1. Section 01 13 01 - Design Guidelines for Energy and Environment
  2. Section 01 13 51 – NGRID Electric Rebate Program
  3. Section 01 17 01 - Building Systems Identification and Labeling
  4. Section 01 17 71 – Contract Record Documents and Turnover Requirements
  5. Section 26 09 01 – Campus Central Metering System Design Criteria
4. DESIGN SUBMITTAL REQUIREMENTS:
  - A. Electrical system designs shall include the following:
  - B. By first submittal or Schematic Design, whichever is earlier:
    1. Design narrative / design intent with description of each system.
  - C. By second submittal, or Design Development phase, whichever is earlier:

1. Basis of Design, including the following:
    - a. Load design criteria
    - b. Description of each system including: including One-Line diagram of the proposed system(s).
    - c. Lighting and fire alarm system controls and sequences of operation.
  2. Deviations from Brown Standards.
- D. By third submittal, final review set, or construction documents, whichever is earlier:
  1. Deviations from previous submittals
  2. Deviations from Brown Standards
  3. Final Design Development information with updates noted.
  4. Accessibility Drawing detailing accessibility for equipment rigging/ installation as well as access to equipment for routine operation, service and maintenance.
5. DESIGN CALCULATIONS:
  - A. For all projects, the Engineer of Record shall perform the following basic electrical system design calculations and information prior to the completion of design. This information shall be submitted, when so requested, as a part of the overall project design documentation for review. Basic electrical system information required for the preparation of these studies shall be provided by the Brown University Project Manager as required.
    1. Fault current availability (Short Circuit Analysis), to determine the worst-case fault current at each major equipment location. This study is required for proper selection and verification of powered mechanical equipment and electrical distribution equipment fault current withstand and interrupting ratings, and protective device sizing.
    2. 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.
    3. 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.
    4. Short circuit and coordination studies for fuse sizing and selection of adjustable trip circuit breakers, relays and other circuit protective devices.
    5. Voltage drop (on long, low-voltage circuit runs).

6. ARC FLASH AND OVERCURRENT DEVICE COORDINATION STUDIES:
  - A. For all new construction, complete building renovations, larger and /or more specialized electrical system design projects, and when so directed by the Brown University Project Manager, perform the following electrical system design studies:
    1. Short circuit and overcurrent device coordination study: perform studies in accordance with IEEE “Red Book” standard 141 for all service and distribution equipment. Overcurrent device coordination study to include time-current plots for phase and ground overcurrent coordination. Provide settings for all adjustable-trip electrical circuit protective devices, such as circuit breakers, relays and voltage sensors; provide settings for all automatic transfer switches, standby power systems, variable speed drives, chillers and large powered mechanical equipment.
    2. Arc-flash protection studies, provision and installation of specific equipment Arc-flash labeling for determination of the level of incident energy available and required personnel hazard protection, per IEEE 1584 and NFPA 70E requirements.
    3. Power system harmonic analysis study: required for all applications involving loads with high concentrations of harmonic content, such as server racks, 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 National Grid Company rebate program requirements.
  - B. Required studies shall include all electrical systems originating from the project primary service, through the service transformer(s) and distribution system down to the representative branch circuit level; include feeders and connections for major mechanical and other powered equipment. Where existing facilities are to be reconnected to new project distribution systems, include existing facility distribution systems in the studies.
  - C. Study reports to be provided in computer-generated format using SKM Power Tools or EDSA software.
  - D. Study reports to be stamped by a registered Professional Engineer and reviewed by the Engineer of Record.
7. MISCELLANEOUS REQUIREMENTS:
  - A. Electrical equipment shall be configured and arranged to allow other Brown University Standards’ requirements to be met.

- B. A detailed lighting control system sequence of operations shall be included in the plans or specifications.
  - C. Rebates: Actively seek out products which can qualify for rebates under National Grid's programs and complete rebate applications as required under Brown Standards, Sections 01 13 51 and 01 13 52.
  - D. Buildings located in areas served by the Brown University campus distribution grid shall be powered from the grid, except as directed in writing by the Brown University Project Manager, in coordination with FM Operations and Engineering staff.
  - E. It is Brown University's intent to coordinate and limit the loads added onto the campus distribution systems based on the size of the new loads and their location on the campus. In general, new building loads of 150 KVA and below shall be served from the 4.16 KV distribution system where it is readily available. Loads larger 150 KVA shall be served from the 11.2 KV distribution system.
  - F. In general, building loads on the 4.16 KV distribution systems are configured as a radial primary connection; building loads on the 11.2 KV distribution system are configured as a loop-primary connection system. Actual distribution system connection locations and service voltages shall be coordinated with the Brown University Facilities Operations and Engineering staff.
  - G. Arc-flash labeling shall be provided for each piece of major electrical utilization equipment being installed in the project that is likely to require examination, adjustment, maintenance or service while energized, including but not limited to, high voltage equipment, transformers, switchboards, panelboards, and safety switches. Arc-flash labeling shall also be provided for all motor starters, variable speed drives, and any other three-phase electrically-powered mechanical equipment likely to require adjustment and calibration while energized, such as chillers, cooling towers, boilers and equipment control panels.
  - H. Electrical components, devices, and accessories: shall be Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Where built-up electrical systems, such as equipment control panels, are installed, they shall be listed as an assembly.
8. GENERAL ELECTRICAL DESIGN REQUIREMENTS:
- A. All system designs shall include detailed building One-line system diagrams showing all major distribution system components, meters, controls and interfaces with other building and campus utility systems.

- B. For renovation projects, existing building One-line system diagrams shall be provided with updates to clearly indicate locations of all new system tie-ins being added, or components to be removed.
  - C. Buildings less than 25,000 gross sq. ft. and connected loads less than 250 kW may have a main secondary voltage of 208Y/120V.
  - D. Buildings with areas exceeding 25,000 gross sq. ft., or connected loads exceeding 150 kW are recommended to have a main secondary voltage of 480Y/277V, and 120/208V for User and small power loads.
    - 1. Mechanical equipment and lighting panels should be 480Y/277V.
    - 2. Distribution step down transformers should provide 208Y/120V to panels serving convenience power and receptacle loads.
9. RELIABILITY AND REDUNDANCY CONSIDERATIONS FOR FACILITIES:
- A. For certain Critical facilities, redundancy of electrical supplies shall be provided where program needs require electrical power to be available in the event of a component failure or to allow for routine preventive maintenance procedures on the building distribution systems.
  - B. Redundant supplies may be achieved by one or more of the following depending upon the type of facility. System redundancy needs shall be as directed by Brown University Project Manager in coordination with FM Operations and Engineering staff.
    - 1. Double-ended switchgear/building service transformers, in a “main-tie-main” configuration, and connected to the primary distribution system in a “loop-fed” primary configuration. The switchgear/building service transformers shall be sized such that the overall building demand load may be carried on only one side of the switchgear.
    - 2. Installation of permanent provisions at building exterior wall for ready connection of a roll-up generator to the building main switchboard.
10. EMERGENCY AND STANDBY POWER CONSIDERATIONS:
- A. In general, many campus facilities (such as offices, small classroom, academic, and support facilities) typically only require Emergency power for Life Safety needs (egress lighting, exit signage and fire alarm systems). Other facilities, typically those containing Research and other important campus functions, or buildings having large Life Safety loads such as electric-powered fire pumps, smoke control systems, etc. will require a Standby generator, as their program or research needs require electrical power to be continuously available in the event of a utility outage or building outage.
  - B. Connections of equipment to Emergency and/or Standby generator power shall be as directed by Brown University Project Manager in coordination with FM Operations and Engineering staff and shall be specified in design documents at all project stages. Where projects require connections to an

existing generator, analysis shall be made on the existing generator system to verify adequate spare capacity is available to accommodate the added load(s). This may require load bank testing of the generator to verify full-load KW output.

- C. Certain buildings may require provisions for the ready connection of a portable, roll-up generator to provide for the ongoing operation of the building power distribution system in the event of a failure in the normal utility power source. These applications shall include the following:
  - 1. “Tri-Star”- brand portable generator connection box (or equal), located on the building exterior. Connection box provided as a NEMA 3R enclosure, with Cam-Lok cable connectors, capacity as required, and phase rotation meter.
  - 2. Wired connection from connection box to dedicated circuit breaker, key-interlocked to building main service circuit breaker, to prevent simultaneous closure of both devices.

## 11. ELECTRICAL SPACE PLANNING GUIDES:

- A. The following requirements are to be used for electrical space planning considerations at the conceptual design level. Refinements and modifications will be considered upon evaluation of the specific requirements in the building:
  - 1. Main Service Entrance room shall provide for adequate equipment and maintenance clearance. Allow for clear access within the room(s) and to the building exterior for rigging in and replacement of major electrical equipment.
  - 2. Medium-voltage equipment, where located in a common main electric room, shall be isolated from routinely accessed low-voltage local distribution panels by a full height chain link fence and a padlockable personnel access gate.
  - 3. Centrally locate and “stack” local electrical rooms wherever possible so that feeder conduits and bus duct are run as straight and short as possible.
  - 4. Electrical rooms shall not share space with storage, telecommunications, custodial supplies, major mechanical systems and piping.
  - 5. Where possible, locate electric rooms away from outside walls, elevator shafts, stairwells, HVAC duct chases and other major utility corridors so that branch circuits can fan out in all directions.
  - 6. Locate electrical room where it is not susceptible to flood from heavy rains, broken pipes, stopped drains, or surface drainage..
- B. Locate branch circuit distribution panels serving general building loads in dedicated closets or rooms; do not locate panels in public corridors. Distribution panels serving multiple branch circuit loads within a room, such as within research labs, may be located within the rooms.
- C. Provide a dedicated space in the building for spare lamp storage.

## 12. ELECTRIC ROOM DETAILED DESIGN GUIDES:

- A. Floor mounted electrical equipment shall be installed on concrete housekeeping pads.
- B. Electric rooms shall have proper ventilation, thermostatically controlled, to remove excess heat.
- C. Electric room lighting shall be fed from an emergency generator source, if available.
- D. Electric Rooms containing medium-voltage distribution equipment to include Safety grounding ring comprised of either a continuous ground bar or multiple interconnected ground busses, with all equipment connected to at least two ground points. Visibly bond all equipment, room door frame(s), etc. to the ground ring.

## 13. ELECTRIC METERING:

- A. All buildings connected to the campus electrical distribution systems shall be separately metered and connected into the campus Central metering system. Academic and Research buildings located in the Jewelry District shall be separately metered and connected into the campus Central metering system.
- B. Refer to section Section 26 09 01 – Campus Central Metering System Design Criteria for additional details on electrical metering.

## 14. EQUIPMENT MANUFACTURERS:

- A. Square D and Siemens shall be standard for all distribution equipment unless a specific or additional manufacturer(s) is identified in detailed electrical Standards.
- B. All new installations requiring switchboards, switchgear, panelboards, disconnect switches, and other power related components shall all be from the same manufacturer. New equipment installed within existing facilities shall be of the same manufacturer as already installed within the facility.
- C. Older installations with obsolete manufacturers: coordinate with Brown Project Manager.

## 15. NAMING CONVENTIONS AND EQUIPMENT LISTS:

- A. Electrical Equipment designations, naming conventions, development of Equipment lists and Operating and Maintenance procedures shall be as indicated in Section 01 17 71 – Contract Record Documents and Turnover Requirements.

## 16. ACCEPTANCE TESTING:

- A. The Engineer of Record shall determine the particular field and factory acceptance testing requirements for each project in coordination with FM Operations and Engineering staff.
- B. As a minimum, factory acceptance tests are required for generators, building distribution transformers and main distribution switchgear.

- C. Field acceptance testing for electrical distribution equipment and equipment feeders shall be completed in accordance with International Electrical Testing Association Inc. (NETA) Acceptance Testing Specifications.
- D. All adjustable-trip electrical protective devices, including relays, circuit breakers and automatic transfer switches shall be set and calibrated per coordination study recommendations.
- E. Perform an infrared thermographic inspection of all distribution equipment and feeder connections per NETA Standards, six months after beneficial occupancy. Submit reports identifying the inspection, summary of issues found and what corrective measures were taken.
- F. Metering systems and equipment shall be commissioned to verify proper setup, calibration and recording of data into the Campus Metering System.

END OF SECTION