262416 PANELBOARDS & BUILDING DISTRIBUTION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Distribution panelboards
   2. Power panelboards

B. Related Sections:
   1. CU Standard 260500, Basic Electrical Requirements
   2. CU Standard 262413, Service and Main Secondary Distribution

1.02 POLICY

A. The following standard applies to both new and retrofit work.

B. This standard applies to all panelboard installations including and downstream of the main building distribution service panel.

C. Arc flash incident energy exposure levels at and downstream of the main panelboard shall conform to Cornell Standard 262413 – Service and Main Secondary Distribution, Part 1.01D and 2.07D3.

D. Drawings shall contain a schedule of panelboards, which shall clearly indicate the following information:

1. Panelboard type
2. Number of pole spaces
3. Main bus ampacity
4. Main circuit breaker or main lug ampacity
5. Flush or surface mounting
6. Panelboard short circuit rating
7. Calculated available short circuit current at the panelboard
8. Calculated arc flash incident energy exposure level at the source side of the panelboard’s main circuit breaker.
9. Circuit breaker trip size and number of poles (1P, 2P or 3P) for all spaces in the panelboard.
10. Panelboard directory shall show space (i.e. 1, 3, 5) and bus (A, B, C) connections for each circuit breaker.
11. Estimated connected and demand loads for each breaker. Indicate total load for each phase (A, B, C) to demonstrate a balanced load.
12. Phase balancing shall be required and shall be shown on the drawings of completed panelboard installations to within 20% accuracy.

13. A description of what each circuit serves shall be shown on the panelboard directory. Indicate spares and spaces where no circuit is used.

14. On remodeling projects, provide a full panelboard schedule with all existing devices and loads shown, and note the vacated/reused circuits. A load study is still required on remodel projects.

E. Non-linear load panelboards (200% rated neutral) shall be provided as appropriate in areas with significant non-linear loads, as evaluated by the Engineer of Record. Non-linear loads include loads such as electronic and computer devices, adjustable speed drives, and electric discharge lighting.

F. Circuit breakers shall be a minimum 100-amp frame. All breakers up to 100-amp trip sizes shall take up the same pole spacing.

G. Electronic trip type circuit breakers shall be utilized where full selective coordination is required (or desired), and where arc-flash reduction can be achieved through circuit breaker trip unit adjustments in order to attain arc-flash incident energy exposure levels as specified by Cornell Standard 262413, Part 1.01D and 2.07D3.

H. Electronic and adjustable instantaneous thermal-magnetic circuit breaker trip settings shall be determined by a protective device coordination, Arc Flash, and Short Circuit study performed by the Engineer of Record. The study shall be performed using the Easypower or SKM electrical system modeling program. The model shall include a system short circuit fault study and a device coordination study in accordance with IEEE Standard 242, and an arc flash incident energy exposure study conforming to IEEE Standard 1584. A schedule of trip settings for each circuit breaker in the panelboard shall be provided to Cornell in spreadsheet format, both printed and Excel electronic file. Trip settings shall be selected to maximize selective device coordination while meeting arc flash incident energy exposure levels per Cornell Standard 262413, Part 1.01D and 2.07D3.

I. If the equipment submitted is different than the basis of design equipment specified by the Engineer of Record, the coordination and arc flash study and circuit breaker trip settings recommendation shall be updated by the Engineer of Record using a professional engineer. This report shall be submitted to Cornell Facilities Engineering for review prior to the release of equipment for manufacture. The updated Easypower or SKM model shall also be provided to Cornell University. In any case, the submitted gear and updated study trip settings shall meet the requirements of Part 1.01D and 2.07D3 of Standard 262413.

J. Provide outline and support point dimensions, voltage, main bus ampacity, short circuit amp rating, circuit breaker arrangement and sizes, interior dimensions including gutter space, locations of main, neutral, and ground; include on drawings.
K. All panelboards to be used as building service equipment shall be UL listed and marked by the manufacturer as suitable for use as service equipment. The location of the main bonding jumper or system bonding jumper (i.e. whether located at the transformer or at the service panelboard) shall be clearly shown on the As-Built and Record Drawings.

L. Provide circuit breakers with handle-locking devices to prevent manual breaker operation where required.

M. Provide panels with auxiliary gutters where panels are of the feed-thru type.

N. Where separately enclosed molded case circuit breakers are required, provide circuit breakers in accordance with the requirements noted for panelboards.

O. Enclosed circuit breakers scheduled for use as service equipment shall be UL listed and marked as service equipment. The location of the main bonding jumper or system bonding jumper (i.e. whether located at the transformer or at the service panelboard) shall be clearly shown on the As-Built and Record Drawings.

P. Ensure that all required clearances can be met when locating panelboards and separately-enclosed MCCB’s if used.

Q. Provide ground fault (G) trip function on the main circuit breaker only when required by the National Electrical Code or when the Engineer of Record documents the specific technical reasons why a ground fault trip unit is necessary for the electric service.

R. On a distribution panelboard, if a ground fault trip function is provided on the main device, it must also be provided on all of the feeder devices.

S. Where ground fault trip units are provided, the ground fault trip settings shall include multiple selectable i2t on (in) and off (out) settings on the main and feeder circuit breakers.

T. The Engineer of Record shall provide ground fault pickup and delay settings for any ground fault circuit breakers provided in the design to ensure that the ground fault settings selectively coordinate with upstream and downstream ground fault circuit breaker trip settings, as well as with all upstream and downstream overcurrent circuit breaker TCC curves.

1.03 QUALITY ASSURANCE

A. The Engineer of Record shall provide information as outlined in Section 1.03B of Cornell Standard 262413 – Service and Main Secondary Distribution.
B. The Owner will provide the Engineer of Record with the information outlined in Section 1.03C of Cornell Standard 262413 – Service and Main Secondary Distribution.

C. Reviews and approvals may be required by multiple Cornell Departments, including but not limited to, Cornell Facilities Engineering (FE) Electrical Design Section, Utilities & Energy Management, and Maintenance Management.

PART 2 SYSTEM REQUIREMENTS

2.01 APPROVED MANUFACTURERS

A. Square D
B. General Electric
C. Eaton

2.02 MATERIALS

A. General

1. Panelboard Assembly:
   a. Provide with main copper bus bar, fully rated throughout the height of the panel, with a separate ground bus and full size neutral bus.
   b. Minimum short circuit rating requirements shall be obtained from the schedules, specifications, and/or contract documents. If this information is not shown, the Engineer of Record shall be consulted. Under no circumstances shall any short circuit current requirements be assumed by the contractor.
   c. Panelboard types shall be as indicated below for the purposes indicated. Type codes noted for illustration are by Square D (provide noted Square D model or equal by other approved manufacturers.)
      1) Small panelboard (loadcenter type) applications: QO
      2) General purpose power, lighting and receptacles: NQ, NF
      3) Distribution: I-Line
   d. Provide flush or surface cabinet front as required with concealed trim clamps, hinged trim door-in-door construction with interior door containing a flush lock all keyed alike. Door-in-door hinged trim enclosure shall contain two quarter turn latches.
e. The maximum number of poles in a panelboard shall be 60. If more are required, specify two section Panelboards. The maximum circuit breaker handle height is 6’7”. Where two section panelboards are required, use full capacity subfeed lugs. Subfeed breakers are prohibited except in remodel projects. Both sections shall be the same size ampacity and number of spaces.

f. Two section panelboards shall be constructed in the same manner as stand-alone panelboards. The hinged covers shall not cover the adjacent panelboard.

g. Panelboards shall be fully rated (fault interrupting current). The use of series rated panelboards is prohibited.

h. Interiors shall be completely factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units or removing the main bus connectors.

i. Provide transient voltage surge protection on the main building service panel (refer to Cornell Standard 262413 – Service and Main Secondary Distribution) and/or at other sensitive locations. Consult with Cornell Facilities Engineering Electrical Section for advice regarding where transient voltage surge protection should be provided.

j. All panelboards shall be from one source of manufacturer on a given project.

k. Power and distribution panelboards shall have bolt-on circuit breakers; plug-in circuit breakers are allowed where individual positive-locking device requires mechanical release for removal. Bolt-on breakers shall be tightened per the manufacturers recommended torque using a torque screwdriver or wrench.

l. Panelboards in hazardous locations and special occupancies shall comply with the requirements of the latest edition of the NEC adopted by the Building Code of New York State (BCNYS).

m. All un-used or abandoned openings in the enclosure shall be sealed using knockout closure or a similar device. Any interior space not covered by a circuit breaker shall be sealed by blank plate made for the panel.
n. Panelboards used as service equipment shall be provided by the manufacturer with an internal main bonding jumper sized in accordance with latest edition of NEC adopted by the Building Code of New York State (BCNYS).

o. Contact Cornell Facilities Engineering for special panelboard, circuit breaker, surge protection, and marking requirements where available service voltage is High-Leg Delta 3-phase, 4-wire (certain existing off-campus applications only). Any new off-campus applications shall be served from 3-phase, 4-wire grounded-Y supply voltage.

p. Contact Cornell Facilities Engineering for requirements and considerations when designing a solar PV system for interconnection at an existing or new panelboard.

2. Molded Case Circuit Breakers:

a. Molded Case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole, or be of the electronic trip type as described in Sections 1.02G, 1.02H, and 1.02I of this standard.

b. Circuit breakers shall not be used as switching devices for regularly turning devices or lighting on and off. Exceptions may be made in certain limited applications approved by Cornell Facilities Engineering where switching rated circuit breakers are provided and the calculated arc flash incident energy exposure level at the subject panelboard is determined to be less than 1.2 cal/cm².

c. Piggyback or tandem mounted breakers shall not be used in new installations.

d. Breakers shall have a common type handle for all multiple pole circuit breakers.

e. The breaker trip size shall be clearly marked on the handle of the breaker. Panel and breaker designs where the panel trim must be removed to determine trip rating are not acceptable.

f. All circuit breakers within panelboards shall be fully rated for the short circuit current and X/R ratio existing at the location of the panelboard as calculated by the Engineer of Record.

g. GFCI, AFCI, and Shunt Trip type breakers shall be used where required by the NEC.
h. Integrially rated (series rated) panelboards utilizing branch breakers with reduced short circuit ratings are not acceptable.

B. Panelboard Layout

1. Lighting and receptacle branch circuit breakers shall be a minimum 20 ampere trip.

2. Provide a minimum of 25% spare (unused) circuit spaces equipped with spare circuit breakers in every new panelboard. Contact Cornell Facilities Engineering or Project Manager for recommendations on size of spare circuit breakers.

3. A panelboard shall be protected by an overcurrent protective device having a trip rating not greater than that of the panelboard frame rating. The overcurrent protective device shall be located within the panelboard or at any point on the supply side of the panelboard.

PART 3  EXECUTION

3.01 INSTALLATION

A. The following is required:

1. Provide and affix a typewritten circuit directory card with a clear plastic cover to the inside of each panelboard door. Directory shall include the Panel ID, voltage rating, and current rating of the panel, as well as identify the type and location of every load and all spares in accordance with NEC. Also note available spaces on the directory.

2. Panelboards which are installed in electrical equipment rooms shall not share the space with other systems such as piping, ductwork, and telephone equipment. Working clearance space as well as dedicated equipment space shall be maintained per NEC.

3. Where main breakers are required, they shall be vertically mounted and bolted to the ends of the main buses. Back connected main breakers and branch mounted main breakers are prohibited.

4. Provide an engraved nameplate for each panel section identifying the panel name and affix to the panel cover. Nameplate labels shall be Self-Adhesive, Engraved with white letters on a black field, and shall be fabricated from 3-layer (black-white-black) thermoset plastic. Nameplate lettering to be upper-case Roman block letters, minimum letter height 3/8 inch.
5. Nameplate for each panelboard shall show the following: Panel name, operating voltage, source panel name, and circuit number. Also indicate if the panelboard is fed from the emergency power system.

6. Where new circuit breakers are added to existing panelboards, update the existing panel directory with a new typewritten label to clearly identify the load(s) served.

7. Measure steady state load currents at each panelboard feeder; rearrange circuits in order to balance phase loads to within 20% of each other. Update panel directories and Record Drawings (As-Builts) accordingly.

3.02 TESTING AND COMMISSIONING

A. The Contractor shall adjust circuit breaker settings in compliance with the Engineer of Record’s equipment coordination study. Engineer shall verify settings during punchlist walkthrough.

B. Testing deliverables as follows:
   1. Digital Multi Meter Test: Low Voltage Cable
   2. Breaker functional tests (secondary injection testing for electronic trip type circuit breakers): distribution panelboards
   3. Metering verification: Verify correct CT ratio.

PART 4: PANELBOARD IDENTIFICATION (For new building construction, major renovations, and new installations.)

4.01 PANELS (480/277 VOLT)

A. Label panelboards per type and use as follows:
   1. HELP – ( ) High voltage emergency lighting panel
   2. HEPP – ( ) High voltage emergency power panel
   3. HLP – ( ) High voltage lighting panel
   4. HPP – ( ) High voltage power panel

4.02 PANELS (208/120 VOLT)

A. Label panelboards per type and use as follows:
   1. LELP – ( ) Low voltage emergency lighting panel
   2. LEPP – ( ) Low voltage emergency power panel
   3. LLP – ( ) Low voltage lighting panel
   4. LPP – ( ) Low voltage power panel
4.03 LABELING ALL PANELBOARDS BY FLOOR

A. Fill in ( ) space shown above as follows:

1. (S) for sub-basement S-1, S-2, etc., if more than one unit per floor.
2. (B) for basement.
3. (G) for ground floor.
4. (1) for first floor.
5. (2, 3, etc.) for second, third, and higher floors.
6. (P) for penthouse.

4.04 PANELBOARD UPGRADES

A. Panelboard upgrades shall meet this standard.

B. For retrofit applications, the panelboard shall be specifically designed for retrofit in existing panelboard boxes. The manufacturer shall supply in advance to the consultant complete application instructions and information on the panelboards.

C. During design, Engineer shall ensure that there is sufficient room within the panelboard box for properly terminating the feeder or branch circuit cables on the circuit breaker terminals while meeting NEC required cable bending radius requirements.

D. Existing enclosures shall be identified for retrofit suitability in advance. The structural integrity of all existing enclosures shall be verified. Any enclosure that is damaged shall be replaced with a new enclosure and panelboard. The contractor shall provide exact dimensions of the existing enclosure to the manufacturer.

E. Where new panelboard interiors are installed in existing panel backboxes, the backboxes shall be cleaned and painted with a rust inhibiting paint before the new interior is installed. New exterior trim, doors, and locks shall be provided for the panels. Provide a new, typewritten circuit directory for all panelboard replacement to clearly indicate the loads being served.

F. Where new circuit breakers are installed in existing panelboards, they shall be listed for use with the existing panelboard type and shall be of sufficient short circuit rating for the application, and shall be a minimum of the highest AIC rated device in the panelboard.
4.05 ARC FLASH LABELING

A. The Engineer of Record shall perform an arc flash incident energy exposure analysis for all new panelboard installations. The Engineer of Record shall provide the arc-flash hazard data to Cornell in printed spreadsheet format. The data shall include panelboard name, building room number, date arc flash analysis was conducted, upstream protective device, consultant’s name, flash hazard boundary (inches), flash energy (cal/cm²) at 18”, voltage, glove class, Limited Approach (inches), Restricted Approach (inches), and Prohibited Approach (inches).

B. The Engineer of Record shall provide and apply the arc flash hazard labels to the equipment. If the equipment submitted is different than the basis of design equipment specified by the Engineer of Record, the Engineer of Record shall be responsible for updating the study and providing and applying the arc flash labels to the equipment.