

**Division 26 – Electrical**

26.1. General

- a. Refer to **CPSM SECTION 6.16 ELECTRICAL DESIGN STANDARDS** which include, but are not limited to, the following topics:

- vi. Conductor color-coding for 208/120V:
  - 1. A-Black
  - 2. B-Red
  - 3. C-Blue
  - 4. N-White
  
- vii. Conductor color coding for 480/277V
  - 1. A-Brown
  - 2. B-Orange
  - 3. C-Yellow
  - 4. N-Grey
  
- viii. All splices in primary cable shall be performed by a Certified Cable Splicer. Splicers shall conform to the recommendations of the ICEA (Insulated Cable Engineers Association) a

- v. Compression-type connectors or couplings shall not be used for interior applications. "Die Cast" connectors of any type are prohibited.
  - vi. Home run conduits from distribution panels shall be installed directly to the first device. No more than three (3) 90 degree bends between junction boxes shall be acceptable. Lighting home runs can go to a junction box within the room being served.
  - vii. Install pull string in all empty conduits.
  - viii. Tubular conduit shall be used for all home runs until the last junction box on the circuit. MC cable will be permitted to extend from junction box to end device.
- b. All panels shall have conductors and MCB (main circuit breaker) sized to full panelboard capacity. Sizing of conductors and MCB's shall *not* be based on load calculation only.

26.6. Underground Ducts and Raceways

26.7. Sleeves and Sleeve Seals for electrical raceways and cabling shall be provided and shown by the A/E on above ground and underground wall/barrier penetrations.

26.8. Identification. The following conduit colors shall be used:

- a. Red – Fire Alarm
- b. Yellow – High Voltage
- c. Blue – Data
- d. Orange – Fiber
- e. Purple Security
- f. Green - Healthcare

26.9. Overcurrent Protective Device shall be provided per code.

26.10. Electrical Power monitoring and Control

- a. Enterprise Wide Power Management and Control System (EPMS)

26.11. Do we need to indicate that for programmable lights ODU has to be provided the means and methods to modify and program the lighting on our own.

26.12. Digital – Network Lighting Controls – is this the right name for this section – its confusing with programmable lights versus lighting controls for occupancy.

- a. Provide occupancy sensors in all occupied spaces except the following where standard toggle switches shall be provided, unless otherwise directed by code:
  - i. Electrical
  - ii. Mechanical
  - iii. Telecom/data/AV
  - iv. Research Laboratories
  - v. Residence Hall Sleeping Rooms
- b. All other occupied spaces shall have occupancy sensors, unless requested by and justified by the end user and not required by code. The A/E shall review spaces to receive occupancy sensors, locations and type, with end users.
- c. When dimming is desired provide modular LED dimmer switches compatible with dimmer drivers.
- d. The lighting control system shall be capable of providing all of the following functions for all lighting, although they may not be required for every project or fixture:

- ii. Occupancy control.
  - iii. Vacancy control.
  - iv. Daylight harvesting.
  - v. Load management.
- e. The lighting control system includes the following components:
- i. Sensors each contain a passive infrared sensor, digital photocell, digital temperature sensor (optional), microprocessor and/or a wireless radio.
  - ii. For systems using controllers, each one shall contain a utility grade power meter chip and a latching relay which powers the sensors and sends the control signal to the light's ballasts or drivers.
  - iii. For systems without separate controllers, the functionality of the controller shall be integrated into an LED driver or have independent functionality when using 2-wire sensors.
  - iv. Hard-wired (preferred) or battery powered (with ODU approval), wireless room controllers with dimming, on-off

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- a. Microcontroller in each sensor.
  - b. Communication Mechanism
  - c. Low power 2.4 GHz Transceiver based on IEEE 802.15.4 with an option for Bluetooth enabling.
- ii. Operations:
- 1. Sensors shall monitor changes in occupancy, changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy stored locally in the sensor.
  - 2. Sensor shall either wired or wirelessly transmit occupancy; light level, power information to a gateway device which allows the data to be stored in a central location on premises or in the cloud.

can utilize data from the lighting system for providing increased savings by optimizing the operations of a building's HVAC system.

- iii. Uses industry standard HTTPS security with AES-128 encryption safeguards the integrity of the entire system. Automatic backups prevent data loss and restore fixtures to operational modes. The system will provide reports that include fixture outages, lamp failure notifications, temperature and occupancy data. It constantly monitors areas to ensure that spaces are managed according to the assigned user preferences and tasks being performed.
- k. Operator's Software
  - i. User programming and editing may be conducted online in web-based software. Data shall be entered through a simple menu-driven user interface. The operators' software provides all the information to the user regarding the consumption and saving of the energy utilized in the building environment. The basic operating software shall provide the following:
    - 1. Site wiring documentation for all connected fixtures and system components shall be in O&M manual and project submittals. Reflected ceiling plan shall also be present in the software to show the location of components.
    - 2. English descriptions of each circuit switch and calculated load.
    - 3. Monitor/Control all fixtures.
    - 4. Software shall show actual fixture states, with an optional menu showing how and when the fixture change occurred.
- l. Central Programming, Monitoring and Control Work Station
  - i. The control work station shall provide monitoring, programming and control of the system. The system shall include at a minimum:
    - 1. Scheduling Profile and Groups
      - a. Profile: "A lighting profile", which is typically shortened to just profile, is a named set of configuration values that determine the setting of the light level of the luminaire (lighting fixture). The configuration values are used by the intelligence in the fixture along with the current operational mode, past and present sensor values, time of day, day of the week, and passage of time to control the light level. How the light is turned on and off and the light level set, is called the behavior of the light.
      - b. Groups: The use for groups is for all fixtures in a room (e.g. conference room) to change to the occupied state (typically resulting in a fixture turning on their lights) when any fixture senses occupancy, and for all fixtures in a room to stay in the occupied state as long as any fixture senses occupancy.
    - 2. Daylighting Controls
      - a. The sensor shall have the ability to sense daylight in the surrounding areas. This feature Tw[(the conR)1.7( esthe



- i. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.



- ii. Multifunction Digital-Metering Monitor shall be a microprocessor-based unit suitable for three- or four wire systems and with the following features:
  - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Accuracy tolerances for values of accumulated energy, megawatt hours shall be plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    - b. Megawatt demand values shall be plus or minus 1 percent; demand interval programmable from five to 60 minutes.
    - c. Contact devices to operate remote impulse-totalizing demand meter.

#### 26.16. Panelboards

- a. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete.
- b. All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.
- c. Entire front trim shall be hinged to box using piano type hinge with standard door within hinged trim cover.
- d. Provide directory card located on the inside panelboard door, mounted in transparent card holder.
- e. Create machine-printed panelboard schedules to replace the handwritten schedules. Loads shall be specific room, piece of equipment, etc. verse using a generic "receptacles" label.
- f. All breakers shall be a minimum of 20A rated.
- g. Every electrical panelboard shall be rated at 225-amp minimum. The MCB and all conductors shall be sized to full panel board capacity. Sizing of conductors and MCB's shall not be based on load calculation only. Each panel board shall have its own 225A circuit from the Main Switchgear or MDP. Main lug or "Pass-Through" lug panels are not allowed.
- h. Electrical panels shall have 15% spare capacity. Supply a minimum of four (4) ¾" empty conduits from recessed panels to an accessible location for future use.
- i. No panelboards shall be located in housekeeping closets. Provide electrical closets on each floor dedicated to electrical panels only.
- j. Commercial kitchens shall have dedicated electric panelboard(s) serving only kitchen-related outlets. Feeding kitchen-related circuits from other electrical panelboards is not acceptable. Commercial kitchen related panelboards shall have a minimum of (4) spare ¾" conduits stubbed into acceptable ceiling space for future kitchen-related circuits.
- k. All interior transformers greater than 45 kva shall be floor mounted.
- l. Integrated transformer/panelboards shall not be used.
- m. Switchboards, panelboards and components shall have copper buss bars.
- n. When panelboards are used as main service equipment, the same meter shall be installed adjacent to it and provisions for current transformers and other connections shall be made.
- o. Fusible switches shall be spring-loaded types, with interlock and padlock capabilities.
- p. Provide 5% spare fuses for fusible switches. Fuses shall be stored in the main electrical room.
- q. Panelboards for light and power shall be of the dead-front, automatic C/B type. Circuit breakers shall be bolt-on or I-line type. Panelboards shall have copper grounding bars.

- r. When an electrical panel is surface mounted, all under slab conduit that turns up into the electrical panel, shall transition from sch40 PVC to a rigid 90o elbow before extending through the floor. IMC conduit shall extend from the 90o elbow into the bottom of the panel.
- s. Provided “fed-from...” phenolic bakelite, or equivalent, labels for panel boards and the lighting inverter.
- t. If an existing building is renumbered, the corresponding electrical panels shall be renumbered and new labels produced and shall be documented by the A/E.
- u. Distribution Panelboards acceptable manufacturers:
  - i. Eaton Electrical Sector; Eaton Corporation.
  - ii. Siemens Industry, Inc.
  - iii. Square D.
- v. Lighting and Appliance branch-Circuit Panelboards acceptable manufacturers:
  - i. Eaton Electrical Sector; Eaton Corporation.
  - ii. Siemens Industry, Inc.
  - iii. Square D.

26.17. Motor-Control Centers (reserved)


26.18. Enclosed Bus Assemblies (reserved)

26.19. Power Distribution Units (reserved)

26.20. Electricity Metering

- a. All new construction and major renovations to be metered. It is the intent of the university to meter all buildings over time. The A/E shall discuss the metering scheme with Facilities Management at the earliest possible opportunity.
- b. Equipment for electricity metering by utility company shall be furnished and installed by Dominion Energy. The general contractor shall provide the meter base. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- c. Meter shall be located outside facility or accessible by local utility without the need of an ODU provided escort.
- d. Equipment for Electricity metering shall be provided by one of the following manufacturers:
  - i. E-Mon.
  - ii. National Meter Industries.
  - iii. Square D.
- e. The meter shall have the potential to interface with the DDC system for HVAC. The meter can be integrated into the switchboard or motor control center.

26.21. Wiring Devices

- a. Typical Building Cover Plates: Stainless Steel
- b. Residence Hall Cover Plates: White Plastic
- c. Controlled Receptacle Cover Plates: To meet the requirements for identifying receptacles that will be automatically de-energized as part of an overall plug load control program, the 2017 NEC requires all 15A & 20A, 125V receptacles that are automatically controlled (as required by code) to be marked with the controlled receptacle marking symbol  and the word “CONTROLLED” on the receptacle face. Provide green colored devices that meet this requirement with stainless steel cover plates (White in Residence Halls)

- d. Emergency Power Cover Plates: red receptacle with stainless steel cover plate with "EMERGENCY" engraved on cover plate with red lettering.
- e. All receptacle covers shall be labeled with the circuit and panel designation with an adhesive type label.
- f. Single device boxes shall be a (4"x4"x2.125") minimum size with appropriate plaster ring or adapter. Junction and pull boxes shall be a minimum of (4"x4"x2.125") with appropriate cover.
- g. Provide at least two (2) separate electrical 20A, 120V receptacle circuits in every Residence Hall room.
- h. Provide (1 or 2) GFCI receptacles outside of each building entrance. Each receptacle shall share a dedicated 20A, 120 volt circuit.

- vii. Ductbank from utility pad mounted transformer to service switchboard CT section, with conductors terminated in switchboard.
  - viii. Conduit seals in accordance with Dominion Energy requirements.
  - ix. 1-1/4" concealed empty conduit from CT section to utility meter base.
- g. Furnish two (2) PDF copies of as-built drawings showing the actual location and installation of the main feeders, main duct bank and complete system.

26.23. Fuses (reserved)

26.24. Enclosed Switches and Circuit Breakers

- a. All exterior disconnects shall be NEMA 4X Stainless Steel

26.25. Controllers: Variable frequency drives shall be specified by the A/E as provided by



## 26.32. Exit Signs

- a. Provide LED internally lighted signs with 50,000 hours minimum rated lamp life.

## 26.33. Interior Lighting

- a. New construction shall utilize LED fixtures.
- b. Renovations shall convert to LED fixtures when appropriate, otherwise re-use and or match existing fluorescent fixtures.
- c. All LED lighting shall carry at least a 5 year full product replacement warranty.
- d. Color temperature shall be no less than 3500K.
- e. Color temperature shall not vary more than 200oK within a connected space.
- f. Recessed "can" type fixture shall only be used in locations with hard ceilings that allow repair access through lamp opening only. The use of these fixtures shall be kept to a minimum regardless of location.
- g. Lights shall be installed over landings verses stair treads wherever possible and meet the minimum egress lighting required by code. If lights are required to be installed above treads they shall be no higher than 10' above finished floor and shall be accessible from a 6' ladder.
- h. Lighting in all multimedia classrooms shall be reviewed and approved by the Assistant Director Classroom and Learning Space Technology.
- i. Use wire guards on all lighting in gymnasiums or similar types of athletic spaces, including emergency lights, fire alarms, and clocks. Lenses shall be Plexiglas/ Lexan type material for better resistance to shattering.

## 26.34. Emergency and Exit Lighting

- a. All emergency lights shall be connected to 277V circuits. Emergency lights shall be connected to emergency power when available. Battery backed-up ballasts connected to house circuits are not acceptable.
- b. Refer to the **BCOM NEWSLETTER #12 DECEMBER 2015**, excerpted below
  - i. *Occupancy sensors shall:*
    - 1. *Be installed throughout the building to provide full coverage of all areas.*
    - 2. *Incorporate both infra-red and ultrasonic technologies within each sensor device.*
    - 3. *be equipped with a time-delay (off) function and shall be set for minimum 15-minute duration.*
  - ii. *The means of egress must be illuminated for the entire floor whenever an occupant is sensed anywhere on that floor.*
  - iii. *Elements of the means of egress that serve all floors shall be illuminated whenever an occupant is sensed anywhere within the building. This shall include, but not be limited to, stairways and common lobbies such as main building lobbies and elevator lobbies.*
    - iv. *Means of egress illumination located outside of the building or on the exterior of the building shall not be controlled by occupancy sensors. Typically, this lighting is controlled by photocell(s) and this practice continues to be acceptable. (ODU Comment: The preference is to use HVAC DDC system to control exterior lighting using one master photocell installed to input to the DDC system which will trigger outside lighting to activate.)*
  - v. *In buildings where a fire alarm system is provided, the means of egress lighting shall be illuminated upon activation of the fire alarm system.*

- vi. *The design and sequence of operation of the occupancy sensing system shall be included in the electrical plans submitted for permit and sealed by the electrical design engineer. The means of egress shall be clearly defined on the architectural plans.*
- vii. *Emergency means of egress illumination required by VCC Section 1006.3 shall not be controlled by occupancy sensors. Note: if the same luminaires are utilized for both normal means of egress illumination (VCC 1006.1) and emergency means of egress illumination (VCC 1006.3)*