nDIVISION 26 – VARIOUS REVISIONS

Modify, Section 26 00 01.01 "Owner General Requirements and Design Intent" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

26 00 01 Owner General Requirements and Design Intent

.01 General

A. Service Voltage
   1. At University Park, service shall be provided from the 12,470V distribution network whenever possible. The 4,160V network may be used where adequate capacity exists with approval of ES (Engineering Services).
   2. At other locations, services may be provided by a local utility or the campus distribution network as appropriate. Details will be provided by Engineering Services.
   3. Identify any medium voltage (600V and greater) raceway system within a building by painting it red in its entirety.

B. Building Voltages

   1. For loads greater than 750kVA, consider 480Y/277V distribution with 208Y/120V step down transformers for receptacles and other 120V loads.
   2. Step down transformers shall be located in rooms with adequate fire ratings and transformers connected for sound isolation using flexible conduit, isolation pads and when supported from the building steel, spring hangers.

C. Utility Demand and Consumption
   1. The Design Professional shall complete the Utility Demand and Consumption form on all projects. It is used to inform the University of the impact on the distribution system capacity. Submit to Engineering Services at the Preliminary Design review submission and at the Final Design submission.

D. Building or Facility Electrical Load Determination
   ~~D.~~1. The Design Professional shall complete the Electrical Load Determination *(Editors Note: hyperlink previous three words to new document in section 00 51 00)* form for all projects that involve new buildings, major renovations, new electrical services or electrical service upgrades. It is used to inform the University of the impact on the distribution system capacity and the building or facility's distribution system. Submit to Engineering Services at the Preliminary Design review submission and at the Final Design submission. Prepare a separate copy

of the form for three types of power; Normal, Emergency and (if required) Standby power.

E. Specification Editing

1. Generally, use the “listed manufacturers” option in lieu of “available manufacturers.” Confirm any manufacturer preference with Engineering Services.
2. Note at least 3 manufacturers, unless otherwise approved by Engineering Services. Publicly funded projects require equals unless a formal exception has been granted by the State.
3. Confirm Requirement for extra materials with Engineering Services. Typical items to provide are occupancy sensors, specialty luminaire lenses, fuses, indicating lamps, and enclosure keys.
4. First edit of specifications shall use "strike-through" instead of actually deleting items to be removed. This will allow Engineering Services to see what is to be deleted rather than search for what is missing.
5. Create an Excel spreadsheet list of spare parts, etc. that are to be turned over to PSU at substantial completion (based upon the final contract documents).

F. Mounting Heights

1. Heights are measured to device centerline, unless otherwise noted.
2. Mount switches, card readers, and similar devices at 44” AFF.
3. Mount receptacles and similar wiring devices at 18” AFF.

G. National Electric Code (NEC)

~~3.~~1. Any exceptions taken while using the latest edition of the NEC shall only be used with the express approval of Engineering Services.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section D was added to add to address the new Electrical Load Determination Form and to provide a hyperlink to the document. Original sections D & E were relabeled due to the additional section D. Section G was added to provide clarity to the designer and to ensure Engineering Services, Electrical Department is aware of any exceptions taken.

Modify, Section 26 00 02.10 "Scope (Basis of Design/Application of Systems)" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

.10 Scope (Basis of Design/Application of Systems)

A. Motors
   1. Motors less than 3/4 hp. shall be single phase, 115 volts for operation on 120-volt circuits. Motors 3/4 h.p. and larger shall be three phase. Motors operating on three phase, 208V shall be rated at 200V. Motors operating on three phase, 480V shall be rated at 460 volts.
   2. On motors 25 hp and above at 480V or 10 hp and above at 208V, discuss the use of soft start and variable speed drives. Voltage sag exceeding 3% on motor start is unacceptable. Download and edit the Variable Frequency Drive specification from Engineering Services.
   3. Where reduced voltage starters of the wye-delta type are used, only closed transition types are acceptable.
   4. Three phase motors rated 25Hp and larger, 480VAC or 208VAC shall utilize Variable Frequency Drive rated cable, as outline in the Variable Frequency Drive specification and section 26 05 19.01.*(Editors note: hyperlink to section 26 05 19.01)*

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Revision to section A, Motors, was added to give direction to the designer when and where to utilize VFD rated cables.

Modify, Section 26 05 19.01 "Low Voltage Electrical Power Conductors and Cables" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

G. VFD rated cable shall be used for 25Hp, three phase, 480VAC or 208VAC motors and above, when used in conjunction with a VFD. The designer may elect to specify VFD rated cables on smaller motors if so desired. The VFD cable shall have the minimum following characteristics:

1. UL listed for 600V, 1000V, 2000V (designer to discuss need for 1000V or 2000V option with Engineering Services)
2. 90°C Wet/Dry
3. UL Listed Type TC-ER
4. Oil and Sunlight Resistant
5. Three symmetrical placed ground wires
6. Un-coated copper shield with minimum 50% overlap, full continuous coverage recommended, shield shall be in contact with ground wires

Acceptable manufacturers are: Belden, Draka, Southwire, or approved equal.

H. Compression lugs shall be utilized for connections were practicable. Compression lugs shall be UL listed, two-hole type, long barrel connectors. Acceptable manufacturer is Burndy, or approved equal.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Added sections G & H. G was added to outline the specifications for VFD rate cable and to provide directive to the designer. H was added to provide specifications for compression lugs.

Modify, Section 26 05 26.01 "Grounding and Bonding for Electrical Systems" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

(Editors note: Add table to end of section 26 05 26.01 and add hyperlink)

J. Ground connections to the ground bus bar shall utilize a long barrel two lug connection. Single lug short barrel connections are NOT acceptable.

K. Grounding conductors shall be installed in PVC conduit, RMC is an acceptable alternative. However, if RMC is used grounding hubs shall be installed on each end of the conduit and connected to the grounding conductor.

L. Typical CADD details are listed below for the Design Professionals reference:

Document	Version Date	Description
Detail # 260526-D01 Grounding Details (AutoCAD) Grounding Details (PDF)	October 2014	Typical University Grounding Details for the Professionals' use. The details provided are a baseline and it is the responsibility of the professional to design and develop complete details that are acceptable.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Added sections J, K & L. J was added to clarify the use of a specific type of compression lug. K was added to clarify that PCV is preferred but RMC can be used if certain guidelines are followed. L was added to hyperlink to PSU's typical design drawings for reference.

Modify, Section 26 05 43.01 "Underground Ducts and Raceways for Electrical Systems – Underground Ducts" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

(Editors note: Add table to end of section 26 04 43.01 and add hyperlink)

F. ~~Contact Engineering Services for Typical CADD details.~~Detectable warning tape shall be placed in the center and at least two feet above the underground duct. The detectable warning cable shall have the following characteristics but are not limited to:

1. Meets or exceeds all ASTM specifications
2. Minimum 6" width
3. Minimum 5 mil thickness
4. Acid, Alkali, Chemical, and Oil Resistant
5. Direct burial rated
6. Multi-layered polypropylene and aluminum
7. Print legend stating "CAUTION BURIED HIGH VOLTAGE LINE BELOW" or "CAUTION BURIED ELECTRIC LINE BELOW"

H. Typical CADD details are listed below for the Design Professionals reference:

Document	Version Date	Description
Detail # 260543-D01 Ductbank Details (AutoCAD) Ductbank Details (PDF)	October 2014	Typical University Ductbank Details for the Professionals use. The details provided are a baseline and it is the responsibility of the professional to design and develop complete details that are acceptable.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section F was updated to call out the use of detectable warning tape and to outline the specifications for the warning tape. Section G was added to add a hyperlink to the typical CADD details for PSU Ductbanks.

Modify, Section 26 05 43.02 "Underground Ducts and Raceways for Electrical Systems – Manholes and Transformer Foundations" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

(Editors note: Add table to end of section 26 05 43.02 and add hyperlink)

H. ~~Contact Engineering Services for Typical CADD details.~~Typical CADD details are listed below for the Design Professionals reference:

Document	Version Date	Description
Detail 260543-D01 Manhole Details (AutoCAD) Manhole Details (PDF)	October 2014	Typical University Manhole Details for the Professionals use. The details provided are a baseline and it is the responsibility of the professional to design and develop complete details that are acceptable.
Detail 260543-D02 Transformer Foundation Details (AutoCAD) Transformer Foundation Details (PDF)	October 2014	Typical University Transformer Foundation Details for the Professionals use. The details provided are a baseline and it is the responsibility of the professional to design and develop complete details that are acceptable.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section H was updated to add hyperlinks to PSU typical CADD details.

Modify, Section 26 05 53.01 “Identification for Electrical Systems” per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

J. Critical Research/Power Labeling - Labeling shall be placed on all switchgear, switchboards, distribution panels and panelboards that are feeding CRITICAL research or power, upstream equipment shall be labeled up to service entrance. The label shall have a yellow background with black lettering. The labeling shall read, “CRITICAL RESEARCH OR POWER IS FED FROM HERE, CONTACT FACILITY COORDINATOR IF A SHUTDOWN IS REQUIRED”

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section J was added to address new labeling requirements for electrical service equipment that feeds CRITICAL research equipment.

Modify, Section 26 20 00.01 "Low-Voltage Electrical Distribution" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

A.Services (480V and below)

3. Provide a set of "as-built" drawings stored in the main electrical room. ~~Storage shall be in a PVC tube mounted to the wall with caps on each end.~~ Storage shall be in a transparent PVC tube with a removable end. The tube shall be mounted to the wall horizontally. Tube shall be sized appropriately for drawings that will be placed inside. Label tube appropriately.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Number 3 was updated to change how the drawings are stored and what are they stored in. This was done to make it easier to see if the drawings are in the document tube and to make it easier to get the drawings out of the document tube.

Add New Section 26 23 00.02 “Low-Voltage Switchgear” per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

.02 Guide Specifications:

A. Design Professional shall carefully review and edit the guideline specifications below, adapting them as needed to achieve application-specific, fully developed specifications for each project.
B. These shall be edited using the process described in the instructions contained at the beginning of the document. Proposed modifications shall be reviewed with OPP Engineering Services.
C. Finalized version shall be included in the project contract documents. Use of other specifications is not acceptable.

(Editors note: Add table to end of section 26 23 00.02 and add hyperlink)

Document	Version Date	Description
26 23 00 Low-Voltage Switchgear Guide Specification	October 2014	This guide specification is intended to provide the Design Professional with general OPP minimum requirements for Low-Voltage Switchgear.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

A new section was added to address new guide specifications; the table contains a hyperlink to the OPP Low-Voltage Switchgear Guide Specification. The guide specification was added as an easy reference for the Design Professional.

Modify, Section 26 36 00.01 "Transfer Switches" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks will be blue underlined with a note describing how many words to include)

C. Transfer switch shall be similar to ASCO 4000 series or ASCO 7000 series if bypass isolation is required. Typically, provide solid neutral connection and open transition without delay. Discuss the following options with Engineering Services:
   1. Overlapping neutrals on systems with ground fault protection
   2. Closed transition (for generator systems only)
   3. Paralleling
   4. Delayed transition
   5. Bypass Isolation (for buildings requiring maintenance without interruption)
   6. Additional auxiliary contact sets to indicate switch position.
   7. Two-pole, double-throw contacts operate when normal source voltage is present at transfer switch terminals.
   8. Two-pole, double-throw contacts operate when emergency source voltage is present at transfer switch terminals.
   ~~5.~~9. One Form C contact for each of the following:
      a. Normal Source Acceptability
      b. Emergency Source Acceptability
      c. Selective Load Disconnect. - Pre and post transfer signal time delay for selective load disconnect with a programmable bypass on source failures - adjustable 0 to 5 minutes.
      d. Fourth contact can be set to mimic the acceptability contacts or annunciate any combination of the acceptability contacts and/or any switch alarm conditions available:
         1. Extended Parallel Time (Closed transition),
         2. Failure to Synchronize (Closed transition),
         3. Transfer Switch Locked Out (Closed transition),
         4. Load Disconnected (Delayed transition).
      ~~6.~~e. Include an extension of the engine start time delay (feature) to 60 seconds if an external 24VDC supply is connected to a controller. This external power source will also allow the LCD display to be active when both normal and emergency sources are unavailable.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section C was updated to provide the Design Professionals with a more comprehensive list of options that will be required on all transfer switches.

Modify, Section 00 51 00 "Miscellaneous Forms" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

Document	Version Date	Description
Title V New Emission Source Information	August 2001	The University's Title V permit requires all new emission sources installed be tracked, "permitted" and reported. The professional must provide the information requested as it becomes available (starting with the design process).
Environmental Quality Board (EQB)	April 2000	The Professional must submit projects involving proposed changes to the exterior of a building for review during the design process. The following document outlines the procedure for doing this.
Utility Demand and Consumption Form	March 2007	The Professional shall complete this form on all their projects. It is used to inform the University of the impact of your project on the distribution system capacity. It needs to the submitted during the Preliminary Design review submission and during the Final Design submission.
Design Phase Deliverables	September 2011	Minimum requirements for documents submitted to the University for Owner Review.
Background Check Policy	January 2013	Background check requirement for construction contracts and professional agreements.
Load Determination Form	October 2014	The Professional shall complete this form for all projects that involve new buildings, major renovations, new electrical services or electrical service upgrades. It is used to inform the University of the impact to the distribution system capacity and the building or facility's distribution system.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Added a row to the table in section 00 51 00, to address the new hyperlink for the new load determination form. Added a new document called New Load

Determination form for the professionals to fill out and submit for any and all projects.

Modify, Section 26 20 00.01 "Low-Voltage Electrical Distribution" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

B. Service Entrance Equipment

3. **Designs for PSU shall strive to provide the lowest possible arc flash incident energy. ~~Consider the use of~~Contact Engineering Services to determine whether to specify ARM (Arc flash Reduction Mode) system on any project. ARM shall utilize either arc flash light/current sensing system or separate arc reduction circuitry switch for use during maintenance and inspection of the service entrance equipment. Alternative arc flash reduction methods will be considered. When utilized, the ~~arc reduction~~ARM switch system shall adjust the trip curve of the breaker relay. Systems utilizing "zone-interlock" exclusively are not acceptable. ~~Arc reduction maintenance~~ARM system shall have remote lockable switch(es) on the front of the gear to initiate this setting with separate blue LED light(s) for notification. When this circuitry is provided, monitor the activation via CCS (Central Control System), per the BAS Specification. Require dual Arc Flash stickers ~~per~~ to meet NFPA 70E ~~Study section~~, refer to Engineering Power Studies section of the Standards. Manufacturer representative shall provide letter stating that they have visited the site and confirmed that the stickers have been applied in appropriate locations, per the Study.**

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section was updated so that designers know to confirm with Engineering Services whether ARM system is required; previous wording seemed to leave the decision to the consultant.

Modify, Section 26 32 13 "Packaged Generator Assemblies" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged. (Hyperlinks with be blue underlined with a note describing how many words to include)

26 32 13 Engine Generators
.01 General

A. When use of a generator is approved by Engineering Services, coordinate manufacturer, silencer type, fuel type, amount of fuel storage, and other options.

B. Maintenance: Not more than four hours' normal travel time from Installer's place of business to University.

C. Equipment shall not be installed on building roof or other locations that are difficult for service and replacement.

~~C.~~D. 250 kW and above, provide a BACnet or Modbus interface. Specify that the BAS contractor coordinate with the Generator and/or Interface Manufacturer to communicate with this Interface.

~~D.~~E. ~~Consider~~ 500 kW and above, discuss the use of paralleling equipment with Engineering Services, ~~for units 500kW and above,~~ to allow for testing under load and include demand side reduction.

~~E.~~F. Specify a 5 year full coverage warranty.

G. **Coordinate monitoring ~~requirements~~ with the BAS Specification.** At minimum, require monitoring of the following points through the BAS to the PSU CCS:

1. Generator Fault Status,
2. Low Fuel Level Status
3. Fuel Tank Leak Detector Status
4. Hand/Off/Auto switch position at generator control panel (initiate Alarm when the switch is not in Auto position)

~~1.~~5. Air Damper Status.

~~F.~~H. Emissions - Internal combustion engines rated at greater than 100 brake horsepower for use at the University Park campus must comply with Section 01 41 00 Regulatory Requirements as well as the following:

Design professional must review all applicable emissions regulations including, but not limited to, Sub parts to EPA 40CFR60 and EPA 40CFR63.

Professional shall specify that each engine manufacturer provide emissions data for the identified pollutants that are the lowest achieved by the proposed engine type in practice, and that can be guaranteed when installed at University Park. One manufacturer should be the base bid, and the "equals" as bid alternates so that the material costs can be compared versus each engine pollutants during the bid process. Non-responsive bidders may be eliminated from consideration. Note that the successful bidder will be judged only partially on the cost, the emissions data will also weigh heavily in the final equipment selection. The manufacturer shall submit the following:

1. **Copy of applicable regulations with highlighting of emissions limits for this specific unit of units.**

2. **Chart comparing identified pollutant limits to those of the proposed engine.**

If the engine is to be utilized as other than a standby source, these emission limits will have to be supported by data collection. Professional shall specify equipment to collect, record, and report such data. Discuss provisions and costs of installing CEMS (Continuous Emissions Monitor System) and CPMS (Continuous Parametric Monitoring System) equipment with Engineering Services.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section was updated to cover CCS monitoring of generators since, it was deleted from the BAS specification and needs to be addressed.

Modify, Section 26 00 01 "Owner General Requirements and Design Intent; .10 Scope (Basis of Design/Application of Systems)" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged.

26 00 01 Owner General Requirements and Design Intent
.10 Scope (Basis of Design/Application of Systems)

C. Building Automation Systems (BAS)

1. **Coordinate the monitoring of certain electrical equipment with the design of the BAS system. Equipment to be monitored shall include, but not be limited to:**

   a. **Arc Flash Reduction Maintenance switches on service entrance equipment (when applicable). EC shall daisy-chain all switch outputs together so that if one is enabled the BAS system sends an alert to CCS.**

   b. **Occupancy sensors for HVAC setback**

   c. **Exterior lighting circuits including building-mounted exterior luminaires. EC shall wire each CT to the BAS monitoring interface**

   d. **Engine Generators (when applicable), refer to Generator section for points to wire to the BAS monitoring interface**

   e. **Automatic Transfer Switches, refer to ATS section for points to wire to the BAS monitoring interface**

   f. **UPS's (when applicable)**

2. **Electrical Equipment BAS Monitoring Interface – Install BAS low voltage work separate from line voltage (>50VAC), specify that a BAS Interface box is provided. Box shall be a minimum of 12x12 with clear cover and contain a labeled terminal strip for each piece of monitored electrical equipment. EC shall wire each point from the equipment to the terminal strip and label the wires at each end.**

~~2.~~3. **Provide a dedicated circuit or circuits to BAS equipment, from the appropriate branch of power. Not every piece of BAS equipment requires a 20A circuit, they may be combined when appropriate. Require that the EC field coordinate with the BAS vendor exact locations and provide a single receptacle for their UPS.**

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

Section was updated to address BAS issues.

Modify, Section 26 50 00 "Interior Lighting" per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged.

26 51 00 INTERIOR LIGHTING

.01 Lighting Design

A. Base bid shall utilize dimmable LED source for all general lighting, discuss luminaire application with Engineering Services. Certain areas such as Mechanical, Electrical, and Telecom may use T8 lamping. ~~Minimize the use of different lamp styles and wattages. Maximize the use of the 48 inch T8 lamp as this source has the best combination of efficiency (about 100 lumens/watt), life (exceeding 50,000 hours for major manufacturers), and low cost.~~ The use of ~~this lamp~~LED will save energy, reduce material sent to recycling, decrease maintenance costs, eliminate Mercury use, and save money on lamp replacements.

~~B. Investigate the use of LED luminaires as a replacement to linear fluorescent. Once dimming/daylight harvesting is added to the design, LED becomes a cost competitive and preferable source. This is due to extending the diode life and LED's better native dimming capability.~~

~~C.~~B. The professional shall submit ~~two (2)~~PDF ~~copies of~~ computer generated point-by-point calculations of most interior spaces to Engineering Services for review. The use of certain "typical" rooms shall be acceptable except when the amount of fenestration or the room orientation changes. Show calculations for each space without daylight contribution as well as with daylight contribution and lighting controls. Point levels shall be legible, shown on a scaled drawing. All pertinent calculation parameters shall be indicated, ~~and~~ highlight~~ed~~ where the design is non-IES compliant. Engineering Services will provide direction and variance where deemed adequate. Utilize AGI-32 full calculation mode or similar program, as approved by Engineering Services.

C. The Illuminating Engineers Society Lighting Handbook, current edition, shall be used as a standard for lighting levels. Provide a spreadsheet showing all room names and numbers along with target illumination levels. For television studios and classrooms used for TV production, consult Engineering Services for guidelines.

~~A.~~1. Refer to 26 00 01 .10 – B Elevator Service and Support for applicable illumination requirements.

~~D. Discuss the use of LED technology with Engineering Services where applications exist. LED shall be used for downlights and decorative luminaires. CFL shall no longer be specified on projects.~~

~~E.~~D. Medium and high bays in shops, lobbies, etc. ~~should take into account lamp life, lamp replacement, and controllability. Investigate the use of T8 fluorescent lamps (with high ballast factor ballast) versus T5HO in these applications, and discuss options with Engineering Services~~shall be LED. ~~Ballasts~~ Drivers must be rated for high temperature environment.

~~F.~~E. Provide ~~two (2)~~a ~~copies~~ PDF copy of ~~a light~~the Luminaire fixture cutsheets ~~booklet~~ with ~~any~~ every review submittal showing lighting layouts. Booklet shall be in color and include the light fixture schedule as well as target illumination levels and proposed lighting controls.

~~G.~~F. Specify the proper disposal of mercury containing lamps per PSU Policy SY-31 and PCB ballasts per PSU Policy SY-26 for all renovation work.

~~H.~~G. Include the luminaire fixture schedule within the drawings, not within the specifications. As-built drawings shall include final installed luminaire information.

.02 Lamps

A. Unless otherwise approved, 48-inch linear flourescent lamps shall be "extra-long life", either full-wattage (32-watt) T8, or the reduced wattage (28-watt) T8. ~~Confirm~~ Typically use low-wattage but confirm selection with Engineering Services.

B. The use of other fluorescent lamps is discouraged. Linear T5HO (high-output) fluorescent lamps are allowed where design applications exist, but only as approved by Engineering Services.

C. Compact fluorescent lamps shall not be specified. LED luminaires or lamps shall be specified instead.

D. Coordinate other lamp wattages and styles with Engineering Services prior to specification.

E. All fluorescent lamps will typically incorporate a 4100 degree Kelvin color temperature and a minimum CRI of 82.

1. Qualifying extra-long life 32 watt T8, 48 inch linear lamps are as follows:

   a. GE Super Long Life: F32T8/SXL/SPX41/ECO

   b. Philips XLL: F32T8/TL841/XLL/ALTO

   c. Sylvania Octron XP/XL: FO32/841/XP/XL/ECO3

2. Qualifying reduced wattage T8, 48 inch linear lamps are as follows:

   a. GE Ecolux UltraMax: F28T8/XL/SPX41/ECO

   b. Philips XLL: F32T8/ADV841/XLL/ALTO 28W

   c. Sylvania Octron XP/XL: F028/841/XP/XL/SS/ECO3

F. Do not use incandescent lamps, unless specifically approved by Engineering Services. When allowed, provide the following:

1. “A” lamps shall be long-life, rated 125 volts, with inside frost.

2. MR-16 lamps, up to 50 watt, shall be replaced with LED equivalent.

3. Any wallbox dimmers or dimming system shall be set to only allow lamp operation to 90% output. This is to conserve energy as well as to extend lamp life by double.

G. Require that the contractor obtain all similar lamp types through one source from a single manufacturer.

~~H. Lamp Orientation: All lamps shall be specifically rated for the burn position in which they are used. Universal burn lamps are only acceptable in luminaires that will require aiming that will result in a lamp orientation that is neither vertical nor horizontal.~~

~~I.~~H. ~~Fluorescent dimming~~Dimming: All ~~fluorescent lamps on dimming ballasts shall be burned in at full brightness continuously for the length of time as required by the lamp manufacturer prior to any dimming (typically 10 hours). Bypass local control as necessary to accomplish~~

~~this task~~dimming luminaires shall be LED. Most applications only require a minimum dimming range of 5% to 10%, confirm the use of 1% dimming with Engineering Services~~.~~

~~J.~~I. CFL Lamp Disposal and Cleanup: Refer to PSU Environmental Health and Safety data sheet for disposal and/or cleanup of broken CFL lamps.

~~K.~~J. LED shall be used instead of CFL for all applications (downlights, decorative luminaires, etc.). Specify luminaire with a minimum lumen output (typically 1000 or 2000 lumen), minimum CRI of 80, minimum L70 of 50,000 hours, and minimum efficiency of 70 lumens per watt. Require testing to IES LM-79 and LM-80 standards and life calculations based on IES TM-21. CCT shall be 4100K. Chips shall be binned to no more than a 2-step MacAdam Ellipse. Consult Engineering Services as to acceptable manufacturers.

~~L.~~K. LED screw-in lamps using medium base, GU24, GU10, bi-pin etc. shall be approved by Engineering Services prior to specification. PSU prefers purpose-built LED luminaires over socket based solutions.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

1) Add reference to Elevator Service section that notes minimum illumination levels.
2) Revise general lighting source to LED.

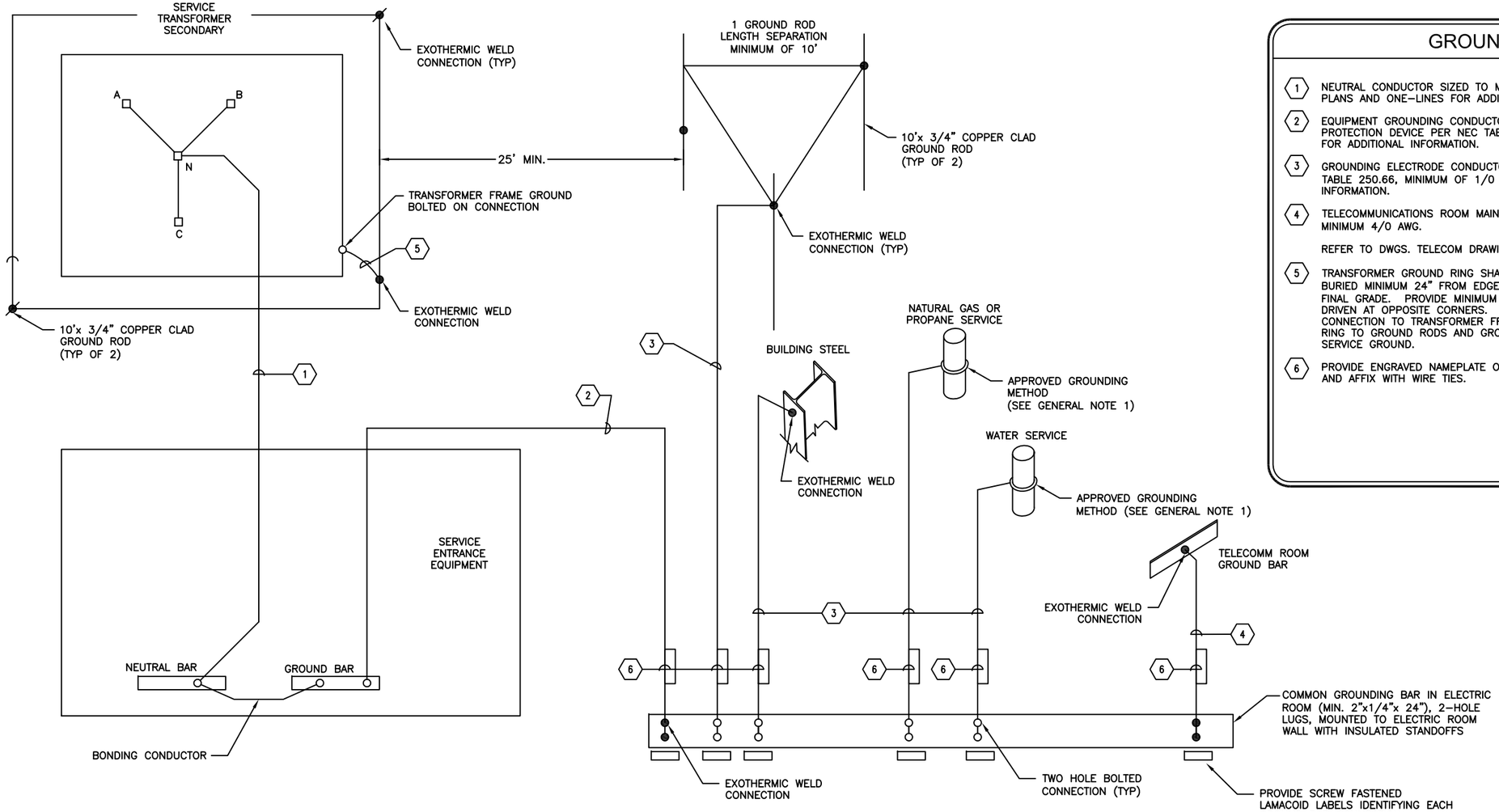
Modify, 26 56 00 EXTERIOR LIGHTING per the following (deletions are shown struck through and additions are double underlined). Remainder of section is unchanged.

26 56 00 EXTERIOR LIGHTING
.01 General

B. Walkway Lighting, University Park Campus:
1. Light Source: Light source~~s~~ for walkway lighting shall be ~~of~~ 10,000 lumen LED with a minimum color rendering index (CRI) of 82 and a correlated color temperature of 4000K. ~~the high intensity discharge, 100 watt ceramic metal halide type clear lamp, pulse-start. Source shall provide a minimum color rendition index (CRI) of 92 and a Kelvin temperature of 4000. Where sidewalks are adjacent to roadways, the roadway light source shall be deemed acceptable where the minimum lighting levels are satisfied. Otherwise, the professional shall review alternatives with Engineering Services. Consider the use of LED source. Confirm with Engineering Services where its use is appropriate.~~
~~1.~~2. Driver: Luminaire shall include the electronic dimmable driver dual-rated at 120V and 277V.
3. Luminaire: Luminaire shall be conical shaped, low profile, incorporating a pressure die-cast UV and weather resistant black top shade, vandal resistant high impact UV stabilized clear injection molded polycarbonate enclosure and a three-arm support. ~~Lamp~~ Source shall be concealed by use of a ~~contoured, graduated reflector shade~~conical white opal acrylic diffuser that ~~creating~~ creates a symmetrical round type V distribution. ~~Luminaire shall include 100 watt metal halide lamp and integral "F" can ballast available in either 120V or 277V.~~
~~2.~~4. Model: Luminaire shall be Louis Poulsen KIPP, model 416. Any exception to this luminaire must be approved by the University Architect prior to the final design submission.
~~3.~~5. Pole: Pole shall be 4.5 inch diameter, round, straight aluminum pole with handhole at base, split cast aluminum base cover and shoe base. Pole shall be 12 ft in height and finished black. Pole shall be Louis Poulsen model RSA-4.5-12-Black.
6. Concrete Base: Concrete bases shall utilize rebar reinforcement and embedded anchor bolts and shall be designed to support the pole and luminaire assembly utilizing local wind load parameters and assembly effective projected area (EPA). Bases shall protrude above grade 6" with a top beveled edge. Above grade concrete shall be finished smooth.
~~4.~~7. Where sidewalks are adjacent to roadways, the roadway light source shall be deemed acceptable where the minimum lighting levels are satisfied. Otherwise, the professional shall review alternatives with Engineering Services.
~~5.~~8. Contact Engineering Services for typical CADD details.

END of revision
Update Commentary:
Section was updated primarily for the following reasons:

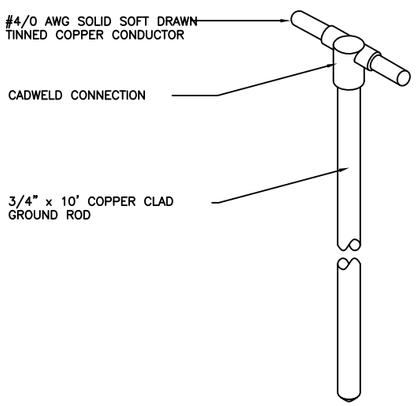
3) Exterior Lighting section updated to require the 10,000 lumen Poulsen Kipp LED luminaire for PSU UP campus walkways.



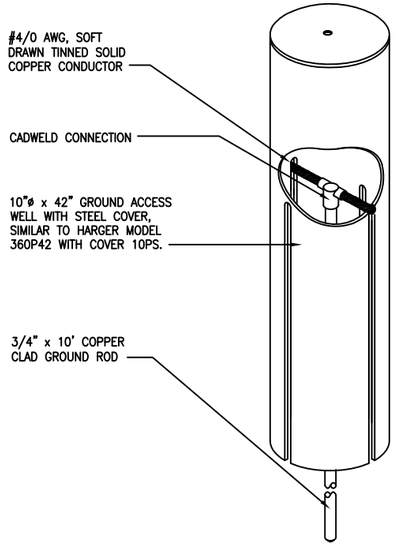
GROUNDING KEY NOTES

1. NEUTRAL CONDUCTOR SIZED TO MATCH PHASE CONDUCTORS MINIMUM. REFER TO FLOOR PLANS AND ONE-LINES FOR ADDITIONAL INFORMATION.
2. EQUIPMENT GROUNDING CONDUCTOR SIZED BASED ON SWITCHGEAR MAIN OVERCURRENT PROTECTION DEVICE PER NEC TABLE 250-122. REFER TO FLOOR PLANS FOR ADDITIONAL INFORMATION.
3. GROUNDING ELECTRODE CONDUCTOR SIZED BASED ON PHASE CONDUCTORS PER NEC TABLE 250.66, MINIMUM OF 1/0 AWG. REFER TO FLOOR PLANS FOR ADDITIONAL INFORMATION.
4. TELECOMMUNICATIONS ROOM MAIN GROUND BUSBAR GROUNDING CONDUCTOR SHALL BE MINIMUM 4/0 AWG.

   REFER TO DWGS. TELECOM DRAWINGS FOR ADDITIONAL INFORMATION.
5. TRANSFORMER GROUND RING SHALL CONSIST OF MINIMUM 2/0 BARE COPPER CONDUCTOR BURIED MINIMUM 24" FROM EDGE OF TRANSFORMER FOUNDATION AND 18"-24" BELOW FINAL GRADE. PROVIDE MINIMUM OF TWO (2) 10'-0"X 3/4" COPPER CLAD GROUND RODS DRIVEN AT OPPOSITE CORNERS. PROVIDE ADEQUATE GROUNDING WHIP FOR BOLTED CONNECTION TO TRANSFORMER FRAME GROUND. PROVIDE EXOTHERMIC WELDS OF GROUND RING TO GROUND RODS AND GROUNDING WHIP TO RING. DO NOT CONNECT TO BUILDING SERVICE GROUND.
6. PROVIDE ENGRAVED NAMEPLATE ON ALL GROUND CABLE CONNECTIONS AT THE BUS BAR AND AFFIX WITH WIRE TIES.



GROUND ROD DETAIL
SCALE: NONE

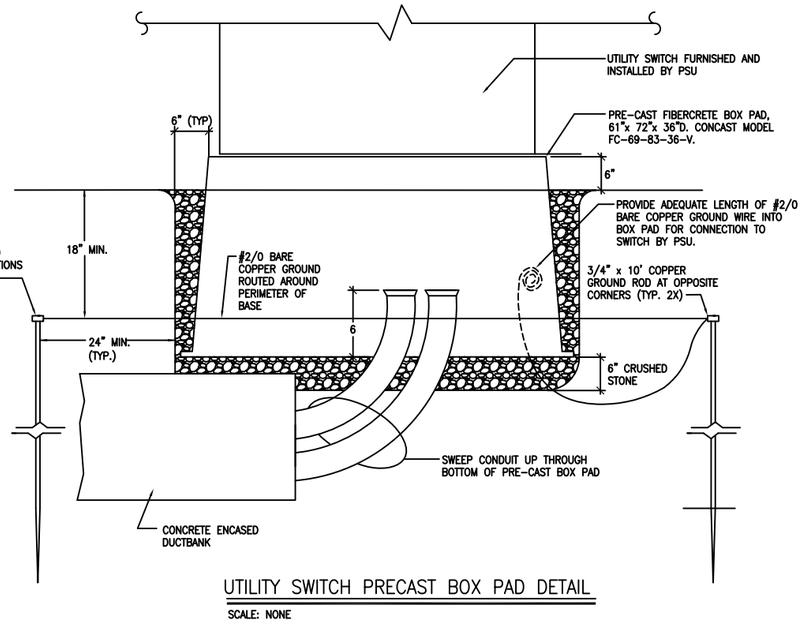


GROUND ROD ACCESS WELL DETAIL
SCALE: NONE

GENERAL NOTES:

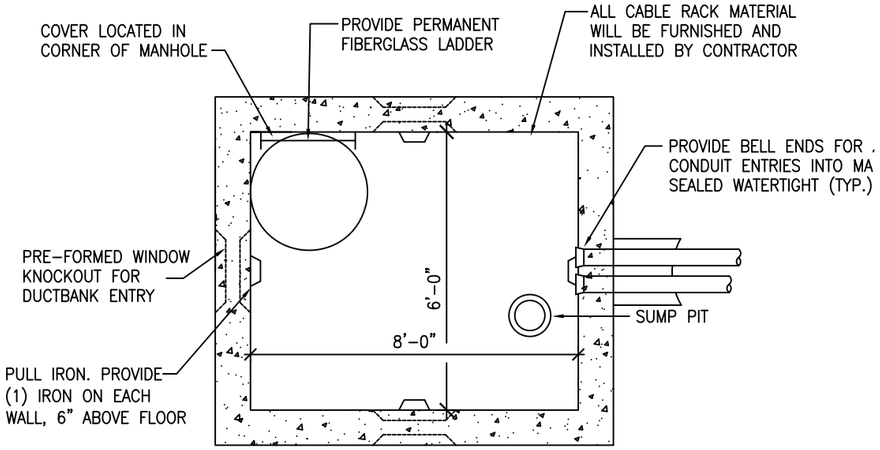
1. A GROUNDING JUMPER SHALL BE PROVIDED AROUND THE WATER OR GAS METER AND BACKFLOW PREVENTER.
2. PVC CONDUIT IS THE PREFERRED METHOD OF PROTECTION FOR THE GROUNDING CONDUCTORS. DISCUSS WITH PSU ENGINEERING SERVICES FOR ANY DEVIATIONS.

PSU OPP STANDARD DETAIL		
TITLE: TYPICAL GROUNDING DETAILS		DETAIL #: 260526-D01
SCALE: NONE	PAGE #1 OF 1	DATE: 10/20/2014

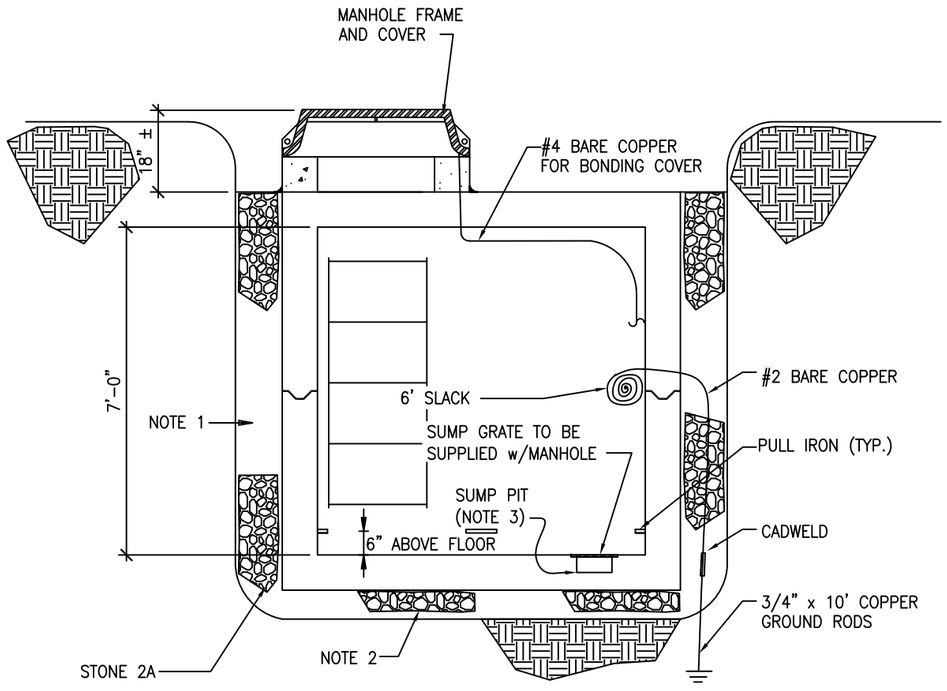


UTILITY SWITCH PRECAST BOX PAD DETAIL

SCALE: NONE



PLAN VIEW



ELEVATION

TYPICAL PRECAST ELECTRICAL MANHOLE DETAILS

SCALE: NONE

NOTES FOR PRECAST MANHOLE INSTALLATION:

1. EXCAVATE
   EXCAVATE TO PROVIDE 12-INCH CLEARANCE ALL AROUND MANHOLE. DEPTH AS REQUIRED.

2. BACKFILL
   BACKFILL USING CRUSHED STONE TO APPROXIMATELY 1/2 THE EXCAVATION DEPTH. REMOVE SHORING AND TAMP OR ROD THE STONE TO BE SURE IT FLOWS INTO ALL VOIDS. COMPLETE BACKFILL TO TOP OF MANHOLE.

3. SUMP
   UNLESS SPECIFIED BY OPP UTILITY ENGINEER, DO NOT OPEN SUMP KNOCKOUT IN FOUNDATION.

4. GROUNDING
   GROUNDING RING SHALL BE PROVIDED AROUND MANHOLE WITH ONE GROUND ROD PLACED AT TWO OPPOSITE CORNERS, SIMILAR TO UTILITY SWITCH GROUND RING DETAIL.

5. CONSTRUCTION
   REINFORCED CONCRETE SHALL BE USED PER MANUFACTURERS RECOMMENDATION. THE TOP CEILING SLAB SHALL BE RATED FOR VEHICULAR TRAFFIC.

APPROVED SUPPLIERS:

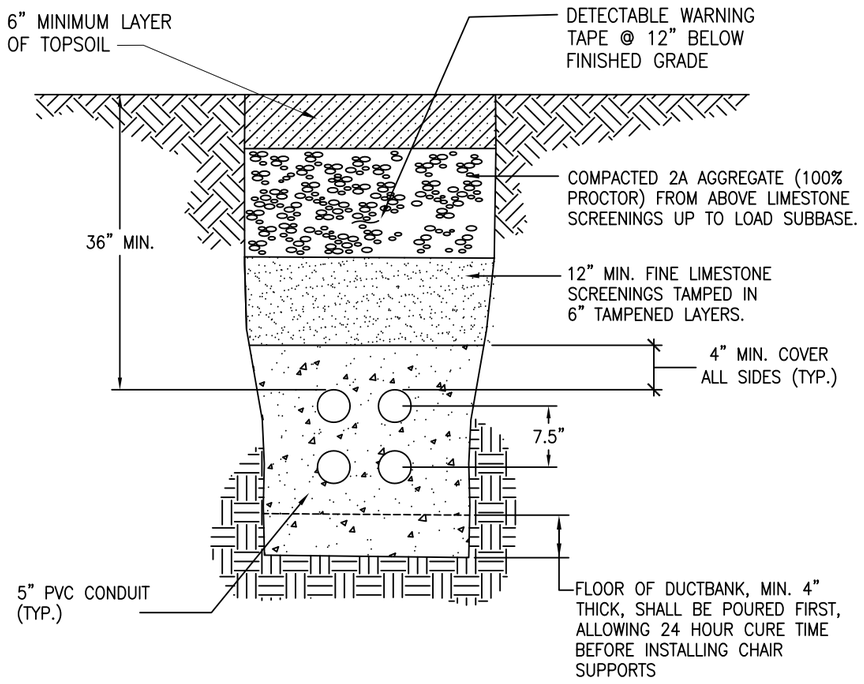
OLDCASTLE PRECAST
200 KEYSTONE DRIVE
TELEFORD, PA 18969
215-257-8081

A.C. MILLER CONCRETE PRODUCT, INC.
BRIDGE STREET
SPRING CITY, PA 19475
800-229-2922

TERRE HILL CONCRETE PRODUCT, INC.
P.O. BOX 10
TERRE HILL, PA 17581
800-242-1509

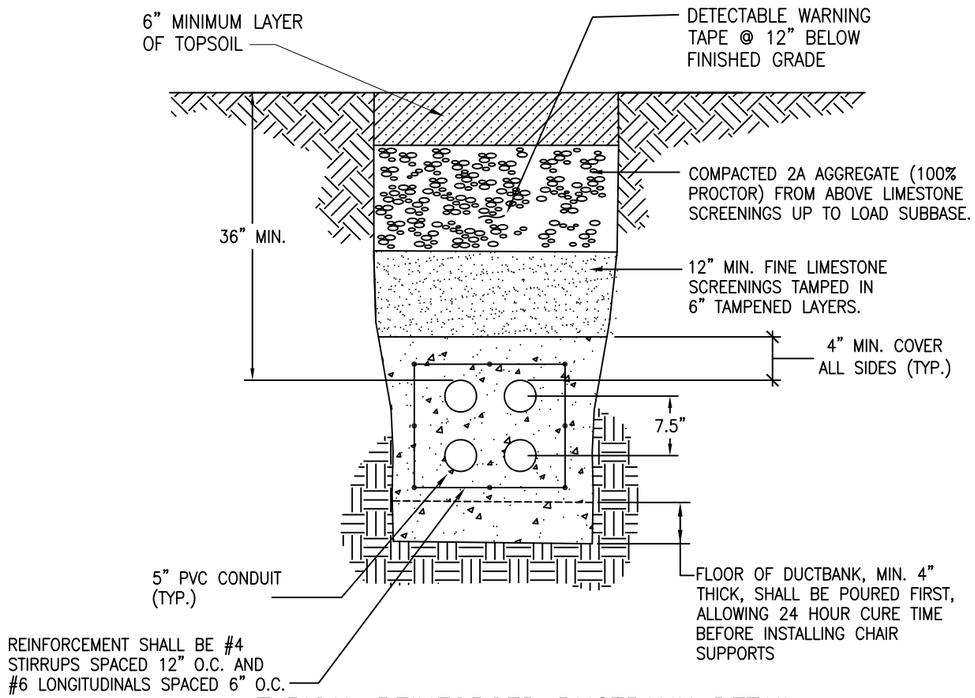
MONARCH PRODUCTS, INC.
385 SIPE ROAD
YORK HAVEN, PA 17570
717-938-8303

PSU OPP STANDARD DETAIL		
TITLE: TYPICAL MANHOLE DETAILS		DETAIL #: 260543-D01
SCALE: NONE	PAGE #1 OF 2	DATE: 10/20/2014



TYPICAL NON-REINFORCED DUCTBANK DETAIL

SCALE: NONE



TYPICAL REINFORCED DUCTBANK DETAIL

SCALE: NONE

GENERAL NOTES- ELECTRICAL DUCTBANK WORK

1. ALL NEW UNDERGROUND DUCTBANK AND MANHOLE WORK SHALL BE PERFORMED BY THE CONTRACTOR UNLESS OTHERWISE NOTED. THE CONTRACTOR SHALL PROVIDE ALL DUCTBANKS FROM NEW MANHOLES TO A LOCATION WITHIN FIVE FEET OF THE ENTRANCE INTO EXISTING MANHOLES. PSU WILL PROVIDE ALL CONDUIT AND DUCTBANK EXTENSIONS INTO THE EXISTING MANHOLES. CONTRACTOR SHALL PROVIDE ALL EXTENSIONS INTO THE NEW MANHOLES.
2. ALL NEW CONDUITS SHALL INCLUDE PULL STRINGS, FURNISHED AND INSTALLED BY ELECTRICAL CONTRACTOR.
3. ALL NEW DUCTBANKS SHALL CONSIST OF CONCRETE ENCASED PVC TYPE EB CONDUITS, SIZES AND QUANTITIES AS INDICATED. REFER TO DETAILS.
4. DUCTBANKS SHALL BE INSTALLED TO SLOPE TOWARD MANHOLES AND NOT ENTRANCES INTO BUILDINGS. VALLEYS IN CONDUIT SYSTEM ARE NOT ACCEPTABLE.
5. PROVIDE REINFORCEMENT IN DUCTBANK WHERE UNDER ROADWAYS, PARKING LOTS, AND SIDEWALKS. REINFORCEMENT NOT REQUIRED UNDER GRASS AREAS. PROVIDE REINFORCEMENT IN DUCTBANK AT MANHOLE ENTRIES WHERE INDICATED.
6. ALL CONDUCTORS, CABLE AND WIRING ASSOCIATED WITH NEW DUCTBANKS WILL BE FURNISHED AND INSTALLED BY PSU.
7. COORDINATE DUCTBANK ROUTING IN-FIELD WITH EXISTING SITE FEATURES AND UNDERGROUND UTILITIES. G.C. SHALL COORDINATE ROUTES ADJACENT TO EXISTING TREES WITH OWNER. REFER TO SPECIFICATIONS FOR EXCAVATION REQUIREMENTS ADJACENT TO TREES.
8. COORDINATE APPROACH OF ENTRIES INTO MANHOLES WITH PSU. EXISTING MANHOLES TO RECEIVE NEW CONDUITS CONTAIN MEDIUM VOLTAGE CABLE AND EQUIPMENT. ENTRY INTO SUCH MANHOLES BY PERSONNEL IS NOT PERMITTED. ALL SUCH WORK MUST BE COORDINATED WITH PHYSICAL PLANT PERSONNEL.
9. ALL NEW DUCTBANKS SHALL BE INSTALLED A MINIMUM 36" BELOW FINISHED GRADE TO TOP OF CONDUIT.
10. DUCTBANK ENTRANCES INTO MANHOLES SHALL ENTER TO AVOID PLACEMENT OF CONDUITS DIRECTLY BELOW OR ADJACENT TO THE MANHOLE COVER.
11. IT IS THE RESPONSIBILITY OF THE PROFESSIONAL TO CONFORM TO NEC 310.46 (C)(2) AND TO CONFIRM WITH PSU ENGINEERING SERVICES REGARDING DEPTH OF DUCTBANKS.
12. PREMANUFACTURED CONDUIT CHAIR SU[PPORTS SHALL BE UTILIZED FOR BOTH REINFORCED AND NON-REINFORCED CONCRETE DUCTBANKS, AND SHALL BE SPACED PER THE MANUFACTURERS RECOMMENDATIONS.

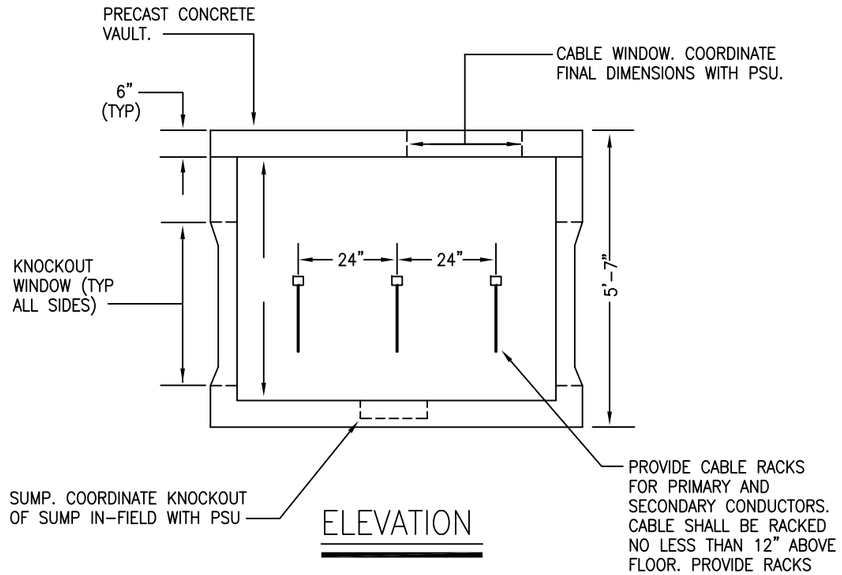
NOTES:

AVOID CONCRETE BLEEDING OUTSIDE OF EXCAVATION. DUCTBANK MUST BE FORMED IF WALL ADJACENT TO POUR EXTENDS BEYOND THE "MAX." DIMENSION OF DUCTBANK.

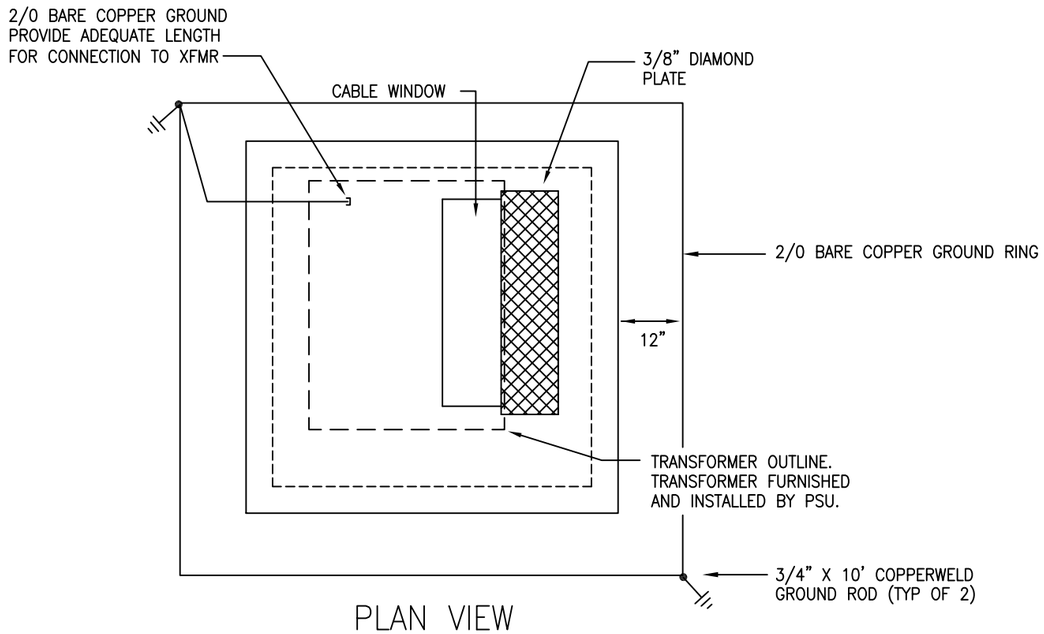
ONCE DUCTBANK FLOOR IS POURED, AFTER INSTALLATION OF CONDUIT AND PRIOR TO FINAL CONCRETE POUR, INSPECTION AND SIGN-OFF BY UNIVERSITY REPRESENTATIVE IS REQUIRED.

PSU OPP STANDARD DETAIL

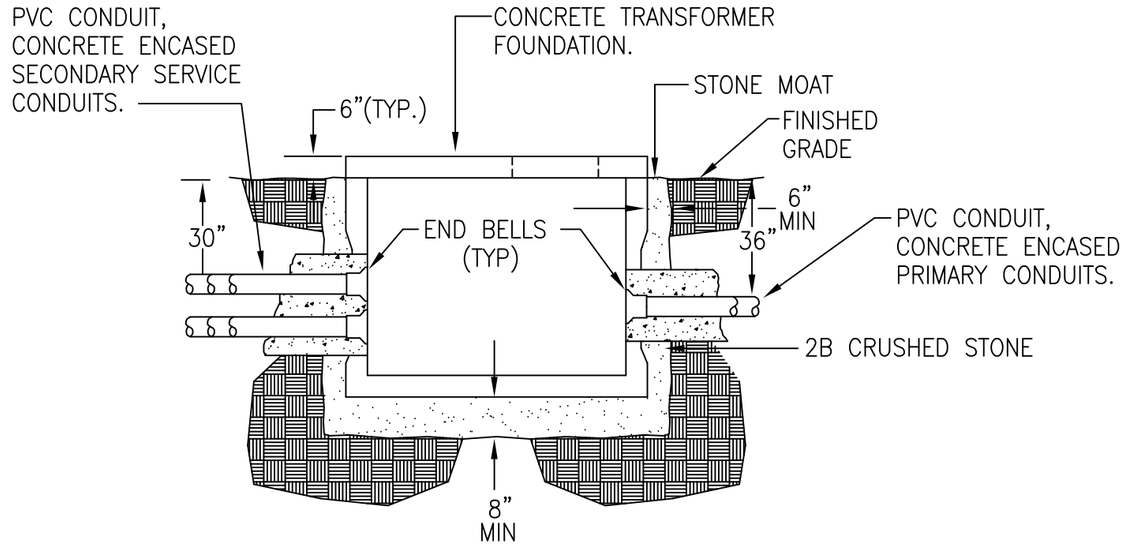
TITLE: TYPICAL DUCTBANK DETAILS		DETAIL #: 260543-D01
SCALE: NONE	PAGE #1 OF 1	DATE: 10/20/2014



ELEVATION



PLAN VIEW



SECTION VIEW

APPROVED SUPPLIER	PHONE NUMBER
A.C.MILLER CONCRETE PRODUCTS SPRING CITY, PA 19475	800-229-2900
BY-CRETE PRECAST PRODUCTS LEBANON, PA 17042	717-866-7690
MONARCH PRECAST CONC. CORP. YORK HAVEN, PA 17570	717-938-8303

ALL WORK ON THIS DETAIL SHALL BE THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR UNLESS OTHERWISE NOTED.

NOTES:

1. SIZE OF TRANSFORMER FOUNDATION SHALL BE DETERMINED BASED ON THE SIZE OF THE TRANSFORMER PLACED ON TO IT. CONFIRM WITH PSU ENGINEERING SERVICES FOR SIZE OF TRANSFORMER.

PRECAST TRANSFORMER FOUNDATION DETAILS

NO SCALE

PSU OPP STANDARD DETAIL		
TITLE: TYPICAL TRANSFORMER DETAILS		DETAIL #: 260543-D02
SCALE: NONE	PAGE #2 OF 2	DATE: 10/20/2014

PSU ELECTRICAL LOAD INFORMATION

Normal ◉ Emergency ○ Standby ○ (choose one)

Prepared By _____ Prepared Date _____
(name and phone number)

Project Name _____ Contact Name _____ Phone # _____

Building Name _____ Campus _____ Building #_____

BUILDING DATA

Building Type _____Gross sqft _____Operating hrs/day_____Operating hrs/wk _____

ELECTRIC SERVICE REQUIREMENTS

Temporary Service
Date required: _____ Voltage _____ Phase _____ Amps _____
Note:

Permanent Service Date Required _____ (choose appropriate boxes below)
New Service ☑ Relocate Existing ☐ Upgrade Existing ☐ Underground ☑ Overhead ☐
Voltage _____ Phases _____ Service Entrance Size _____ (amps)

LOAD DATA

Description	Ratings (choose from dropdown)	Amount (# of units)		Total Load		Hours Used per Day
Lighting		N/A				
Space Heating						
Air Conditioning						
Water Heating						
Boiler						
Cooking Equipment						
Refrigeration Equip.						
Motors - 3Ph Duty						
Motors - 3Ph Standby						
Motors - 1 Phase						
Office Equipment						
X-Ray Equipment						
Receptacles						
Largest Motor (not listed above)						
Total Connected Load						

Largest Motor (HP), if 25 HP or greater provide the following:

Starting kVA of motor or motor code letter	
Number of starts per day	

Additional Information:

*No welders allowed on electrical service.
*Separate form required for each service type (Normal, Emergency and Standby)

By signing below I verify that the load information is true and accurate:

Name _____ **Name** _____ **Company** _____
(Print) (Sign)

Revision Date 10/20/14

Email return completed electronic document to PSU Engineering Services, opp_es@psu.edu

SECTION 262300 - LOW-VOLTAGE SWITCHGEAR

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes metal-enclosed, low-voltage power circuit-breaker switchgear rated 1000 V and less for use in ac systems.

B. Related Sections include the following:

List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.

Retain subparagraph(s) below if Project includes requirements for electrical power monitoring and control, power factor correction, or SPD.

1. Section 260913 "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.

2. Section 263533 “Power Factor Correction Equipment” for capacitor bank requirements.

3. Section 264313 “Surge Protective Devices for Low-Voltage Electrical Power Circuits” for SPD requirements.

1.3 DEFINITIONS

Retain abbreviations that remain after this Section has been edited.

A. ATS: Acceptance Testing Service.

B. GFCI: Ground-fault circuit interrupter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Engineering Power Studies must be submitted and approved by PSU Engineering Services prior to final approval of the switchgear shop drawings and prior to any release of equipment for manufacture.

B. Shop Drawings: For each type of switchgear and related equipment.

1. Dimensioned plans, elevations, sections, three-line diagram, and details, including required clearances and service space around equipment. Include the following:

a. Tabulation of installed devices with features and ratings.
b. Enclosure types and details.
c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
e. Current rating of buses.
f. Short-time and short-circuit current rating of switchgear assembly.
g. Nameplate legends.
h. Mimic-bus diagram.
i. Penn State metering provisions with indication of approval by OPP Engineering Services.
j. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
k. Three-line diagram to include field connection points.

2. Wiring Diagrams: Power, signal, metering, and control wiring.

C. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipe and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

Retain paragraph and subparagraphs below if required by seismic criteria applicable to Project. Coordinate with Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Manufacturer Seismic Qualification Certification: Submit certification that switchgear, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Retain one of first two subparagraphs below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Second definition is used for essential facilities where equipment must operate immediately after an earthquake.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Coordinate paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as supplemented in "Quality Assurance" Article.

C. Qualification Data: For testing agency.

Retain first paragraph below if Contractor is responsible for field quality-control testing.

D. Field quality-control test reports.

E. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

Extra materials may not be allowed for publicly funded projects.

Revise this Article to suit Project. Spare-fuse cabinets are specified in Section 262813 "Fuses."

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Six of each type and rating used. Include spares for potential transformer fuses, control power fuses, and fuses and fusible devices for fused circuit breakers.
2. Indicating Lights: Six of each type installed.

3. Touchup Paint: Three containers of paint matching enclosure finish, each 0.5 pint.

1.8 QUALITY ASSURANCE

Independent testing agency is required; see Section 014000 "Quality Requirements" for general testing and inspecting agency qualification requirements. If additional control is needed, use first paragraph below to specify 29 CFR 1910.7 or other more specific criteria (e.g., NETA). 29 CFR 1910.7 defines a nationally recognized testing laboratory as it applies to testing and inspecting for safety, and lists, labels, or accepts equipment and materials that meet certain OSHA criteria.

A. Testing Agency Qualifications: An independent third party agency which can function as an unbiased testing authority professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated. An organization having a designation of InterNational Electrical Testing Association (NETA) accredited Engineering and Testing Firm (Testing Firm) meets the previous criteria. Prior to bidding, the name of the proposed testing organization shall be submitted to PSU OPP Engineering Services for approval.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain switchgear through one source from a single manufacturer.

Retain paragraph below to allow drawing details based on one manufacturer's product to establish requirements and still allow competition. Coordinate with Section 016000 "Product Requirements" requirements.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Section 016000 "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. The switchgear shall bear a UL 1558 label.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.

B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 PROJECT CONDITIONS

Revise paragraph below to describe specific requirements for moving switchgear into place. Where appropriate, indicate alterations to existing facilities that may be required to accommodate an indicated delivery path. Coordinate with Drawings.

A. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

Retain paragraph and subparagraphs below if interruption of existing electrical service is required.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than fourteen days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.

Retain paragraph below if installation space for switchgear is limited; show maximum dimensions on Drawings.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

Specify unusual environmental or service conditions here. See Editing Instruction No. 3 in the Evaluations. Otherwise, indicate typical environmental conditions as follows: For switchgear installed outdoors, indicate minimum ambient temperature and expected humidity range and specify compliance with IEEE C37.24.

D. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 40 deg C.
2. Altitude: Not exceeding 6600 feet.
3. <**Insert unusual service conditions.**>

1.11 COORDINATION

Edit first paragraph below to delete or add types of construction that penetrate or are supported by ceilings.

A. Coordinate layout and installation of switchgear and components with other construction that penetrates ceilings or is supported by them, including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Refer to Section 016000 "Product Requirements."

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cutler-Hammer, Inc.; Eaton Corporation.
   2. General Electric Company.
   3. Siemens Energy & Automation, Inc.
   4. Square D; Schneider Electric.

Show ratings for switchgear on the Drawings. Ratings include system voltage/phase, bus size, short circuit ratings, etc.

2.2 RATINGS

A. Refer to drawings for equipment ratings.

2.3 FABRICATION

A. Factory assembled and tested and complying with IEEE C37.20.1/UL1558.

B. Indoor Enclosure Material: Steel.

Retain paragraph above or first paragraph below or both, and revise to suit Project. See Editing Instruction No. 4 in the Evaluations.

C. Outdoor Enclosure Material: Galvanized steel.

D. Outdoor Enclosure Fabrication Requirements: Weatherproof; integral structural-steel base frame with factory-applied asphaltic undercoating; and each compartment equipped with the following features:

   1. Structural design and anchorage adequate to resist loads imposed by [**125-mph**] <**Insert wind speed**> wind.
   2. Space heater operating at one-half or less of rated voltage, sized to prevent condensation.
   3. Louvers equipped with insect and rodent screen and filter; arranged to permit air circulation while excluding insects, rodents, and exterior dust.

Delete first three subparagraphs below if weatherproof internal aisle construction is specified.

   4. Hinged front door with padlocking provisions.
   5. Interior light with switch.
   6. Weatherproof duplex receptacle.
   7. Common internal aisle of sufficient width to permit protective-device withdrawal, disassembly, and servicing in aisle.

8. Aisle access doors with outside padlocking provisions and interior panic latches.
9. Aisle space heaters operating at one-half or less of rated voltage, thermostatically controlled.
10. LED aisle lights controlled by wall switch at each entrance (minimum 30fc).
11. GFCI duplex receptacles, a minimum of two, located in aisle.

Revise subparagraph below if forced ventilation rather than convection ventilation is required.

12. Aisle ventilation louvers equipped with insect and rodent screen and filter and arranged to permit air circulation while excluding insects, rodents, and exterior dust.

E. Finish: IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.

F. Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment. Construct barrier to prevent arc event from traveling through the rear of the lineup (not arc resistant).

G. Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus. Construct barrier to prevent arc event from traveling through the rear of the lineup (not arc resistant).

H. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and tie circuit breaker.

I. Circuit-breaker compartments shall be equipped to house drawout type circuit breakers and shall be fitted with hinged outer doors.

J. Fabricate enclosure with removable, hinged, rear cover panels to allow access to rear interior of switchgear. Doors shall have hasp for padlock.

K. Label front and rear sections to match.

L. Provide in the cell when the circuit breaker is withdrawn, a safety shutter which automatically covers the line and load stabs and protects against incidental contact.

M. Auxiliary Cubicles: All auxiliary cubicles shall be front accessible and isolated from main bus. Include the following:
1. PSU metering cubicle that complies with PSU requirements.
2. SPD cubicle(s). Separate SPD required on each side of any double-ended switchgear.

N. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:

Typically require meter compartment per PSU standards. Modify if used at a Commonwealth Campus for a Utility that requires a meter compartment or section. Coordinate with Engineering Services.

1. Utility metering compartment that complies with [**Penn State]** [**Utility Company**] requirements.

Coordinate first subparagraph below with Drawings. Pull section is not usually required in low-voltage power switchgear. Metering provisions and main circuit-breaker connections may influence space available for incoming lines. Edit to suit Project.

2. Bus transition sections.
3. Incoming-line pull sections.
4. Hinged front panels for access to metering, accessory, and blank compartments.
5. Pull box on top of switchgear for extra room for pulling cable, with removable top, front, and side covers and ventilation provisions adequate to maintain air temperature in pull box within same limits as switchgear.

Retain first subparagraph below if top-mounted, circuit-breaker removal mechanism is used.

a. Set pull box back from front to clear circuit-breaker lifting mechanism.
b. Bottom: Insulating, fire-resistant material with separate holes for cable drops into switchgear.
c. Cable Supports: Arranged to ease cabling and adequate to support cables indicated, including those for future installation.

Coordinate paragraph and subparagraphs below with Drawings.

O. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.

1. Main Phase Bus: Uniform capacity the entire length of assembly.

See Editing Instruction No. 7 in the Evaluations.

2. Neutral Bus: 100 percent of phase-bus ampacity, except as indicated. Equip bus with pressure-connector (compression) terminations for outgoing circuit neutral conductors. Include braces for neutral-bus extensions for busway feeders.

Retain subparagraph below if switchgear assembly includes spare circuit breakers and spaces for future circuit breakers. See Editing Instruction No. 6 in the Evaluations.

3. Vertical Section Bus Size: Comply with IEEE C37.20.1, including allowance for spare circuit breakers and spaces for future circuit breakers.
4. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
5. Use copper for connecting circuit-breaker line to copper bus.
6. Contact Surfaces of Buses: Silver plated.
7. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
8. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector (compression) for feeder and branch-circuit ground conductors, minimum bus size 1/4 by 2 inches.
9. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
10. Neutral bus equipped with pressure-connector (compression) terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.

Retain first subparagraph below for switchgear with main service disconnect switches. Edit to suit Project. Coordinate with Drawings.

11. Neutral Disconnect Link: Bolted, uninsulated, minimum 1/4-by-2-inch copper bus, arranged to connect neutral bus to ground bus.

12. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
13. Bus-Bar Insulation: Individual bus bars coated with factory-applied flame-retardant insulation.

    a. Insulation Thickness: 5mils, minimum.
    b. Bolted Bus Joints: Insulate with secure joint covers that can easily be removed and reinstalled.

2.4 COMPONENTS

A. PSU Metering Cubicle:
   1. Compartment shall include CT's on a shorting block and voltage connection brought to an insulated (finger safe) fuse block with disconnect (install voltage connection ahead of the main).
   2. PSU Utilities will install service metering. Modify compartment to accept a Square D meter, contact OPP Engineering Services for details.

B. Instrument Transformers: Comply with IEEE C57.13.

   1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

Coordinate subparagraph below with Drawings.

   2. Current Transformers: Ratios as indicated; burden and accuracy class suitable for connected relays, meters, and instruments.

Delete paragraph below unless relays not integral with circuit breakers or circuit-breaker trip units are required. Specify relay functions and characteristics below or indicate on Drawings.

C. Relays: Comply with IEEE C37.90, types and settings as indicated; with test blocks and plugs.

Retain paragraph and subparagraphs below if system analysis shows arresters are required at switchgear. Show ratings of Surge Protective Devices on Drawings.

D. Surge Protective Devices (SPD): Distribution class, metal-oxide-varistor type. Comply with ANSI/IEEE C62.42.1-2002, C62.41.2-2002, C62.45-2002, NEMA LS-1 and NEC Article 285 and be UL listed under UL 1449 and UL 1283.

   1. Install in cable termination compartments and connect in each phase of circuit.
   2. Coordinate rating with circuit voltage.
   3. Coordinate minimum surge rating current capability with Engineering Services and other downstream devices.
   4. SPD shall include visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
   5. SPD shall be installed in accordance with the manufacturer's installation manual using recommended breaker and wire sizes.

E. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.

Edit first paragraph and subparagraphs below to accommodate special needs such as dc control, battery, or uninterruptible power supply for control.

F. Control Power Supply: Control power transformer supplying 120-V control circuits through secondary disconnect devices. Include the following features:

1. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.

Retain subparagraph below for electrically interlocked main and tie circuit breakers.

2. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.

a. Secondary windings connected through a relay or relays to control bus to affect an automatic transfer scheme.

3. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.
4. Fuses are specified in Section 262813 "Fuses."

G. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:

1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
2. Conductors sized according to NFPA 70 for duty required.
3. All control wire shall be type SIS. Control wiring shall be 14 AWG for control circuits and 12 AWG for current transformer circuits. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All current transformer secondary leads shall first be connected to conveniently accessible shorting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided. All groups of control wires leaving the switchgear shall be provided with terminal blocks with suitable numbering strips and provisions for #10 AWG field connections. Each control wire shall be marked to the origin zone/wire name/destination zone over the entire length of the wire using a cured ink process. Provide wire markers at each end of all control wiring. Plug-in terminal blocks shall be provided for all shipping split wires. Terminal connections to remote devices or sources shall be front accessible via doors above each circuit breaker.

2.5 CIRCUIT BREAKERS

A. Description: Comply with IEEE C37.13 and UL 1066.

Coordinate first paragraph below with Drawings.

B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.

C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:

1. Normal Closing Speed: Independent of both control and operator.
2. Slow Closing Speed: Optional with operator for inspection and adjustment.

Electrically charged required for main-tie-main lineup.

3. Stored-Energy Mechanism: [**Manually charged**] [**Electrically charged, with optional manual charging**].

Select motor operator voltage, discuss with OPP

4. Electrically operated breakers shall be complete with [**120 VAC**] [240 VAC] [24 VDC] [48 VDC] [125 VDC] motor operators. The charging time of the motor shall not exceed 6 seconds.
5. Operation counter.

D. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:

Delete subparagraphs below not required. Coordinate trip unit type with OPP Engineering Services. Jobs will often use the Eaton 1150+ for main and 520MC for feeders (or equal by approved manufacturers).

1. Trip unit shall be Eaton Digitrip RMS [**520MC**] [**1150+**] or pre-approved equal.

2. The trip unit shall include a display panel, containing a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.
3. Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:
   a. All circuit breakers shall have adjustments for long delay pickup and time
   b. [Main] [Tie] [Feeders] [All circuit breakers] shall have individual adjustments for short delay pickup and time, and include I2t settings
   c. [Main] [Tie] [Feeders] [All circuit breakers] shall have an adjustable instantaneous pickup
   d. [Main] [Tie] [Feeders] [All circuit breakers] [Circuit breakers, where indicated on the drawings,] shall have individually adjustable ground fault current pickup and time, and include I2t settings or ground alarm only

4. The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be +/- 2% of full scale.

5. The trip unit shall be equipped to permit communication via a network twisted pair for remote monitoring and control.

Keep items as marked only if using the 1150+ trip unit

6. <1150+ only> The display for the trip units shall be a 24-character LED display.

7. <1150+ only>Metering display accuracy of the complete system, including current sensors, auxiliary CTs, and the trip unit, shall be +/- 1% of full scale for current values. Metering display accuracy of the complete system shall be +/- 2% of full scale for power and energy values.
8. <1150+ only>The unit shall be capable of monitoring the following data:

a. Instantaneous value of phase, neutral and ground current
b. Instantaneous value of line-to-line voltage
c. Minimum and maximum current values
d. Watts, vars, VA, watthours, varhours and VA hours

9. <1150+ only>The energy-monitoring parameter values (peak demand, present demand, and energy consumption) shall be indicated in the trip unit's alphanumeric display panel.
10. <1150+ only>The trip unit shall display the following power quality values: crest factor, power factor, percent total harmonic distortion, and harmonic values of all phases through the 31st harmonic.
11. <1150+ only>An adjustable high load alarm shall be provided, adjustable from 50 to 100% of the long delay pickup setting.
12. <1150+ only>The trip unit shall contain an integral test pushbutton. A keypad shall be provided to enable the user to select the values of test currents within a range of available settings. The protection functions shall not be affected during test operations. The breaker may be tested in the TRIP or NO TRIP test mode.
13. <1150+ only>Programming may be done via a keypad at the faceplate of the unit or via the communication network.
14. System coordination shall be provided by the following microprocessor-based programmable time-current curve shaping adjustments. The short-time pickup adjustment shall be dependent on the long delay setting.
    a. Programmable long-time setting
    b. Programmable long-time delay with selectable I2t or I4t curve shaping
    c. Programmable short-time setting
    d. Programmable short-time delay with selectable flat or I2t curve shaping, and zone selective interlocking
    e. Programmable instantaneous setting
    f. Programmable ground fault setting trip or ground fault setting alarm
    g. Programmable ground fault delay with selectable flat or I2t curve shaping and zone selective interlocking
15. <1150+ only>The trip unit shall have the following advanced features integral to the trip unit:
    a. Adjustable under-voltage release
    b. Adjustable overvoltage release
    c. Reverse load and fault current
    d. Reverse sequence voltage alarm
    e. Under-frequency
    f. Over-frequency
    g. Voltage phase unbalance and phase loss during current detection
16. The trip unit shall utilize ARMs Technology (Arc Flash Reduction Maintenance System), or similar as prior approved by OPP Engineering Services. The ARMs Technology shall be provided in a system that shall reduce the trip unit Instantaneous pickup value when activated. The ARMs device shall not compromise breaker phase protection even when enabled. Once the ARMs unit is disabled, the recalibration of trip unit phase protection shall not be required. Activation and deactivation of the ARMs Technology trip setting shall be accomplished without opening the circuit breaker door and exposing operators to energized parts. The ARMs Technology shall provide a clearing time of 0.04 seconds, adjustable with a minimum of five settings ranging from 2.5X to 10X of the sensor value.
    a. The ARMs Technology shall be enabled via a switch on the trip unit. It shall also provide confirmation of protection via a Blue LED.
    b. The ARMs Technology shall be provided with remote "enable/disable" control and confirmation of protection via an IR communication link.

c. The ARMs Technology shall be provided with a switchgear panel mounted enable padlockable selector switch and indication via Blue LED pilot light.
d. The ARMs Technology shall be wired locally with interposing relays and wired to terminal blocks to enable a remote selector switch and confirmation light to be mounted a the downstream protected distribution equipment.

17. Arc flash light/current sensing system may be used in lieu of ARMS Technology with prior approval from PSU OPP Engineering Services.

18. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
19. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 deg C.
20. Field-adjustable, time-current characteristics.
21. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
22. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I^2t operation.
23. Pickup Points: Five minimum, for instantaneous-trip functions.

Coordinate first subparagraph and associated subparagraphs below with Drawings. Indicate circuits with ground-fault protection. Show type of protection for each circuit where switchgear has more than one type. Do not specify for 208v projects unless approved by OPP Engineering Services. 480v Services shall include 2 levels of protection.

24. Ground-fault protection with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:

a. Three-wire circuit or system.
b. Four-wire circuit or system.
c. Four-wire, double-ended substation.

25. Trip Indication: Labeled, battery-powered LED lights or mechanical targets on trip device to indicate type of fault. A reset button shall be provided to turn off the LED indication after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

E. Auxiliary Contacts: For interlocking or remote indication of circuit-breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit-breaker operation, quantity as indicated. Each consists of two Type "a" and two Type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.

F. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:

1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
2. Circuit-Breaker Positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker

may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:

a. Test Position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
b. Disconnected Position: Primary and secondary devices and ground contact disengaged.

G. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

H. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.

I. Operating Handle: One for each circuit breaker capable of manual operation.

J. Electric Close Button: One for each electrically operated circuit breaker.

First paragraph below limits competition because some manufacturers will not provide mechanical interlocks. Edit to suit Project. See Editing Instruction No. 8 in the Evaluations.

K. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.

L. Key Interlocks: Arranged so keys are attached at devices indicated. Mountings and hardware are included where future installation of key-interlock devices is indicated.

M. Shunt-Trip Devices: Where indicated.

Retain first paragraph and subparagraphs below for fused circuit breakers.

N. Fused Circuit Breakers: Circuit breaker and fuse combinations complying with requirements for circuit breakers and trip devices and with the following:

1. Fuses: NEMA FU 1, Class L current limiting, sized to coordinate with and protect associated circuit breaker.

Delete nonapplicable items in first two subparagraphs below.

2. Circuit Breakers with Frame Size 1600 A and Smaller: Fuses on line side of associated circuit breaker, on a common drawout mounting, arranged so fuses are accessible only when circuit breaker is in disconnected position.
3. Circuit Breakers with Frame Sizes More Than 1600 A: Fuses and circuit breakers may be installed in separate compartments on separate drawout mountings. Fuse drawout element is interlocked with associated power circuit breaker to prevent drawing out fuse element unless circuit breaker is in open position.
4. Open-Fuse Trip Device: Positive means of tripping and holding circuit breaker in open position when a fuse opens. Open-fuse status is indicated at front of circuit breaker or fuse drawout element.

O. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices.

Delete section below unless approved by Engineering Services

2.6 MAIN – TIE – MAIN

A. Switchgear shall have an electrically operated main-tie-main system to automatically transfer all of the loads to the live source upon failure of either incoming service.
1. The control sequence shall allow for automatic and/or manual transfer between sources.
2. Provide a synch-check relay to allow for closed transition.
3. Provide dual power supplies with interconnection in the tie section.

B. Main-Tie-Main Sequence of Operations:
1. Normal conditions: Both utilities available 52-1 and 52-2 closed, 52-T Open, Auto Mode.
2. When utility 1 fails, after the delay, 52-1 will open and 52-T will close. When utility 1 returns after the delay, 52-T will open & 52-1 will close (open transition, auto return). For closed transition, 52-1 will close then 52-T will open (maximum overlap of 100 ms). Closed transition requires additional synch-check function.
3. When utility 2 fails after time delay, 52-2 will open and 52-T will close. When utility 2 returns, after time delay, 52-T will open and 52-2 will close (Open transition, auto return). For closed transition, 52-2 will close then 52-T will open.
4. When both utilities fail simultaneously, no action is taken. System will not react until at least one of the utilities becomes available.
5. If both utilities return simultaneously, no action is taken if both mains are closed, and the tie is open. If not, the system will self-restore but ONLY if in auto mode.
6. If only one utility returns, the system will respond as in (2) or (3) above. The system will keep the entire bus energized as long as one source remains or becomes available.
7. When switched to manual mode, control of breakers is in the hands of the operator. No automatic transfer will occur.
8. System shall not operate in Automatic Mode unless all of the following conditions are met:
   a. all main and tie breakers are in the connected position
   b. all main and tie breaker Overcurrent Trip Switches (OTS) have been reset
   c. If provided, the Programmable Logic Controller (PLC) is running.
9. If any of 52-1, 52-T or 52-2 trip on downstream fault condition, all automatic functions will cease. The faulted breaker's trip unit and OTS switch must be reset in order to re-establish auto mode.
10. When set for manual return, retransfer after utility returns is initiated by the operator. If the second source fails followed by the return of the first-failed source, the system will transfer to the live source and will remain single-ended.
11. Emergency operation: If no control power is available, all breakers shall be capable of being mechanically operated. Caution: Under these conditions, no interlocking will be active. Operator must **NOT** parallel any sources.
12. When 43 control is switched to manual all control is by operator, and is outside of PLC. The HMI (if on) will continue to indicate the system status.
13. Settings note: 62 relays must be set no less than 4 seconds – if set for less, they may operate before automatic transfer logic, and may cause loss of power to the bus.

C. Main-Tie-Main Functions and Accessories:
1. The system should be capable of being tested by operating the test switches on the manufacturer supplied Human Machine Interface (HMI). NOTE: This is a live test, and the system will respond as if a real failure had occurred. Test function will self-cancel if a real failure should take place while testing.
2. All user-settable time delays are input using the settings page on the HMI. Allow delay time to be changed at any time.
3. Provide a selector switch to allow the following operations:
   a. Fully Automatic
   b. Auto Transfer/Manual Return
   c. Fully Manual
4. Provide “Not in Automatic” indicator light.

2.7 ACCESSORIES

Retain paragraph and subparagraphs below if required.

A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.

1. Racking handle to manually move circuit breaker between connected and disconnected positions.
2. Portable full function test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.

Coordinate apparatus space requirements with Drawings; typically provide both floor and overhead devices.

B. Circuit-Breaker Removal Apparatus [one for each switchgear lineup]: Portable, floor-supported, roller-base, elevating carriage arranged for moving circuit breakers in and out of compartments. Unit shall be a hydraulic foot-pump platform lift, Beech Engineering (Division of Miller Products Inc.) Model PS-2460, or approved equal by Genie, Vestil, or Wesco. 72" overall height, rated load of 1000lbs., minimum lift height of 60", and platform measuring a minimum of 20"X20".

If paragraph below is used for outdoor switchgear, it must be walk-in aisle type. Coordinate apparatus space requirements with Drawings.

C. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.

Coordinate first paragraph below with Drawings.

D. Storage Cabinet: Floor-mount with padlock and hasp, for storing equipment and breakers. Unit shall be 60”H x 24”D x 36”W, capable of 900lb/shelf built by Durham, Lyon, Stronghold, or approved equal.

E. Padlocks: Provide Best #11B772-L, with core #1C7F1-626, in quantity as follows:
1. One (1) for each rear hinged section
2. One (1) for each draw-out breaker cubicle and cubicle space
3. One (1) for each storage cabinet
4. Two (2) spare, place in storage cabinet.

Coordinate with Engineering Services whether to provide IR windows

F. IR Viewports: Provide UL recognized infrared (IR) viewports (windows) to permit infrared thermographic scanning without the need to expose personnel to energized equipment. Provide sufficient quantity of IR viewports to scan each circuit breaker, and all cable terminations. Viewports shall pass flammability and impact resistance requirements of UL 508A, UL 746C and ANSI C37.20.2 and shall be arc flash rated. IR viewports shall be Fluke CLV or approved equal.

G. Breaker Remote Racking Device: Switchgear manufacturer shall provide one (1) portable breaker remote racking device per lineup. Device shall mount to the face of the gear at any breaker location and allow the operator to stand up to 30 feet from the equipment as breaker is engaged or disengaged.

2.8 IDENTIFICATION

A. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram.

1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
2. Medium: Painted graphics.
3. Color: Contrasting with factory-finish background; as selected by OPP Engineering Services from manufacturer's full range.

B. System Power One-Line Diagram(s): Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:

1. Frame size of each circuit breaker.
2. Trip rating for each circuit breaker.
3. Plug rating for each circuit breaker.
4. Conduit and wire size for each feeder.

PART 3 - EXECUTION

3.1 Factory testing

A. The switchgear shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear shall be tested to ensure the accuracy of the wiring and the functioning of all equipment. The main bus system shall be given a dielectric test of 2200 volts for one minute between live parts and ground and between opposite polarities.

B. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute, or 1800 volts for one second, between live parts and ground, in accordance with ANSI C37.20.1.

C. A certified test report of all standard production tests shall be shipped with each assembly.

Confirm with OPP Engineering Services whether factory witness trip is required.

D. Factory test as outlined above shall be witnessed by the owner's representative.

1. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed
2. The manufacturer shall include the cost of transportation and lodging for up to three (3) owner's representatives. The cost of meals and incidental expenses shall be the owner's responsibility
3. Provide cost as a line item to the bid in case the trip is canceled or declined.

3.2 EXAMINATION

A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with applicable portions of NECA 400.

B. Anchor switchgear assembly to 4-inch, channel-iron floor sill embedded in [**floor**] [**concrete base**] and attach by bolting.

1. Sills: Select to suit switchgear; level and grout flush into [**floor**] [**concrete base**].

Retain subparagraph below if Project is in seismic area.

2. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 "Vibration and Seismic Controls for Electrical Systems" for seismic-restraint requirements.

Delete subparagraph below if deemed not required by Engineering Services. Typically this may occur in existing buildings with space constraints. If retaining, coordinate with Drawings.

3. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 3 inches in all directions beyond the maximum dimensions of switchgear unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Section 260529 "Hangers and Supports for Electrical Systems."

4. Verify pad location is level to within 0.125 inches per three foot of distance in any direction.

5. Leveling Rails: Consult with Engineering Services if leveling rails will be required.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Identification for Electrical Systems."

B. Provide engraved nameplate on each upright section, matching for both front and rear, as well as on each cubicle door.

C. Diagram and Instructions:

Coordinate size of one-line diagram with OPP. Typically specify 30x42.

1. Aluminum frame and mount under clear acrylic plastic in location as noted on the drawings. Size shall be minimum of 30” x 42**”**.

   a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
   b. System Power Single-Line Diagram(s): Provide 30”x42”, laminated copy of the single-line diagram(s) adjacent to the switchgear. Mount in aluminum frame under plexi-glass.

2. Storage for Maintenance: Place a copy of maintenance manual in the storage cabinet required per 2.7 Accessories.

3.5 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems" and per details on the drawings.

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Contractor shall confirm in writing that all bus bars are torqued to the manufacturer’s recommendations.

3.6 FIELD QUALITY CONTROL

A. Refer to Electrical Acceptance Testing section for additional requirements.

B. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect switchgear installation, including wiring, components, connections, and equipment.

Retain first subparagraph below if point-to-point verification of all internal control wiring is required. Confirm this option with Engineering Services.

2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in electrical Sections.
3. Complete installation and startup checks according to manufacturer's written instructions.
4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
5. Report results in writing.

D. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

E. Perform the following field tests and inspections and prepare test reports:

Edit to suit Project.

1. Perform each visual and mechanical inspection and electrical test stated in current NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:

a. Switchgear.
b. Circuit breakers.
c. Protective relays.
d. Instrument transformers.
e. Metering and instrumentation.
f. Ground-fault systems.
g. Battery systems.
h. Surge Protective Devices.
i. Capacitors.

2. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion or at a mutually agreed upon date prior to bond expiration.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.7 ADJUSTING

A. Set field-adjustable, protective-relay trip characteristics according to results in Section 260573 "Overcurrent Protective Device Coordination Study."

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturers stipulated service conditions.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 262300