ELECTRICAL DIVISION 26 00 00

The UVU Standards are provided in CSI format for ease of locating requirements from UVU. These requirements are in addition to the State of Utah Division of Facilities and Construction Management (DFCM) Design Requirements. In the event of any discrepancy between the DFCM Design and UVU Standards requirements, the Architectural/Engineering Team shall use the UVU Standards over the DFCM Design Requirements.

Items below are not intended to specify all the requirements needed for the completion of a project. The Engineer of Record shall provide their expertise for full completion. Items below that UVU does currently give direction on, are left to the discretion of the Engineer of Record.

SECTIONS

SECTION 26 00 00 ELECTRICAL

1. GENERAL

1.1. Campus Electrical System Description

1.1.1 Electrical power is furnished to Utah Valley University campus from Rocky Mountain Power at 46 KV. The power is then transformed in the UVU owned, substations to 12470Y. The campus distribution voltage is 12470.

1.2. Workmanship

1.2.1 Electrical work performed for Utah Valley University must be executed in a professional manner. Careful consideration should be taken to minimize the disruption of campus operations while performing work during normal operating hours.

1.2.2 Electrical Contractors hired to perform work for Utah Valley University are required to have at least one Journeyman Electrician, currently licensed by the state of Utah on site at ALL times while work is being performed

1.3. Deviations for Standards

1.3.1 Any deviation from these standards can be allowed if written permission is obtained from ALL the following individuals:

(A) UVU Construction Project Manager – Changes per Project
(B) UVU Director of Campus Facilities
    (i) 801.863.8131
    (ii) campusservices@uvu.edu
        (a) When emailing please put “Standard Deviation” in the subject line
(C) UVU Manager of Electrical
    (i) 801.863.8022

1.4. Materials and Equipment

1.4.1 All electrical materials and equipment (panel boards, disconnects, circuit breakers, fuses, luminaires, devices, cover plates, etc.) must be NEW. Re-furbished or re-purposed materials and equipment of any kind are not acceptable. Utilization of existing, unused materials and equipment (empty conduits, circuit breakers, junction boxes, existing wiring, etc.) must be approved by a representative of UVU.

1.5. Applicable Codes and Standards

1.5.1 The most recent of any code adopted by the state of Utah shall be followed. The most recent handbook of the standards referenced here-in shall be followed.

(A) NFPA 70 – National Electrical Code
(B) NFPA 72 – National Fire Alarm and Signaling Code
(C) IBC – International Building Code
(D) International Fire Code

(E) Internal Energy Conservation Code OR ASHRAE 90.1
(F) NFPA 780 – Standard for Installing Lightning Protection Systems
(G) Illumination Engineering Society: The Lighting Handbook
(H) NFPA 110 – Standard for Emergency and Standby Power Systems
(I) State of Utah High Performance Building Standard

1.6. Temporary power

1.6.1 The campus will allow contractors to provide permanent transformers to be used for temporary power without back billing.
1.6.2 All other temporary electricity shall be provided by the contractor. The use of temporary transformers is not allowed.

1.7. Interruption of Existing Electric Service

1.7.1 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.
1.7.2 Notify the owner no fewer than 40 working days' in advance for outages involving two or more buildings, 20 working days' in advance for outages involving one building, and 10 days' in advance for outages involving a portion of one building in advance of proposed interruption of electric service.
1.7.3 Do not proceed with the interruption of electric service without the owner's written permission.
1.7.4 To gain permission please provide the following to the UVU Construction Project Manager, UVU Director of Campus Facilities, and UVU Manager of Electricity (contact information is outlined under Deviation of Standards):
(A) Date and time of the interruption
(B) Duration of the interruption
(C) Equipment associated with the interruption
1.7.5 Interruptions shall only be approved for Sundays and during the week between 10:00 PM and 6:00 AM. M-F during normal hours is allowed if the interruption only affects small areas and with approval.

1.8. System Phasing and Voltage

1.8.1 New buildings shall contain one or both of the following electrical system configurations on the secondary side of the secondary derived system.
(A) Wye/Star Configuration 208/120 V, 3 Phase, 4 Wire
(B) Wye/Star Configuration 480/277 V, 3 Phase, 4 Wire

2. PRODUCTS

2.1. None

3. EXECUTION

3.1. Install all free-standing equipment on a 4” thick concrete housekeeping pad. This shall include switchboards, switchgear, transfer switches, low-voltage transformers, enclosures, etc. Construct concrete bases using manufactures recommendation dimensions but not less than 4 inches larger in both directions than supported unit unless it impedes on the clearance requirements of the NEC.

3.2. Follow the equipment manufacturer's current written anchorage recommendations and setting templates for anchor-bolt and tie locations unless otherwise indicated. Anchor equipment to the concrete base.

SECTION 26 01 00 OPERATIONS AND MAINTENANCE OF ELECTRICAL SYSTEMS

1. GENERAL

1.1. None

2. PRODUCTS

2.1. Hard Copy O&M Manual Binder

2.1.1 2-1/2" D Ring, Buckram Type Binder, Color Blue.
2.1.2 The cover of binder shall include a custom printed embossed label indicating
(A) Project Name
(B) "Electrical O&M Manual"
(C) Date of Substantial Completion

3. EXECUTION

3.1. Clearance

3.1.1 All interior and exterior electrical equipment and equipment rooms shall be designed to ensure adequate clearances for service, maintenance, and removal/replacement of electrical equipment (panels, switchboards, transformers, generators, etc.)
3.1.2 All electrical rooms shall only contain electrical equipment. No data equipment, plumbing piping, HVAC ductwork or piping, (unless it is associated with the electrical room), are allowed.
3.1.3 All electrical panels, transformers, and switchboards shall be installed in electrical rooms. Motor control centers shall be located in mechanical equipment rooms with the equipment that they serve.
3.1.4 Locate electrical equipment so it will be accessible for inspection, service, repair, and replacement without removing permanent construction, with working clearance and dedicated space as required by the *NEC* and as recommended by the manufacturer

3.2. One Line Plaque

3.2.1 For new buildings and building-wide electrical service modifications. The contractor shall provide a laminated One Line Power Diagram (full size of drawing) and locate it near the main switchboard. Verify the location with the owner.

3.3. O&M Manuals and Redlines

3.3.1 O&M Manuals and Relines shall be provided to the Director of Campus Services before Final Retention shall be released. The Director of Campus Services shall sign for these O&Ms.
3.3.2 O&M Manuals shall be delivered as follows:
(A) 1 Hard Copy in a Buckram Binder

(B) Electronic Copy indexed with quick links to the individual specification section.

3.3.3 Redlines shall include the following:

(A) All underground routing of conduits greater than 1-1/4”.

(B) All underground locations where there are more than 4-3/4” conduit or greater in number or size within 12” of each other.

(C) All overhead conduit racks that contain 3-3/4” conduit or greater in number or size.

(D) All overhead conduit that is greater than 1-1/4”

(E) All home run junction boxes before it transitions into MC Cable.

(F) All junction boxes containing more than 3 circuits.

3.3.4 Plan markings for Redlines shall include dimensions or blocked areas on drawings with dimensions indicating the location of the underground conduit.

3.3.5 Plan markings shall show the general location to the area (within 5’) of the actual location for overhead conduit and junction boxes.

3.3.6 Exterior junction boxes outside the footprint of the building shall be GPS located.

SECTION 26 05 13 MEDIUM VOLTAGE CABLES

1. GENERAL

   1.1. None

2. PRODUCTS

   2.1. Cable

      2.1.1 Cable Manufacturer Kerite, Okonite Company

      2.1.2 All medium voltage conductors shall be MV-105 copper conductors, single conductor EPR (Ethylene Propylene Rubber) insulated with a black sun-light resistant polyvinyl chloride jacket rated 5,000 or 25,000 volts, and 133% insulation level. All MV conductors shall have copper tape shields.

   2.2. Shielded-Cable Terminations

      2.2.1 Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include a shield ground strap for shielded cable terminations. Verify with the owner the exact type of terminations required.

         (A) 1. Class 1 Terminations: Modular type, furnished as a kit, with a stress-relief tube; multiple, molded-silicone rubber, insulator modules; a shield ground strap; and a compression-type connector.

         (B) 2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer non-tracking tubes; multiple, molded, non-tracking skirt modules; and a compression-type connector.

         (C) 3. Class 1 Terminations, Indoors: Kit with stress-relief tube, a non-tracking insulator tube, a shield ground strap, a compression-type connector, and an end seal.

         (D) 4. Class 2 Terminations, Indoors: Kit with a stress-relief tube, a non-tracking insulator tube, a shield ground strap, and a compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink

3. EXECUTION

   3.1. Medium voltage conductor splices shall only be made with approval from the deviation of standards group identified in the general requirements. Splices, when allowed, shall be of the molded material type with conductor mating seal to provide a fully shielded and fully submersible splice. Splices shall not be made with taped splice kits.

   3.2. The color code for medium voltage conductors shall be:

      3.2.1 A phase – Red; B phase – Yellow; C phase – Blue.

3.3. Medium Voltage Terminations

3.3.1 All 500kcmil MV cable concentric neutral conductors (whether of round or FLAT STRAP design, and comprising an area of one-third (1/3) each cable circular mils), shall be irreversibly connected with a “C”-type compression lug or “Figure 6”-type compression tap connector to a 3/0 stranded copper conductor which extends four (4) to six (6) feet in length. Each of these three neutral “extensions” shall be irreversibly connected with a “C”-type or equivalent lug to a 4/0 stranded-copper, 600V, THHN neutral / grounding conductor which is grounded at the nearest vault and/or pad MV equipment grounding plate via crimped 2-hole (of ½” x 1-3/4” spacing) barrel lugs.

3.3.2 At all terminations and at splices where flat-strap concentric-neutral conductors are to be connected to a neutral “extension” conductor as described above, neatly fold back individual conductors, without twisting, and maintain concentric spacing. Secure conductors with tape before applying jacket sealing tube. Before “bundling” conductors for connection to neutral “extension”, secure conductors in place with a hose clamp (which encircles flat-strap conductors over cable jacket) and then “train” to suitable location for irreversible tap connection.

3.3.3 All cable and apparatus shielding drain wires or tinned copper braid (used for electric field stress reduction only, no return currents present) shall be connected to a #2 AWG stranded copper, 600V, THHN grounding conductor which is 4 to 6 feet in length. The connection shall be made using appropriately sized irreversible compression connectors or split bolts. Each of these grounding tap “extensions” shall be connected to a 4/0 stranded-copper, 600V, THHN neutral / grounding conductor which is grounded at the nearest vault and/or pad MV equipment grounding plate via crimped 2-hole (of ½” x 1-3/4” spacing) barrel lugs or secured to a service post at similarly grounded MV switch location from which it is fed.

3.3.4 All 4/0 copper conductors within vaults, pull-boxes, j-boxes, pad enclosures, or those associated with any MV equipment which are part of the neutral / grounding-conductor return-path to a substation feeder breaker, shall be irreversibly inter-connected together by a 4/0 copper jumper, within the same location, whether they are connected to a shared equipment grounding plate or not.

3.3.5 Cable shielding drains shall only be connected at ONE end of each cable (source side) to avoid circulating ground currents and cable heating. At the ungrounded cable termination end, neatly fold excess copper braid and tape to the cable jacket. Note that elbow or T-body termination bleed wires still require (split-bolt) connection to copper braid if not integral to shield-adaptor-kit design.

3.4. Perform testing in accordance with the most recent version of the InterNational Electrical Testing Acceptance Testing Standards section 7.3.3. Include all test outlined and inspections including visual, mechanical, and electrical testing.

SECTION 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

1. GENERAL

1.1. The minimum size for general use branch circuits and lighting branch circuits is 20 amps

2. PRODUCTS

2.1. Conductors

2.1.1 Conductors shall have type THHN/THWN insulation except where extreme heat or water conditions exist, thus requiring special insulation based upon installation requirements.

2.1.2 Conductor Material: All conductors shall be stranded copper except for the following:

(A) Bare copper ground conductors 10 AWG or smaller

(B) Insulated conductors 12 AWG or smaller

2.1.3 Conductor Material: Aluminum conductors are allowed only in the following instances, with prior written approval from the UVU Manager of Electrical and only when the feeder is larger than #1/0:

(A) Between transformers and switchboards

(B) Between switchboards and panelboards

(C) Between panel boards and other panelboards

(D) Between switchboards and transformers

(E) Between transformers and panelboards

2.1.4 Aluminum conductors are NOT allowed to be connected to any VFD, mechanical equipment, branch circuits or motors.

2.1.5 Conductor insulation for ungrounded conductors shall be the same color throughout the circuit from the main transformer to the device.

2.1.6 Grounded conductor insulation shall use a trace color on the white neutral to correspond to the phase attached to the grounded conductor throughout the circuit.

2.2. Metal Clad Cable

2.3. Conductors

2.3.1 Conductor insulation must correspond to the voltage and phasing when using MC cable.

(A) Taping for re-identification purposes is discouraged but allowed if only one ungrounded conductor is in the MC cable.

(B) Trace colors for neutrals

2.4. Jacketing

2.4.1 Jacketing of metal clad cable shall be light-steel (equivalent to MC-Tuff) or steel (equivalent to MC-Steel) or aluminum (MC-AL or MC-Lite).

2.5. NMC Cable (Romex)

2.5.1 NMC Cable (Romex) shall not be used in any instance except if written permission is given by the UVU Manager of Electrical. It is expected that permission will only be given in residential applications where wood framing is used.

3. EXECUTION

3.1. Conductor Size

3.1.1 Minimum conductor size shall be 12 AWG
3.1.2 Conductors shall be sized for no more than 5% voltage drop from a transformer at a 12-amp load.

3.2. MC Cable

3.2.1 MC Cable may be used for the following:
(A) From the first light fixture of the circuit.
(B) In-walls but no further than 80 feet from a home run junction box with an EMT, RNC, IMC raceway home. A junction box that has MC cable feeding the junction box does not count as a home run junction box.

3.2.2 MC Cable is strictly prohibited as follows
(A) No mechanical equipment shall be wired with MC cable from the panelboard, MCC, Switchboard to the piece of mechanical equipment.
(B) In any mechanical room.
(C) In any electrical room.
(D) In any exposed ceiling areas.
(E) Within 30’ lateral distance of electrical panelboards, switchboards, switchgear, or transformers.

3.3. All branch ungrounded (hot) circuit conductors shall be ran with individual grounded (neutral) conductors. Multiple ungrounded conductors shall be ran with individual grounded conductors. No more than 3 ungrounded conductors or circuits shall be ran in a single raceway.

3.4. At all junction boxes containing branch circuits at least 10% of the conductors or no fewer than 1 circuit (including an ungrounded, grounded and grounding conductor) shall have a service loop. The loop shall be 12” in length at minimum. .

SECTION 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1. Underground Distribution System Grounding. Provide grounding for the following:

1.1.1 Manholes and Hand-holes.
1.1.2 Underground concrete encased duct banks.
1.1.3 Connections to Manhole Components
1.1.4 Pad-Mounted Transformers and Switches.

2. PRODUCTS

2.1. Grounding Conductors

2.1.1 Use only copper conductors.
2.1.2 Use green insulated conductors THHN/TWHN for wire size #6 AWG and smaller.
2.1.3 Bare copper can be used for sizes larger than #1/0.

2.2. Isolated Grounding Conductors

2.2.1 Isolated grounding conductors shall be green with two strips of yellow continuous on the insulation jacket.
2.2.2 Isolated grounding conductors shall only be used for where large loads of computer equipment are used.

2.3. Underground Grounding Conductors Approved Installation Methods:

2.3.1 Use copper conductors, No. 4/0 AWG minimum for all vault and MV equipment grounding, with the exception of ground rods, MV duct bank concrete-encased electrodes, and cable and apparatus shielding drain wires (used for electric field stress reduction only, no return currents present). For MV tape-shielded power cables or concentric-neutral cables of less than 500kcmil, and feeding individual loads only, size ground according to cable mils, but not less than a #2 AWG copper conductor.
2.3.2 Use a #6 AWG ground conductor for all ground rods unless noted otherwise.
2.3.3 All grounding and bonding connections for MV circuits within vaults, pull-boxes, man-holes, tunnels, substations, direct-burial in earth, etc. shall employ the use of “C” type, irreversible compression connectors, or equivalent. Any bolted connections (such as to common grounding electrode plates) shall use standard two-hole barrel connectors with ½” holes and 1-3/4” c.l. spacing.
2.3.4 Use of split bolts shall be limited to elbow and T-body shielding drain connection taps, split bolts must be properly sized for the conductors involved, and properly tightened to ensure all cable shields remain continually grounded.
2.3.5 For NEW MV vaults: Ring vault (at accessible location within outside-edge of cable tray) with a 4/0 stranded-copper conductor which completely encircles vault and is bonded to a grounding plate via crimped 2-hole barrel lug. All

concentric-neutrals of new cables pulled into vaults with such “ground rings” shall be irreversibly connected to the ground ring in the vicinity of the cable entry (leaving some cable slack for repositioning cables if needed).

2.3.6 All metal raceway, cable trays, ladders, vault hatches, supporting structures, etc. shall be adequately grounded and bonded to common grounding electrode plate with a 4/0 stranded copper conductor.

2.3.7 Bury all grounding conductors at least 24-inches below grade.

2.3.8 Ufer Ground (Concrete-Encased Grounding Electrode). Provide Ufer grounds for new service entrances, transformer and generator pads and all medium voltage duct banks.

2.3.9 Ufer grounds installed within duct banks shall be a minimum #2 AWG solid, bare copper conductor, applied in parallel, in opposite top corners or sides, run the entire length of the duct bank, tied to rebar at appropriate intervals, and connected to a common grounding electrode plate located at vault or pad at each end of the runs. (For Ufer grounds within MV duct banks, use two #2 AWG bare solid-copper conductors.)

2.3.10 If the concrete foundation is less than 20-feet long, coil excess conductor within the base of the foundation.

2.3.11 Bond the grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

2.4. Grounding Bus

2.4.1 Rectangular bars of annealed copper 1/4 by 4 inches by 14 inches in cross section

2.4.2 Use insulated spacer; space 1 inch from wall and support from wall 20 inches above finished floor unless otherwise indicated.

3. EXECUTION

3.1. Metallic conduit shall not be used for grounding, but a separate equipment grounding conductor shall be used.

3.2. Provide the following Grounding requirements:

3.2.1 Provide a grounding bus in each electrical room.

3.2.2 The main building grounding bus shall be located outside and adjacent the main switch board enclosure.

3.2.3 Extend all building main grounding conductors to the main building grounding bus.

3.2.4 Install in all communication equipment rooms under all raised floors and elsewhere as indicated.

3.3. Grounding Installation Approved Methods:

3.3.1 Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone and similar materials.

3.3.2 In raceways, use insulated equipment grounding conductors.
3.3.3 Exothermic-Welded Connections: Permitted for connections to structural steel and for underground connections, except those at test wells.
3.3.4 Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
3.3.5 Ferrous metal raceways solely containing grounding electrode conductors shall be bonded at both ends with designated fittings or bushings with bonding-jumpers equivalent to grounding electrode conductors.

3.4. Grounding Bus:

3.4.1 Install in all electrical and all telephone equipment rooms, in rooms housing service equipment, under all raised floors and elsewhere as indicated.
3.4.2 Grounding bus installed in medium voltage vaults or pad locations shall be securely mounted to a wall or permanent structure in a readily-accessible location, provide sufficient working clearance, be manufactured from copper plate of suitable size and strength, i.e. 6” x 18” x ¼”, and have standard NEMA two-hole lug design for ½” hole x 1-3/4” o.c. spacing at 1-1/2 inch lug termination intervals throughout.
3.4.3 The main building grounding bus shall be located outside and adjacent the main switch board enclosure.

3.5. All bolted connections for grounding and bonding purposes which are on or below ground level such as in vaults, pull-boxes, man-holes, hand-holes and equipment pads shall use hardware manufactured of stainless steel.

3.6. MV Bushing Inserts: Ground all 200A bushing well-inserts installed in transformers or switches if provisions are available. Use bare #14 solid copper to connect from bushing insert semi-con loop to switch or transformer bushing well retention plate.

3.7. Install Ground Rods as follows:

3.7.1 Drive ground rods until tops are 4 inches below the finished floor or final grade unless otherwise indicated.
3.7.2 Interconnect ground rods with grounding electrode conductors.
3.7.3 Use exothermic welds except at test wells and as otherwise indicated.
3.7.4 Make connections without exposing steel or damaging copper coating.
3.7.5 Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated.
3.7.6 Make connections without exposing steel or damaging coating if any.

3.8. Testing

3.9. Perform the following test:

3.9.1 Fall of Potential Test for Ground Testing is preferred. If obstacles are found in the earth that would negate the test another test shall be performed as directed by the EOR.
3.9.2 NETA ATS Section 7.13 – Grounding Systems
(A) All Visual, Mechanical and Electrical Tests.

SECTION 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1. All raceways, boxes, and conductors shall be supported directly from building structure by a listed supporting device, independent from all other electrical or mechanical systems.

2. PRODUCTS

2.1. Multiple Raceways or Cables:

2.1.1 Install trapeze-type supports fabricated with steel or aluminum, uni-strut type.

3. EXECUTION

3.1. Size multiple raceways or cable trapeze-type supports so capacity can be increased by at least 25 percent in the future without exceeding specified design load limits.

3.2. Where trapeze-type (uni-strut) support is utilized, minimum widths shall be 24”.

3.3. Provide outlet boxes with rigid support using metal bar hangers between studs

SECTION 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1. Cable tray shall be installed per OIT requirements and not defined in this design standard.

2. PRODUCTS

2.1. Conduit Raceways

2.1.1 Aluminum Conduit is prohibited.
2.1.2 Electric Metallic Tube (EMT) shall be used in all above ground areas except:
(A) Loading docks, parking lots, central plant mechanical rooms below 6' then Rigid Metal Conduit shall be used.
2.1.3 Nonmetallic PVC Raceways can be used underground only.
(A) Factory provided bends must be used for any bends 45 degrees and over.
(B) Use EMT to come up through slab on grade.
(i) EMT shall be wrapped with corrosion wrap tape 40 mil thick.
2.1.4 Flexible Liquid-Tight Conduit (LFMC)
(A) Provide a minimum of 18" of LFMC between motors and junction boxes. Maximum 6' length per NEC.
(B) Provide LFMC with approved moisture-tight fittings for wet, humid, corrosive environments (such as evap sections of an AHU and Well House Pumps).

3. EXECUTION

3.1. Raceways

3.1.1 The minimum raceway shall be ¾".
3.1.2 For telecom or data all conduits shall be a minimum of 1-1/4" with no more than 180 degrees worth of bends.
3.1.3 Conduit bends for telecom or data shall not have bends less than 6 times the inside diameter.
3.1.4 All conduit terminations larger than ¾" will terminate with plastic or metal bushings. Includes in junction boxes, panelboards, switchboards, and device enclosures.
3.1.5 When installing conduits under concrete slabs; install the top of the conduit a minimum of 4" below the bottom of the concrete slab. Raceways embedded in concrete slabs are not permitted.
3.1.6 Provide a 200 lb nylon cord pull cord in all spare conduits.
3.1.7 For all recessed panelboards provide at least 2-1" spare conduit and enough ¾" to allow for every spare or space circuit to be pulled later. If the panelboard is already fully used with no spare circuits or spaces, then provide 1-1" spare conduit.
(A) Have all spare conduit terminate into an accessible ceiling or accessible floor.

3.1.8 For all wall mounted panelboards provide at least 1-1” conduit and 1-3/4” spare conduit. In addition, provide at least enough spare ¾” conduit to provide for 20% of spare and space for circuits to be pulled and connected later.

(A) Conduit shall terminate into an adjacent hallway or corridor with an accessible ceiling.

3.2. Testing

3.2.1 Demonstrate capability and compliance with requirements on completion of installation of raceway systems.

(A) Pull a metal, plastic, or wood test mandrel through the conduit to prove joint integrity and test for out-of-round duct. Provide a cylinder style mandrel equal to 80 percent fill of duct as follows:

(i) 2" conduit - Mandrel 1.5" diameter 4.25" long.
(ii) 3" conduit - Mandrel 2.75" diameter 4.25" long.
(iii) 4" conduit - Mandrel 3.6" diameter 4.25" long.
(iv) 5" conduit - Mandrel 4.6" diameter 4.25" long.

3.3. Cleaning

3.3.1 Pull a leather-washer-type duct cleaner, with graduated washer sizes or cleaner mandrels, through the full length of conduit. Follow with a rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts. Clean internal surfaces of manholes, including sump. Remove foreign material.

SECTION 26 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1. None

2. PRODUCTS

2.1. Nonmetallic PVC Raceways can be used underground only.

2.1.1 Factory provided bends must be used for any bends 30 degrees and over.
2.1.2 Use EMT to come up through the slab on grade conduit.
(A) EMT shall be wrapped with tape 40 mil thick.

3. EXECUTION

3.1. Direct-Buried Duct Banks:

3.1.1 Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3.1.2 Grout end bells and seal using approved sealant into structure walls from both sides to provide watertight entrances.
3.1.3 Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-PSIG hydrostatic pressure.
3.1.4 Pulling Cord: Install 200-lbf-test nylon cord in ducts including spares. The use of steel cables shall not be permitted.
3.1.5 Support ducts on duct separators coordinated with duct size duct spacing and outdoor temperature.
3.1.6 Space separators close enough to prevent sagging and deforming of ducts with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill while also permitting linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3.1.7 Excavate the trench bottom to provide firm and uniform support for the duct bank.
3.1.8 After installing the first tier of ducts backfill and compact. Start at the tie-in point and work toward the end of the duct run leaving ducts at the end of the run free to move with expansion and contraction as temperature changes during this process. Repeat this procedure after placing each tier. After placing the last tier hand-place backfill to 4 inches over the ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use a hand tamper only. After placing controlled backfill over the final tier, make the final duct connections at the end of the run and complete backfilling with normal compaction.
3.1.9 Set the elevation of the bottom of duct bank below the frost line.

3.1.10 Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

3.1.11 Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

3.1.12 Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.

3.1.13 For equipment mounted on outdoor concrete bases extend steel conduit horizontally a minimum of 60 inches from the edge of the equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.2. All duct banks containing voltage greater than 60 V shall be encased in concrete and dyed red.

3.3. All duct banks shall be inspected by the owner or their representative before concrete is poured.

3.4. All underground conduit shall be a minimum of ¾", unless it is telecommunications which shall be 1-1/4"

3.5. Only approved bending appliances shall be used in accordance with NEC requirements. Weed burners are not allowed unless listed for the purpose of bending electrical conduit.

SECTION 26 05 48 VIBRATION AND SEISMIC CONTROL FOR ELECTRICAL SYSTEMS

1. GENERAL

    1.1. Determined by the Engineer of Record.

2. PRODUCTS

    2.1. None

3. EXECUTION

    3.1. None

SECTION 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1. WARNING LABELS AND SIGNS

1.1.1 Comply with NFPA 70 and 29 CFR 1910.145.

2. PRODUCTS

2.1. Self-Adhesive Warning Labels: Factory-printed multicolor pressure-sensitive adhesive labels shall be configured for display on front cover door or other access to equipment.

2.2. Engraved Laminated: Acrylic or Melamine Label: Adhesive backed with white lettering 3/8” high. The background shall be black for normal power and red for emergency power. Labels shall be punched or drilled and mounted with screws.

2.3. Self-Adhesive P-Touch Type Label: Use a white background with black letters on white outlet covers. For architectural sensitive areas labels shall be placed on the back of the covers or use of a clear background with black lettering on the front of the cover.

3. EXECUTION

3.1. Warning labels and signs shall include (but are not limited to) the following legends:

3.1.1 Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
3.1.2 Workspace Clearance Warning: "WARNING – NEC/OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR:XXX inches"

3.2. Provide floor markings to show required kept clear distances as required by the NEC.

3.3. Provide ARC Flash warning labels in accordance with code and OSHA requirements.

3.4. Equipment Identification Labels and Breaker Labels for Switchboards

3.4.1 Use Engraved Laminated Labels with the equipment designation.
3.4.2 Use these labels for panelboards, switchboards, breakers located in switchboards and switchgear, and breakers 100 AMP and larger.

3.5. Color Banding Raceways, Boxes and Exposed Cables: Band exposed and accessible raceways and boxes as listed below:

3.5.1 Raceway Connector Paint: Paint conduit couplings and connectors using an acrylic spray paint.

3.5.2 Cable Bands: Band cable each color band 2 inches wide (min.) completely encircling place adjacent bands of two-color markings in contact side by side.

3.5.3 Locations: At each junction or pull box, and at penetrations of walls and floors, paint conduits and cables at 10-foot maximum intervals in straight runs and at 5-foot maximum intervals in congested areas.

3.5.4 Apply the following colors to the systems listed below:

(A) Fire-Alarm System: Red.
(B) Fire-Suppression Supervisory and Control System: Red and Yellow.
(C) Security System: Purple
(D) Mechanical and Electrical Supervisory System: White.
(E) Telecommunications System: Blue
(F) Emergency/UPS power system: Yellow.
(G) 277/480 volts system: Brown.
(H) 120/208 volts system: Black.
(I) Clocks & Bells: Orange.
(J) Sound System: Green.
(K) Traveler (switch to light or switch to switch) 120 volts: Pink and Black.
(L) Traveler (switch to light or switch to switch) 277 volts: Pink and Brown.
(M) Lighting control and dimmers systems: White.

3.6. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with permanent markers showing the wiring system legend and system voltage. System legends shall be as follows:

3.6.1 Fire-Alarm System.
3.6.2 Fire-Suppression Supervisory and Control System.
3.6.3 Security System.
3.6.4 Mechanical and Electrical Supervisory System.
3.6.5 Telecommunications System.
3.6.6 Emergency/UPS power system.
3.6.7 277/480 volts system.
3.6.8 120/208 volts system.
3.6.9 Clocks & Bells.
3.6.10 Sound System.
3.6.11 Traveler (switch to light or switch to switch) 120 volts.
3.6.12 Traveler (switch to light or switch to switch) 277 volts.
3.6.13 Lighting control and dimmers systems.

3.7. In gutter type boxes (or junction boxes with more than 3 ungrounded conductors) label each circuit inside (using a sharpie), next to the conduit entering and leaving the gutter box.

3.8. Color-Coding for Phase and Voltage Level Identification, more than 600 V: Use colors listed below for all cables.

3.8.1 Colors for over 600-V circuits:

(A) Phase A: Red.
(B) Phase B: Yellow.
(C) Phase C: Blue.

3.8.2 Colors for 480 V circuits
- (A) Phase A: Brown.
- (B) Phase B: Orange.
- (C) Phase C: Yellow.

3.8.3 Colors for 208-240 V circuits
- (A) Phase A: Black.
- (B) Phase B: Red.
- (C) Phase C: Blue.

3.9. All outlets/receptacles and covers shall be labeled with a Self-Adhesive P-Touch type label.

SECTION 26 05 73 POWER SYSTEM STUDIES

1. GENERAL

   1.1. The following studies shall be done by the contractor:

      1.1.1 Short-Circuit
      1.1.2 Coordination Studies
      1.1.3 Arc-Flash Hazard Analysis
      1.1.4 Harmonic-Analysis Study

2. PRODUCTS

   2.1. None

3. EXECUTION

   3.1. These studies shall be done after submittals but before equipment shall be ordered.

   3.2. Final studies shall be handed over to the owner and confirmation from the contractor shall be provided to the EOR and Owner that the studies recommendations were implemented.

SECTION 26 09 13 ELECTRICAL POWER MONITORING

1. GENERAL

   1.1. None

2. PRODUCTS

   2.1. Electrical meter manufacturers: Schneider Electric Meters, WattNode

   2.2. All meter's current transducers, voltage and accessories shall be from one manufacturer/supplier to ensure consistency.

   2.3. Split Core or Removable Leg Current Transducers shall be used.

3. EXECUTION

   3.1. All electrical meters shall be BACnet TCP/IP capable and report to the division 230900 system.

   3.2. All electrical meters shall be tied to the owner's network and the engineer of record shall show a 1-1/4" conduit to each meter from the nearest IDF/MDF room.

   3.3. Meters shall comply with the most current edition of the State of Utah High Performance Building Standard.

   3.4. All meters shall be started up by a competent approved manufacturer representative. The electricians installing the equipment shall not be considered to be competent unless they provide written training certificates on the meters being installed.

SECTION 26 09 23 LIGHTING CONTROL DEVICES

1. GENERAL

    1.1. Follow minimum code requirements, including not providing daylighting controls for areas with lighting power of 150W or less.

2. PRODUCTS

    2.1. Manufactures: Wattstopper, Crestron, Legrand

    2.2. All occupancy, daylighting and low voltage button switches shall be white unless deemed to be an architecturally sensitive area in which approval of color shall be made by the UVU Electrical Manager.

3. EXECUTION

    3.1. All occupancy sensors in offices, conference rooms, classrooms, and break rooms shall be connected to the BMS system.

    3.2. Offices, conference rooms, and classrooms shall contain the ability to dim lighting.

SECTION 26 09 43 NETWORK LIGHTING CONTROLS

1. GENERAL

1.1. All public spaces shall be controlled via the BMS system.

2. PRODUCTS

2.1. Lighting Circuits shall be controlled by a Relay in a Box (Functional Devices) or approved equal with a Closed-Open-Auto switch. Lighting Panel Relay boards are not desired by the Owner.

2.2. Where required by code a line voltage photocell shall be used in line with the lights needing to be controlled.

3. EXECUTION

3.1. The EOR shall place all public lights on as few circuits as possible.

3.2. Emergency lighting shall be placed on a dedicated circuit and shall be hardwired with no relay controlling that circuit.

3.3. The 230900 contractor shall provide relays that will be installed by the 260000 contractor.

3.4. The 230900 contractor shall provide programming for the lighting control system.

3.5. A single override switch shall be provided in the main janitorial closet on the main floor to override lights on and off. The design team will review with the owner other locations for lighting controls override switches.

3.6. Relay in the Box devices shall be labeled by the 260000 contractor to indicate which circuit they control.

3.7. Requirements for graphics shall be enumerated in Division 230900.

SECTION 26 11 00 SUBSTATIONS

1. GENERAL

    1.1. Deferred to the Engineer of Record

2. PRODUCTS

    2.1. None

3. EXECUTION

    3.1. None

SECTION 26 12 00 MEDIUM VOLTAGE TRANSFORMERS

1. GENERAL

    1.1. Deferred to the Engineer of Record

2. PRODUCTS

    2.1. None

3. EXECUTION

    3.1. None

SECTION 26 13 00 MEDIUM VOLTAGE SWITCHGEAR

1. GENERAL

    1.1. Deferred to the Engineer of Record

2. PRODUCTS

    2.1. Basis of Design shall be S&C. While other manufacturer will be considered S&C shall always be the basis of design.

3. EXECUTION

    3.1. None

SECTION 26 22 00 LOW-VOLTAGE TRANSFORMERS

1. GENERAL

1.1. None

2. PRODUCTS

2.1. None

3. EXECUTION

3.1. All step-down transformers shall be Energy Star NEMA TPI K rated or HMT with 200% neutral capability, unless proven unnecessary and approved by the designated representative of the UVU Facilities Department. The K rating shall be as determined by Manufacturer recommendations for the equipment they serve.

3.2. .All step-down transformers feeding computer rooms or areas subject to high non-linear loads shall be fed from a Harmonic Mitigating Transformer with 200% neutral.

3.3. Testing

3.3.1 Comply with NETA ATS 7.2.1.1, 7.2.1.2, 7.2.2 (depending on the type of transformer) testing requirements.

(A) Perform all visual, mechanical and electrical test outlined.

SECTION 26 24 00 SWITCHBOARDS AND PANELBOARDS

1. GENERAL

1.1. Spaces designated as “break rooms, work rooms or copy rooms” require a minimum of three dedicated circuits for equipment/appliance utilization.

1.2. Minimum branch circuit size shall be 20 amps

2. PRODUCTS

2.1. None

3. EXECUTION

3.1. For all recessed panelboards provide at least 2-1” spare conduit and enough ¾” to allow for every spare or space circuit to be pulled later. If the panelboard is already fully used with no spare circuits or spaces, then provide 1-1” spare conduit.

3.1.1 Have all spare conduit terminate into an accessible ceiling or accessible floor.

3.2. For all wall-mounted panelboards provide at least 1-1” conduit and 1-3/4” spare conduit. In addition, provide at least enough spare ¾” conduit to provide for 20% of spare and space circuits to be pulled and connected later.

3.2.1 Conduit shall terminate into an adjacent hallway or corridor with an accessible ceiling.

3.3. TVSS shall be provided for the main service of each facility with services greater than 200 amps. A second level of TVSS shall be provided for panels serving primarily computer or non-linear loads.

3.4. Multi-pole breakers shall be used in lieu of joining multiple single pole breakers together.

3.5. All panelboards shall have typed schedules. Handwritten schedules are not allowed. All schedules shall reflect all changes done during the project.

3.6. Testing

3.6.1 Comply with NETA ATS 7.1 for Switchboards and Main Distribution Panels.
(A) Perform all visual, mechanical, and electrical test

3.6.2 Comply with NETA ATS 7.6.1.1 or 7.6.1.2 testing requirements
(A) Perform all visual, mechanical, and electrical test

SECTION 26 27 26 WIRING DEVICES

1. GENERAL

   1.1. None

2. PRODUCTS

   2.1. Receptacles/Outlets

      2.1.1 All receptacles shall be 20 amp rated.
      2.1.2 Color shall be white with stainless cover except:
         (A) In areas deemed to be architecturally sensitive in which a plan shall be submitted to the UVU Electrical Manager showing what other colors will be used and in what areas.

   2.2. Lighting Toggle Switches

      2.2.1 All lighting toggle switches shall be rated 20 amps.
      2.2.2 Color shall be white with stainless cover except:
         (A) In areas deemed to be architecturally sensitive in which a plan shall be submitted to the UVU Electrical Manager showing what other colors will be used and in what areas.

3. EXECUTION

   3.1. None

SECTION 26 29 23 VARIABLE-FREQUENCY MOTOR CONTROLLERS

1. GENERAL

1.1. Variable Frequency Drives shall be provided by the mechanical contractor and installed by the electrical contractor. The mechanical engineer of record shall define this in specifications and reference requirements in specifications Division 26; however, the actual specification for VFD shall be defined in Division 26 by the electrical engineer of record.

2. PRODUCTS

2.1. Manufacturers: ABB, Mitsubishi, Schneider and Yaskawa. ABB is preferred to be the basis of design.

3. EXECUTION

3.1. All VFD shall have a manual bypass to bypass the VFD.

3.1.1 Exception: Redundant pieces of equipment (Duty/Standby) each having their own VFD, do not require a manual bypass.

3.2. Harmonic Filters shall be provided for VFDs 15 HP and larger. Harmonic Filters shall keep Voltage to 5% and Amperage Harmonic to 12% or less as measured at the input terminals. (Total Harmonic Distortion)

3.2.1 Exception: If the design team provides an IEEE Standard 519 study showing current total harmonic distortion is kept below IEEE and Rocky Mountain Power Standards then current harmonic filtering is not required.

SECTION 26 32 13 ENGINE GENERATORS

1. GENERAL

1.1. Generators shall be provided on new buildings larger than 40,000 sqft.

2. PRODUCTS

2.1. Manufacturers: Cummins, Caterpillar, Kohler

2.2. Generators shall be provided with BACNet device for monitoring of BMS

3. EXECUTION

3.1. For new construction, a service that is to be backed up by a generator shall be designed to have no more than 12% current THD or 3% voltage THD when measured at the point where the generator connects to the system, while loads are running on generator. For existing services to be backed up by a generator, power quality testing shall be performed to determine that there is not more than 12% current THD or 3% voltage THD and that there is not a leading power factor. If there is, it shall be corrected prior to bringing the generator on line.

3.2. When generators are provided, size the fuel tank to comply with the needs of the facility or a minimum of 24 hours of operation at full load capacity.

3.3. Testing

3.3.1 Comply with NFPA 110 Section 7.13 for acceptance testing.

SECTION 26 36 00 TRANSFER SWITCHES

1. GENERAL

   1.1. None

2. PRODUCTS

   2.1. Manufacturers: Cummins, Caterpillar, Kohler

   2.2. Transfer switch shall be provided with BACnet device for monitoring by BMS.

3. EXECUTION

   3.1. Testing

      3.1.1 Comply with NFPA 110 Section 7.13 for acceptance testing.

SECTION 26 41 00 FACILITY LIGHTNING PROTECTION

1. GENERAL

   1.1. Provide lighting protection on new buildings and large remodels.

   1.2. Defer to engineer on design.

2. PRODUCTS

   2.1. None

3. EXECUTION

   3.1. None

SECTION 26 51 00 INTERIOR LIGHTING

1. GENERAL

1.1. Lighting shall conform to the products listed below. One architectural lighting fixture may be used for architectural purposes unless written permission is given from the UVU Electrical Manager.

2. PRODUCTS

2.1. Light Fixtures

2.1.1 Only LED Lighting shall be used.
(A) Exception: In areas requiring non-LED units written prior approval is required from all Deviation from Standards personnel listed in Section 26 00 00

2.1.2 The cost for light fixture shall not be more than $150. A/E team shall provide a list price for each of these.
(A) Exception: In architectural sensitive or grand entrance areas a higher cost fixture can be used. The A/E team shall provide for approval these areas, the count of fixtures in these areas, and the cost of these fixtures for these areas. Written prior approval is required from all Deviation from Standards personnel listed in Section 26 00 00.

2.1.3 4000K lighting shall be used in offices, classrooms, conference rooms, study rooms, and teaching areas.

3. EXECUTION

3.1. Illuminance values shall comply with the IESNA Lighting Handbook.

3.1.1 The general use for classrooms and study rooms are for people between the age of 18-25.

3.1.2 The general use for offices and conference rooms are for people between the ages of 25-60.

SECTION 26 56 00 EXTERIOR LIGHTING

1. GENERAL

1.1. Lighting shall conform to the products listed below.

1.2. LED Lighting shall be used only.

2. PRODUCTS

2.1. Light Fixtures

2.1.1 Bollard Fixtures
- (A) Bollard type fixtures are strongly discouraged on campus in areas that would require snow removal; such as walkways.

2.1.2 Walkway Poles
- (A) 14’ Square Straight Aluminum
- (B) 4” Wide
- (C) 0.125” Wall Thickness
- (D) Handhole with cover at base of the pole or hinged base required.
- (E) Color: Bronze

2.1.3 Parking Poles
- (A) 25’ Square Straight Aluminum
- (B) 5” Wide
- (C) 0.188” Wall Thickness
- (D) Handhole with cover at base of the pole.
- (E) Color: Bronze

3. EXECUTION

3.1. Illuminance values shall comply with IESNA Lighting Handbook.