



State of Utah

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Lieutenant Governor

Department of Administrative Services

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Executive Director

Division of Facilities Construction and Management

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Director

## ADDENDUM #2

Date: October 28, 2008

To: Contractors

From: Mike Ambre, Project Manager, DFCM

Reference: Exterior Lighting Improvements  
Utah Valley University – Orem, Utah  
DFCM Project No. 08063790

Subject: **Addendum No. 2**

|       |                           |                 |
|-------|---------------------------|-----------------|
| Pages | Addendum                  | 1 page          |
|       | <u>Engineers Addendum</u> | <u>48 pages</u> |
|       | Total                     | 49 pages        |

**Note:** *This Addendum shall be included as part of the Contract Documents. Items in this Addendum apply to all drawings and specification sections whether referenced or not involving the portion of the work added, deleted, modified, or otherwise addressed in the Addendum. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to Disqualification.*

While we contend that SB220 should only be potentially applicable to a contract issued after the effective date of said bill, this is to clarify that for purposes of this contract, regardless of the execution or effective dates of this contract, the status of Utah Law and remedies available to the State of Utah and DFCM, as it relates to any matter referred to or affected by said SB220, shall be the Utah law in effect at the time of the issuance of this Addendum.

- 1.1 **SCHEDULE CHANGES** – There are no changes to the project schedule.
- 1.2 **GENERAL** - Envision Engineers – Questions and Answers, Specifications, and Drawings.

**Utah!**  
Where ideas connect



ENVISION  
ENGINEERING

Direction. Then Velocity.

ENVISION MEMO

# Memo

|       |                           |
|-------|---------------------------|
| To:   | Mike Ambre                |
| From: | Ryan Van Voast            |
| CC:   | Denny Rucker              |
| Date: | October 28, 2008          |
| Re:   | UVU site lighting upgrade |

## Bidder Questions

1. Are we responsible for equipment outside of the panel? i.e. Autodialer and external wiring.
2. Are we responsible for installation and start-up of the system?
3. Are we responsible for programming the SCADAPack PLC's?
4. Can the grounding rod in detail 1 of sheet EG001 be replaced with ten feet of #6 bare copper wire coiled up in the pole base?

## Response:

1. The contractor is responsible for reconnecting the site/walkway lighting to contactors adjacent to the electrical panels for the areas served. The contractor should provide additional contactors as required for a complete functional installation per the Universities standards.
2. Yes the contractor is responsible for the installation and start-up of the system. The contractor will confirm all programming with the University.
3. There are no SCADA packs or PLC's on the project.
4. Yes, the ten feet of # 6 in the pole base acceptable.



# Addendum

|  |   |
|--|---|
| To: Mike Ambre   | From: Ryan Van Voast  |
| Company: DFCM  | Date: October 28, 2008  |
| Phone: 801.538.3018  | Address: Division of Facilities and Construction Management<br>4110 State Office Building |
| Project: <b>Utah Valley University site lighting upgrade</b> | Salt Lake City, Utah 84114  |

Envision Engineering, PC, is transmitting the following for your use and review:

| <u>Copies/Sets</u> | <u>Addendum Number &amp; Description</u> |
|--------------------|--|
| 1                  | Electrical Addendum 2                    |

**Please issue these electrical items.** Should you have questions, please feel free to contact our office directly at the number below.

Thank you.

The following is a description of Electrical Addendum changes to the electrical construction documents for Utah Valley University site lighting upgrade:

### **Lighting**

1. The light fixtures and poles have been specified by the owner to match what is existing in other areas on campus.

### **SPECIFICATIONS**

1. Electrical specifications have been included. Please see attached.

### **ELECTRICAL DRAWINGS**

#### SHEET EG001: Legend/ Schedules:

1. The detail for the in-grade junction has been modified to show the code required depth for buried conduits.

#### SHEET ES101: Electrical site lighting:

1. The drawing has been changed to reflect the additional circuits to the existing panel OL in work area 2, and panel CL in work area 1. The conduit quantity and routing has also been changed for these new circuits. Several keyed notes have also been changed or added.

#### SHEET ED101: Electrical site demolition:

1. The drawing has been changed to reflect the demolition to work area 2 regarding panel OL. Several associated keyed notes have also been changed.

#### SHEET EL601: Light fixture schedule, details, panel board schedules:

1. The drawing has been changed to reflect the new voltage for the lights, circuit changes to panels CL and SL. The schedule for panel OL has been added. The panel manufacturer and AIC rating have been included on the schedules.

**End of Addendum**

TABLE OF CONTENTS

| <u>ITEM</u>                             | <u>SECTION</u> |
|---|----------------|
| ELECTRICAL GENERAL PROVISIONS           | 16001          |
| ELECTRICAL CONNECTIONS FOR EQUIPMENT    | 16070          |
| ELECTRICAL SUPPORT & SEISMIC RESTRAINTS | 16072          |
| ELECTRICAL DEMOLITION                   | 16080          |
| CONDUIT RACEWAYS                        | 16110          |
| CONDUCTORS & CABLES                     | 16120          |
| ELECTRICAL BOXES & FITTINGS             | 16135          |
| OVERCURRENT PROTECTIVE DEVICES          | 16180          |
| GROUNDING                               | 16452          |
| EXTERIOR BUILDING LIGHTING              | 16510          |
| EXTERIOR AREA LIGHTING                  | 16551          |

## SECTION 16001 - ELECTRICAL GENERAL PROVISIONS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification sections, apply to work of this section.

## 1.2 DESCRIPTION OF WORK:

- A. The contract documents indicate the extent of electrical work. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system as described in division 16.

## 1.3 RELATED SECTIONS:

- A. Other Divisions relating to electrical work apply to the work of this section. See other applicable Divisions including, but not necessarily limited to:
  - 1. Division 16 - Electrical

## 1.4 INTERPRETATIONS OF DRAWINGS AND SPECIFICATIONS:

- A. Prior to bidding the job, submit requests for clarification in writing to the Architect/Engineer prior to issuance of the final addendum.
- B. After signing the contract, provide all materials, labor, and equipment to meet the intent, purpose, and function of the contract documents.
- C. The following terms used in Division 16 documents are defined as follows:
  - 1. "Provide" - Means furnish, install, and connect, unless otherwise indicated.
  - 2. "Furnish" - Means purchase new and deliver in operating order to project site.
  - 3. "Install" - Means to physically install the items in-place.
  - 4. "Connect" - Means make final electrical connections for a complete operating piece of equipment. This includes providing conduit, wire, terminations, etc. as applicable.
  - 5. "Or Equivalent" - Means to provide equivalent equipment. Such equipment must be approved by the Engineer prior to bidding.

## 1.5 EXAMINATION OF SITE:

- A. Visit the site and verify existing field conditions prior to submitting bid.
- B. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

## 1.6 QUALITY ASSURANCE:

- A. Perform work in accordance with all governing codes, rules, and regulations including the following minimum codes (latest editions or as otherwise accepted by the Authorities Having Jurisdiction):
  - 1. National Electric Code (NEC)

2. International Building Code (IBC)
  3. International Fire Code (IFC)
  4. International Mechanical Code (IMC)
  5. International Plumbing Code (IPC)
  6. American Disability Act (ADA)
  7. National Electrical Safety Code (NEC)
  8. Local Codes and Ordinances
- B. Comply with all standards where applicable for equipment and materials including the following minimum standards:
1. Underwriter's Laboratories (UL)
  2. American Society for testing Materials (ASTM)
  3. Certified Ballast Manufacturers (CBM)
  4. Insulated Cable Engineers Association (ICEA)
  5. National Electrical Manufacturer's Institute (NEMA)
  6. American National Standards Institute (ANSI)
  7. Electrical Testing Laboratories (ETL)
  8. National Fire Protection Association (NFPA)
  9. Institute of Electrical and Electronics Engineers (IEEE)
  10. American Institute of Electrical Engineer's Electrical Power
  11. Systems and Grounding in Commercial Construction
  12. Illuminating Engineers Society (IES)
- C. Provide new electrical equipment conforming to all requirements as set forth in the above standards. Provide UL labeled equipment where such label is applicable.
- D. Comply with all state and local codes and ordinances. When conflicts occur among codes, standards, drawings, and/or specifications, the most stringent requirements shall govern.
- E. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Provide a certificate of approval to the owner's representative from the inspection authority at completion of the work.
- F. Provide only first-class workmanship from competent workers, conforming to the best electrical construction practices.
- G. The contractor shall have a current state contracting license applicable to type of work to be performed under this contract.
- 1.7 SUBMITTALS:
- A. Shop Drawings: After the contract is awarded, but prior to manufacture or installation of any equipment, submit eight (8) complete sets of shop drawings. Partially complete sets of shop drawings are not acceptable. Submit all shop drawings in one complete submittal package. Prior to submitting shop drawings, review and certify that they are in compliance with the contract documents; Sign all approved shop drawings. Allow a minimum of two weeks for architect/engineer to review shop drawings. Refer to architectural general provision section for additional requirements.
  - B. Provide equipment catalog "cut sheets", brochures and/or drawings which clearly describe the proposed equipment. Include plans, elevations, sections, isometrics, and detailed engineering and dimensional information as applicable including equipment room layouts. Electrical room layouts are required to show all electrical equipment locations for all projects that include electrical rooms. Do not submit catalog sheets which describe several different items in addition to those items to be used, unless all relevant information is clearly identified. Bind each

information set in three ring binder or binders of sufficient size or sizes to enclose all information. Organize all information by section. Provide separate tabbed covers for each section of Divisions 16 indicating section number for each section requiring submittals.

- C. Include on front cover of binder or binders the name and location of the project, architect, electrical engineer, general contractor, electrical contractor, subcontractors, supplier/vendor, order number, volume, date, and any other applicable information. Certify that shop drawings are submitted in accordance with the contract documents with a written statement indicating compliance. Submittals will be reviewed and comments produced two times maximum. Additional reviews will be billed at current rates.

#### 1.8 OPERATION AND MAINTENANCE MANUALS:

- A. Submit four (4) complete sets of operating instruction and maintenance manuals for all equipment and materials provided under Divisions 16 prior to the Substantial Completion Inspection.
- B. Provide manufacturer's recommended operating and maintenance instructions, cleaning and servicing requirements, serial and model number of each piece of equipment, complete list of replacement parts, performance curves and data, wiring diagrams, warranties, and vendor's name, address, and phone numbers. Do not submit information which describes several different items in addition to those items to be used, unless all relevant information is clearly identified. Assemble all data in completely indexed volume or volumes. Engrave the job title, and name, address, and phone numbers of the contractor on the front cover and on the spine. Incomplete O&M manuals will be returned to the contractor for corrections / additions.

#### 1.9 RECORD DRAWINGS:

- A. Maintain on a daily basis a complete set of "Red-Lined Drawings", reflecting an accurate record of all work including addendums, revisions, and changes. Indicate precise dimensioned locations of all concealed work and equipment, including concealed or embedded conduit, junction boxes, etc. Record all "Red-Lined Drawing" information on a set of full sized prints of the contract drawings.
- B. Certify the "Red Lined Drawings" for correctness. Indicate on each drawing the name of the general and electrical contractors with signatures of each representative responsible for the work.
- C. The electrical engineering design firm will create record (as-built) drawings from the certified red-lined drawings; however, the general and electrical contractors retain the responsibility for the accuracy of the record drawings.

#### 1.10 WARRANTY:

- A. Ensure that the electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes and is free from electrical defects. Without additional charge, replace or repair, to satisfaction of the owner's representative, except from ordinary wear and tear, any part of the installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance or as otherwise indicated in individual sections, but in no case less than one year. Warranty incandescent and fluorescent lamps only for a period of two months from the date of substantial completion.
- B. Provide complete warranty information for each item including beginning of warranty period, duration of warranty, names, addresses, and telephone numbers and procedures for filling a claim and obtaining warranty services. Written warranties and guarantees are to be submitted

separately as:

1. Originals bound in a binder clearly identified with the title, "WARRANTIES AND GUARANTEES," the project name, the project number, and the Contractor's business name.
2. Electronic documents in \*.pdf format.

## PART 2 – PRODUCTS

### 2.1 GENERAL:

- A. All materials shall be new and shall bear the manufacturer's name, trade name, and the approved testing laboratory such as the UL label in every case where a standard has been established for that particular material. Used materials are acceptable only if specifically indicated on drawings.

### 2.2 SUBSTITUTION OF MATERIALS:

- A. Provide only specified products or products approved by addendum. Substitutions will be considered if two copies of the proposal is received at the architect's/engineer's office eight (8) working days prior to the bid day. Include in the proposal the specified and proposed catalog numbers of the equipment under consideration and a catalog cut sheet(s) with pictorial and descriptive information. Certify that the equipment proposed is equal to that specified, that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents.
- B. It is the responsibility of the contractor to make all substituted equipment comply with the intent of the contract documents and bear all cost associated with conflicts arising from the use of substituted equipment.
- C. Provide samples if so required by the architect or engineer before or after bid day.

### 2.3 SPARE PARTS:

- A. Provide spare parts as specified in Divisions 16 sections. Deliver all spare parts to owner's representative prior to substantial completion.

## PART 3 – EXECUTION

### 3.1 GENERAL:

- A. Workmanship: Provide only first class workmanship from competent workers. Defective materials or workmanship will not be allowed on the project. Provide competent supervision for the work to be accomplished. Keep same foreman on the job, unless a change is authorized by the engineer.
- B. Coordination: Prior to construction, layout electrical work and coordinate work with other trades. Sequence, coordinate, and integrate installation of materials and equipment for efficient flow of the work. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Install electrical equipment to facilitate maintenance and repair or replacement of equipment

components. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components. Coordinate with all utilities including power, communication, and data installations.

- C. Provide cutting, drilling, channeling, etc. only as necessary for proper completion of the work. Do not cut structural members unless authorization is issued in writing by the architect/engineer.
- D. Repairs: Repair damage to building, grounds, or utilities as a result of work under this contract at no additional cost to the owner.
- E. Dimensioning: Electrical drawings indicate locations for electrical equipment only in their approximate location, unless specifically dimensioned. Do not scale electrical drawings for dimensional information. Refer to architectural drawings and shop drawings where applicable for locations of all electrical equipment. Field verify all dimension on the job site.
- F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.
- G. Standards: Provide electrical installation in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- H. All workmen doing work of any nature on State of Utah projects must at all times carry their electrician's license with them and show it upon request. The acceptable ratio of apprentice to journeyman electricians on the job is 1:1.

### 3.2 REQUESTS FOR INFORMATION:

- A. When it is clearly apparent that information is not adequately described in the construction documents or when a coordination problem exists, submit a request for information (RFI) through proper contractual channels. The electrical engineering design firm will provide a response through its contractual channel. Although verbal direction may be given to expedite changes, responses are not considered part of the contract documents until a change order has been issued and signed by the Owner or his designated representative. The Contractor shall bear all costs associated with proceeding on any change order that has not been approved by the Owner or his designated representative.
- B. It is not the electrical engineering design firm's responsibility to answer questions that could clearly be answered by a thorough review of the construction documents. Should an RFI be issued by the Contractor where information was available, the electrical engineering firm will bill the contractor at the following rates:
 

|    |                            |                |
|----|----------------------------|----------------|
| 1. | Principal                  | \$148.00 / Hr. |
| 2. | Engineer                   | \$ 92.00 / Hr. |
| 3. | Designer                   | \$ 74.00 / Hr. |
| 4. | Construction Administrator | \$ 86.00 / Hr. |
| 5. | Drafting                   | \$ 54.00 / Hr. |
| 6. | Clerical                   | \$ 45.00 / Hr. |
- C. Any damages caused by construction delays due to frivolous RFI's, will be born solely by the Contractor.

### 3.3 SAFETY PRECAUTIONS:

- A. Provide all necessary guards or construction barriers and take all necessary precautions to

insure the safety of life and property.

#### 3.4 CLEAN:

- A. Clean up all equipment, conduit, fittings, wire, packing cartons, plastic, and other debris that is a direct result of the installation of the work of this division, both during the execution, and at the conclusion, of the project. Keep the site clean and safe during the progress of the work. Clean fixtures, interior and exterior of all equipment, and raceways prior to final acceptance. Vacuum interior of all electrical panels and equipment. Correct any damaged equipment. Touch-up or repaint if necessary.

#### 3.5 TEMPORARY POWER:

- A. Make arrangements with the proper institution authority for all temporary electricity.
- B. Provide temporary power, complete with metering and wiring for lighting and power outlets for construction tools and equipment. Report the initial meter reading to the owner/institution, or otherwise as may be directed.
- C. Service shall be provided with a main disconnect and all 20 ampere receptacles protected by 20 amp GFI, single-pole breakers. No attempt is made herein to specify construction power requirements for equipment in detail. Provide all electrical equipment and wiring as required.
- D. As soon as permanent power and metering is available, the temporary power supply shall be disconnected and removed from the project site.
- E. All temporary wiring shall meet the requirements of NEC Article 305 and the State Industrial Commission.

#### 3.6 POWER OUTAGES:

- A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the owner. Any electrical service interruption will be coordinated at least 7 days in advance of the power shut-off. Include all costs for overtime work in bid. Coordinate all outages and proceed only after receiving authorization from the owner's representative. Keep all outages to an absolute minimum.

#### 3.7 STORAGE AND PROTECTION OF MATERIALS:

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. Lost or damaged materials will be replaced at no additional cost to owner. Do not store materials and apparatus in any public thoroughfare or in any area on the site where such storage would constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

#### 3.8 EXCAVATING FOR ELECTRICAL WORK:

- A. Verification: Prior to excavating, locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling. Observe all State and Local codes prior to excavating. Do not disturb walls, footings, and other structural members in any way.
- B. Protection: Provide barricades, warning signs, and illumination to protect persons from injury at excavations. Provide temporary coverings and heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation

bases or subbases.

- C. Coordination: Do not excavate for electrical work until the work is ready to proceed without delay.
- D. Excavated Materials: Temporarily store excavated materials near excavation in manner which will not interfere with or damage excavation or other work. Dispose of and remove excavated materials which are either in excess of quantity needed for backfilling or do not comply with the requirements for backfill material.
- E. Burial Depths: Burial depths must comply with NEC Section 300-5 (or State of Utah requirements, whichever is more stringent), unless noted otherwise on drawings.
- F. Excavation Permits: Obtain all shut-down and excavation permits as may be required for proper completion of the work.

### 3.9 BACKFILL MATERIALS:

- A. For buried conduits or cables (other than below slab-on-grade, or concrete-encased), provide 2" thickness of well-graded sand on all sides of conduits or cables.
- B. For trench backfill to within 6" of final grade, provide soil material suitable for compacting to required densities.
- C. For top 6" of excavation, provide top soil.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment:
  - 1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
  - 2. Paved Areas, other than roadways: 90 percent for cohesive soils, 95 percent for cohesionless soils.
- E. Where subsidence is observable at electrical work excavations during project warranty period, remove surface, add backfill material, compact, and replace surface treatment. Restore surface to original condition.

### 3.10 FIRE PENETRATION SEALS:

- A. Seal all raceway and/or cable penetrations through fire-rated floors, wall, and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. Provide penetration sealants and fittings of ratings to match the rating of the penetrated materials so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the NEC.
- B. Sealant Systems: Provide sealants, wall wraps, partitions, caps, and other accessories complying with UL 1479 (ASTM E-814) from the following where applicable:
  - 1. 3M Fire Barrier Sealing Penetration System
  - 2. Chase Foam Fire Stop System
  - 3. Thomas and Betts Flame Safe Fire Stop System
  - 4. Nelson Fire Stop Products
- C. Fittings: Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit

and cable penetrations through concrete and masonry wall, floor, slabs, and similar structures.

- D. Install sealants and fittings in accordance with all manufacturer's written instructions.

3.11 LABELING:

- A. Engraved black plastic laminated, with white-core labels, 1/16" thick, shall be permanently attached on both the interior and exterior the following electrical equipment:

1. Branch panels
2. Push buttons
3. Time switches
4. Similar equipment.
5. Lighting contactors and associated switches
6. Junction boxes larger than 4x4x1/2.

- B. The labels shall have 1/4" high, engraved letters, such as EF-1, AC-1, Panel A, etc.

3.12 TESTS:

- A. Notify engineer prior to all testing specified herein at least three business days prior to testing. Engineer shall observe all tests to insure the proper operation of the electrical system.

3.13 PROJECT FINALIZATION AND START-UP:

- A. Upon completion of the work, have each factory representative and/or subcontractor assist in start-up and testing of their respective systems.
- B. Have each representative give personal instructions on operating and maintenance of their equipment to the owner's maintenance and/or operation personnel.
- C. Have representatives certify each system with a written statement indicating that they have performed start-up and final check out of their respective systems.

3.14 FINAL REVIEW:

- A. Have the project foreman accompany their reviewing parties and remove coverplates, panel covers, access panels, etc. as requested, to allow review of the entire electrical system.

END OF SECTION 16001

## SECTION 16070 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B. This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to electrical connections.

## 1.2 DESCRIPTION OF WORK:

- A. Extent of electrical connections for equipment include all final electrical connections for all equipment having electrical requirements including, but not necessarily limited to the following:
  - 1. Equipment specified under all divisions of the contract. Refer to other divisions for specific electrical requirements.
  - 2. Etc.

## 1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.
- B. SHOP DRAWINGS: Not required.

## PART 2 – PRODUCTS

## 2.1 GENERAL:

- A. Provide all materials for electrical connections including, but not necessarily limited to the following:
  - 1. Raceways
  - 2. Fittings
  - 3. Conductors
  - 4. Cords
  - 5. Cord caps
  - 6. Wiring devices
  - 7. Lugs (CU-AL)
  - 8. Electrical insulating tape
  - 9. Heat-shrinkable tubing
  - 10. Cable ties
  - 11. Wire nuts
  - 12. Other items and accessories as required.
- B. Crimp on or slip-on type splicing materials designed to be used without wire stripping are not acceptable.
- C. Power Distribution Blocks: Provide Square D Type LB or Equivalent.

- D. Refer to other Division 16 sections for specification of electrical materials as applicable.

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Make electrical connections in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 CONNECTIONS:

##### A. Permanently Installed Fixed Equipment:

1. Install conductors in flexible conduit from junction box to equipment control panel or connection point.
2. Where such installations are subject to moisture, install in liquid-tight flexible conduit.

##### B. Movable equipment:

1. Provide wiring devices, cord caps, and multi-conductor cables as required.

##### C. Other methods as required by the NEC and/or as required by special equipment or field conditions.

##### D. Power Distribution Blocks: Unless noted otherwise on drawings, provide power distribution blocks only for tapping of feeders and branch circuits. Locate in junction box or gutter in NEMA ratings to suit application.

#### 3.3 MANUFACTURER'S INSTRUCTIONS:

- A. Obtain manufacturer's instruction and wiring diagram regarding electrical connections of each piece of equipment and provide connections in accordance therewith.

#### 3.4 VERIFICATION OF LOAD CHARACTERISTICS:

- A. Verify electrical load characteristics of all equipment prior to rough-in. Review respective shop drawings of all other Divisions and Owner's equipment manuals. Report any variances from electrical characteristics noted in the contract documents to the Architect/Engineer prior to rough-in.
- B. Value of rough-in work, electrical equipment, etc. installed and/or purchased by the contractor not meeting equipment requirements shall be credited back to the owner.

END OF SECTION 16070

## SECTION 16072 - ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

## PART 1 – GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including Division 16 Specification Sections, apply to this Section.

## 1.2 SUMMARY:

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Seismic restraints for electrical equipment and systems.

## 1.3 DEFINITIONS:

- A. IBC: International Building Code.
- B. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

## 1.4 SUBMITTALS:

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.
  - 1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
  - 2. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Include the following:
  - 1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.
  - 2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
    - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
  - D. Welding certificates.
  - E. Qualification Data: For professional engineer and testing agency.
  - F. Field quality-control test reports.
- 1.5 QUALITY ASSURANCE:
- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
  - B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3.
  - C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS:

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.
- B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
  - 1. Available Manufacturers:
    - a. Cooper B-Line; a division of Cooper Industries.
    - b. ERICO International Corporation.
    - c. Allied Support Systems; Power-Strut Unit.
    - d. GS Metals Corp.
    - e. Michigan Hanger Co., Inc.; O-Strut Div.
    - f. National Pipe Hanger Corp.
    - g. Thomas & Betts Corporation.
    - h. Unistrut; Tyco International, Ltd.
    - i. Wesanco, Inc.
  - 2. Finishes:
    - a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
  - 3. Channel Dimensions: Selected for structural loading and applicable seismic forces.

- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Verify suitability of fasteners in subparagraph below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
  - 2. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers:
      - 1) Hilti, Inc.
      - 2) ITW Construction Products.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co. Inc.
  - 3. In the following subparagraph, use stainless steel anchors in corrosive environments.
  - 4. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers:
      - 1) Cooper B-Line; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc
      - 3) Hilti, Inc.
      - 4) ITW Construction Products.
      - 5) MKT Fastening, LLC.
      - 6) Powers Fasteners.
  - 5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 6. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
  - 7. Toggle Bolts: All-steel springhead type.
  - 8. Hanger Rods: Threaded steel.

### 2.3 SEISMIC-RESTRAINT COMPONENTS:

- A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.
  - 1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.
- B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

- C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.
  - 1. Available Manufacturers:
    - a. Amber/Booth Company, Inc.
    - b. Loos & Co., Inc.
    - c. Mason Industries, Inc.
  - 2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
  - 3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
  - 4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
  - 5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

#### 2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES:

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for raceways as within 12 inches of coupling, fitting, and box, at each 90 degrees bend, minimum of two supports per ten foot run. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps, or as otherwise required by an agency acceptable to authorities having jurisdiction.

#### 3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION:

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, raceways may be supported by openings through structure members, as permitted in NFPA 70.
- C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

- D. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
  - E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
    - 1. To Wood: Fasten with lag screws or through bolts.
    - 2. To New Concrete: Bolt to concrete inserts.
    - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
    - 4. To Existing Concrete: Expansion anchor fasteners.
    - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
    - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.
    - 7. To Light Steel: Sheet metal screws.
    - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
  - F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
  - G. Do not drill or core cut holes for anchors or use powder-activated fasteners in post-tension slabs, joists, and beams.
- 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS:
- A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
  - B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
  - C. Field Welding: Comply with AWS D1.1/D1.1M.
- 3.4 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS:
- A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
  - B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
  - C. Restraint Cables: Provide slack within maximums recommended by manufacturer.
  - D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing: Test pullout resistance of seismic anchorage devices.
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5. Test to 90 percent of rated proof load of device.
  - 6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Record test results.

END OF SECTION 16072

SECTION 16080 - ELECTRICAL DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B. This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to electrical demolition.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical demolition work is indicated by drawings.
- B. Electrical demolition items are shown to give a basic description of the extent of demolition work, but may not be inclusive.
- C. Do not assume that the electrical drawings reflect as-built conditions. Visit and observe the project prior to submitting bid and determine extent of electrical demolition work.

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to Section 16001 - Electrical General Provisions as applicable.

PART 2 – PRODUCTS - Not used.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Demolition work shall be laid out in advance to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary, perform with care, use skilled mechanics of the trades involved. Cutting work of other contractors shall be done only with the consent of that contractor. Cutting of structural members is not permitted. Repair damage to building and equipment as a result of electrical demolition work under this contract at no additional cost to owner.
- B. Obtain permission from the owner's representative before penetrating any ceiling, floor, and wall surfaces.

3.2 METHODS:

- A. Disconnect and remove any/all fixtures, devices, equipment, etc. required for proper completion of the work whether shown or not.
- B. Relocate, rewire, and/or reconnect any/all fixtures, devices, equipment, etc. that for any reason obstructs construction.
- C. Maintain circuit integrity and continuity of all existing circuits/feeders, and systems that interfere

with or are interrupted by remodel work, unless those circuits/feeders are to be abandoned completely. Maintain all circuits and systems in operation during construction. Provide temporary panels, temporary wiring and conduits, etc. as required.

- D . Leave all existing fixtures, devices, equipment, etc. In portions of the building not being remodeled, in working condition.
- E . Remove and dispose of all raceways, conductors, boxes, devices, equipment, etc., that are not to be reused. Terminate at accessible junction box by providing proper knockout closure, tape conductors, and label as "spare" with circuit no., Zone no., or other characteristic identifying source.
- F . Existing raceways may be reused, if in place, where in compliance with the contract documents and the National Electrical Code. Upgrade and/or provide new conduit supports where necessary for all raceways being reused. Insure integrity of existing raceways before re-use.
- G . Return to owner all light fixtures which are to be removed. Dispose of all light fixtures if so directed by owner in accordance with local environmental laws and policies. Those fixtures indicated for re-use shall be thoroughly cleaned, repaired as required, re-lamped, and installed as indicated. When storing fixtures for reuse, store in area and/or provide protective covering that will keep construction dust and materials off fixtures.

### 3.3 PATCHING AND REPAIR:

- A . Finished Surfaces: The electrical contractor is responsible for patching and repair of all existing interior surfaces pertaining to the installation of work under this Division, unless specifically noted elsewhere in the contract documents. Where patching and repair is necessary, surfaces shall be finished (painted, etc.) to match the adjacent materials, finished, and colors. Requirements of other Divisions such as Division 9 - finishes shall apply.
- B . Hard Surfaces: Whenever excavation or trenching is required for the installation of electrical work, it shall be the responsibility of the electrical contractor to make repairs and/or replacements of hard finish surfaces such as concrete, asphalt, etc.

### 3.4 CONCEALING:

- A . All raceways shall be concealed within the ceilings, walls, and floors, except in locations where exposed raceways are specifically permitted, such as equipment rooms and unfinished storage areas.
- B . Surface-mounted raceways or systems shall be permitted only where approved by Architect/Engineer.

END OF SECTION 16080

## SECTION 16110 - CONDUIT RACEWAYS

## PART 1 – GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B. This section is a Division 16 General Provisions section, and is part of each Division 16 sections making reference to conduit raceways.

## 1.2 DESCRIPTION OF WORK:

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the followings:
  - 1. Rigid Metal Conduit
  - 2. PVC Externally Coated Rigid Steel Conduit
  - 3. Intermediate Metal Conduit
  - 4. Electrical Metallic Tubing
  - 5. Flexible Metal Conduit
  - 6. Liquid-tight Flexible Metal Conduit
  - 7. Rigid Non-metallic Conduit

## 1.3 QUALITY ASSURANCE:

- A. Standards: Refer to Section 16001 - Electrical General Provisions as applicable. Provide conduit raceway installation in accordance with recommendations of the American Iron and Steel Institute "Design Manual on Steel Electrical Raceways", latest edition.
- B. Manufacturers: Firms regularly engaged in the manufacture of raceway of types and sizes required, whose products have been in satisfactory service for not less than three (3) years.
- C. Shop Drawings: Not required.

## PART 2 – PRODUCTS

## 2.1 CONDUITS:

- A. Rigid Metal Conduit (RMC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in accordance with Federal Specification WW-C-0581 and ANSI C80.1.
- B. PVC Externally Coated Rigid Metal Conduit: Provide hot-dipped galvanized, rigid metallic conduit externally coated with Polyvinyl Chloride (PVC) in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.
- C. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in accordance with Federal Specification WW-C-581.
- D. Electric Metallic Tubing (EMT): Provide electric metal tubing in accordance with Federal Specification WW-C-563 and ANSI C80.3.

- E. Flexible Metal Conduit: Provide zinc-coated, flexible metal conduit in accordance with Federal Specification WW-C-566.
- F. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit, constructed of single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible Polyvinyl Chloride (PVC).
- G. Rigid Non-Metallic Conduit: Provide rigid non-metallic conduit (PVC) in accordance with ANSI/NEMA TC 2, Type 1 for concrete encasement, Type 2 for direct burial.

## 2.2 FITTINGS:

- A. Rigid Metal Conduit, Intermediate Metal Conduit, and PVC Externally Coated Rigid Metal Conduit: Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.
- B. Electric Metallic Tubing: Provide insulated throat, non-indenter, set screw, malleable steel fittings. Screws must have a full set. Provide concrete-tight compression-type fittings in suspended slabs. All EMT fittings shall be fabricated from steel. Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable. Install OZ Type B bushings on conduits 1" and larger.
- C. Flexible Metal Conduit: Provide flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 1, and Style A. Commercial "greenfield" not less than 1/2" diameter or as otherwise specified on drawings is acceptable.
- D. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 3, Style G.
- E. Non-Metallic Conduit: Provide non-metallic conduit fittings (PVC) in accordance with ANSI/NEMA TC 3 to match conduit types and materials.
- F. Expansion Fittings: OZ Type AX, or equivalent to suit application.
- G. Sealing Bushings: Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ Type CSB internal sealing bushings.
- H. Cable Supports: Provide OZ cable supports for vertical risers, type as required by application.

## 2.3 SIZES:

- A. Provide conduits in sizes as indicated in contract documents or as otherwise specified herein, but not less than 3/4".

## PART 3 – EXECUTION

### 3.1 GENERAL:

- A. Install raceway and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

### 3.2 LOCATIONS:

- A. Rigid Metal Conduit and Fittings: Use for conduit bends greater than 22 degrees where buried below grade or slab on grade. Install RMC where raceway passes vertically through slab-on-grade. Where raceways penetrate building, manholes, or vault walls and floors below grade, provide RMC for a minimum distance of 10' on the exterior side of the floor or wall. Use RMC for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.
- B. Intermediate Metal Conduit and Fittings: Use for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.
- C. Electric Metal Tubing and Fittings: Use for above-grade feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Install in suspended slabs subject to local code requirements and fire rating considerations.
- D. Flexible Metal Conduit and Fittings: Use as whips for lighting fixtures, fixed equipment where not exposed to weather or moisture, other devices where required by NEC, and as requested by the Engineer. Maximum length not to exceed 6', unless specifically approved by the Electrical Engineer.
- E. Liquid-Tight Flexible Metal Conduit and Fittings: Use for connection to motor terminal boxes, fixed equipment where subject to moisture or weather, and other equipment subject to movement or vibration. Maximum length not to exceed 6', unless specified otherwise.
- F. Rigid Non-Metallic Conduit and Fittings: Use for below-grade service entrances, feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Do not use above grade.

### 3.3 METHODS:

- A. Maintain a minimum of 12" clearance between steam or hot water lines or other hot surfaces. Where such clearance is impractical, insulate conduit with approved materials.
- B. Install conduits parallel with or at right angles to lines of the structure. Route conduits symmetrically where possible.
- C. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed. Conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no additional cost to owner.
- D. Precaution shall be exercised to prevent accumulation of water, dirt or concrete in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.
- E. Any conduit which pierces airtight spaces or plenums shall be sealed to prevent air leakage with mastic acceptable to the Architect.

### 3.4 CONCEALING:

- A. All raceways shall be concealed within the ceilings, walls, and floors, except in locations where exposed raceways are specifically permitted, such as equipment rooms and unfinished storage areas. In equipment rooms, if lighting raceways are run exposed, installation shall not be done until piping and duct work layout has been determined in order that lighting boxes may be

located so as to avoid being covered by overhead ducts and piping. If lighting raceways in equipment rooms are concealed in the structural ceiling slab, after mechanical work is complete, exposed conduit extensions shall be run to locate lighting fixtures where they are not obscured by work of other trades.

### 3.5 BURIED CONDUITS:

- A. Comply with all burial depths as defined in NEC Section 300-5. Bury all conduits at least 24" below grade, unless specifically indicated otherwise on drawings. Provide magnetic 6" wide "Yellow Warning" ribbon 12" directly above conduit and 6" below finished grade measured from the top of the conduit or duct bank. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single marker.
- B. Slope all conduits toward manholes or pull boxes for proper drainage. Use weep holes. Gravel drainage pockets are not permitted.
- C. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.
- D. Under Concrete Slab on Grade: Horizontal conduit must be installed a minimum of 2" below the bottom of the concrete slab. Conduits should not be installed in concrete slabs.
- E. Concrete Encasement: Where concrete-encasement is indicated on drawings, provide ductbank construction using red 3000 psi at 28 day strength concrete. Provide minimum 4" cover on all sides of exterior conduits. Provide conduit spacers where applicable. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.
- F. Where conduits are extended for future use, cap and clearly mark.

### 3.6 ELECTRICAL CONTINUITY:

- A. Provide electrically continuous conduit systems throughout.

### 3.7 FIELD CUTS AND THREADS:

- A. Cut all conduits square. Remove all sharp or rough edges and ream all burrs, inside and outside. Provide clean sharp threads on RMC and IMC.
- B. Engage at least five full threads on all RMC and IMC fittings. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

### 3.8 CONDUIT ENDS:

- A. Cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

### 3.9 SPARE CONDUITS:

- A. Install a 200 lb. polypropylene pull cord in each empty conduit run.

### 3.10 HAZARDOUS LOCATIONS:

- A. Install RMC and IMC in all hazardous locations as defined by the NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with all NEC requirements and/or as shown on the drawings.

Provide inspection fittings with hazardous location rated drains to prevent water from accumulating in conduit runs.

3.11 CLEANING:

- A. Pull mandril and swab through all conduits before installing conductors.

END OF SECTION 16110

## SECTION 16120 - CONDUCTORS AND CABLES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A . Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B . This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to conductors and cables.

## 1.2 DESCRIPTION OF WORK:

- A . This section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B . Types of conductors and cables in this section include the following:
  - 1. Copper Conductors.
- C . Applications for conductors and cables required for project include:
  - 1. Branch Circuits.

## 1.3 SUBMITTALS:

- A . Product Data: For each type of conductor and/or cable indicated.
- B . Field Quality-Control Test Reports: From Contractor. Refer to Section 16001 – General Electrical Provisions.

## 1.4 QUALITY ASSURANCE:

- A . 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.
- B . Comply with NFPA 70.

## PART 2 - PRODUCTS

## 2.1 GENERAL:

- A . Manufacturers: In other Part 2 articles where subparagraph titles below introduce lists, provide products by the manufacturer specified, subject to compliance with requirements.
- B . Ambient Conditions: Conductors used for branch circuits in areas where the ambient conditions exceed 30 degree C. shall be provided with insulation approved for that temperature.
- C . Wire Sizes: As indicated on electrical drawings or as specified herein, but in no case less than No. 12 AWG.

## 2.2 COPPER CONDUCTORS:

- A . Manufacturers:
  - 1. American Insulated Wire Corporation; a Leviton Company.
  - 2. General Cable Corporation.
  - 3. Senator Wire & Cable Company.
  - 4. Southwire Company.
- B . Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.
- C . References and Ratings:
  - 1. ICEA S-95-658 / NEMA WC70.
  - 2. ASTM.
  - 3. UL Standard 83.
  - 4. UL Standard 1063 (MTW).
  - 5. Federal Specification J-C-30B.
  - 6. NEC.
- D . Conductor Material: Copper.
- E . Stranding: Solid conductor for No. 12 AWG, stranded for No. 10 AWG and larger.
- F . Conductor Insulation Types: Thermoplastic-insulated, Type THHN / THWN-2.

## 2.3 CONNECTORS AND SPLICES:

- A . Manufacturers:
  - 1. AMP Incorporated/Tyco International.
  - 2. Hubbell/Anderson.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M Company; Electrical Products Division.
- B . Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C . Splices for wire sizes #10 and smaller shall be screw-on type similar to scotch or ideal wing nut connectors. Crimp-on splices designed to be used without wire stripping are not acceptable.

## PART 3 – EXECUTION

### 3.1 GENERAL:

- A. Install conductors, cables, and accessories as indicated, in compliance with manufacturer's written instruction, applicable requirements of NEC, NECA's "Standards of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

### 3.2 CONDUCTOR AND CABLE APPLICATIONS:

- A. Branch Circuits:

1. Exposed, including in crawlspaces: Copper conductors in raceway.
2. Concealed in ceilings, walls, and partitions: Copper conductors in raceways.
3. Concealed in concrete and below slabs-on-grade: Copper conductors in raceway.

B. Class 1 Control Circuits: Copper conductors in raceway.

### 3.3 INSTALLATION:

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. When raceway is not required, install concealed cables parallel and perpendicular to surfaces of structural members, and follow surface contours where possible.

E. Support cables according to other applicable specification sections.

F. Seal around cables penetrating fire-rated elements to comply with applicable fire stop specification sections.

G. Color Coding: Color code secondary service, feeder, and branch circuit conductors. Colors shall remain consistent throughout the project and shall match existing coding system where applicable.

1. Conductor sizes No. 6 AWG and smaller: Colored insulation.
2. Conductors sizes No. 4 AWG and larger: 2 inch (51 mm) band of Colored adhesive marking tape applied at all terminations, junction boxes, and pull boxes.
3. Branch circuit switched-legs and travelers: Colored insulation (in colors other than those indicated below).
4. Color-code 277/480V system conductors:
  - a) Phase A: Brown.
  - b) Phase B: Orange.
  - c) Phase C: Yellow.
  - d) Neutral: White with colored stripe or gray.
  - e) Ground: Green.

### 3.4 HOMERUN CIRCUITS:

A. Homerun circuits may be combined in common conduits at the option of the contractor in compliance with the following:

1. Three-Phase Installations: Not more than three single-phase circuits with common neutral in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a, b, or c).
2. Single-Phase Installations: Not more than two single-phase circuits with common neutral in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a or b).

### 3.5 NEUTRAL CONDUCTORS:

A. LIGHTING CIRCUITS: Where multiple circuits serving lighting are run in a single raceway (see

paragraph above for allowable number or circuits per conduit), a common neutral shall be allowed. When any one circuit is serving fluorescent lighting loads, provide an oversized neutral conductor. Size the neutral conductor one size (AWG) larger than the largest phase conductor.

### 3.6 VOLTAGE DROP:

- A. Provide branch circuit conductors in sizes such that voltage drop for branch circuits do not exceed 3 percent at the farthest outlet. Provide service, feeder, and branch circuit conductors so that the voltage drop on the entire electrical system does not exceed 5 percent at the farthest outlet. This shall be strictly followed regardless of the conductor sizes indicated on the electrical drawings. Increase conductor sizes (and conduits where necessary to comply with NEC conduit fill requirements) as necessary to accommodate this requirement. Calculations shall be based on the following:

1. Lighting Branch Circuits: Connected load plus 25% spare.
2. Appliance and Equipment Branch Circuits: Nameplate or NEC required load.
3. 120V Convenience Outlet Branch Circuits: 12 amps minimum, but in no case less than NEC loading requirements. Use the following schedule:

| <u>Distance (feet)</u> | <u>Wire Size (AWG)</u> |
|------------------------|------------------------|
| 0-80                   | #12                    |
| 81-125                 | #10                    |
| 126-200                | #8                     |
| 201-320                | #6                     |

4. Use the NEC method to calculate voltage drop.

### 3.7 CONNECTIONS:

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack. Use pig tails when wiring outlets.

### 3.8 FIELD QUALITY CONTROL:

- A. Testing: Perform the following field quality-control testing:
1. Visual and Mechanical Inspection:
    - a) Inspect cables for physical damage and proper connection in accordance with the electrical construction documents.
    - b) Test cable mechanical connections to manufacturer's recommended values with a calibrated torque wrench.
    - c) Check cable color coding for compliance with electrical specifications.
  2. Electrical Tests:
    - a) Perform insulation resistance test on each conductors for feeders 100 amps and greater with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
    - b) Perform continuity test to insure proper cable connection.
  3. Test Values:

- a) Minimum insulation resistance values shall not be less than two megohms.
- B. Test Reports: Prepare a written report and submit to the Electrical Engineer at the completion of the project. The report shall include the following:
- 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 16120

## SECTION 16135 - ELECTRICAL BOXES AND FITTINGS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A . Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B . This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to electrical boxes and fittings.

## 1.2 DESCRIPTION OF WORK:

- A . Extent of electrical boxes and fittings work is indicated by drawings and schedules.
- B . Types of electrical boxes and fittings in this section include the following:
  - 1. Junction Boxes
  - 2. Pull Boxes
  - 3. Conduit Bodies
  - 4. Bushings
  - 5. Locknuts
  - 6. Knockout Closures
  - 7. Miscellaneous Boxes and Fittings

## 1.3 QUALITY ASSURANCE:

- A . Standards: Refer to Section 16001 - Electrical General Provisions as applicable.
- B . Manufacturers: Firms regularly engaged in the manufacturer of boxes and fittings required, whose products have been in satisfactory service for not less than three years.
- C . Shop Drawings: Submit shop drawings on floor boxes only where required.

## PART 2 - PRODUCTS

## 2.1 WEATHERPROOF OUTLET BOXES:

- A . Provide corrosion-resistant, cast-metal weatherproof outlet boxes, of types, shapes, and sizes, with threaded conduit ends, cast metal coverplates with spring-hinged waterproof caps, face plate gaskets, and corrosion-resistant fasteners.

## 2.2 JUNCTION AND PULL BOXES:

- A . Provide code-gauge sheet steel junction and pull boxes, with removable screw-on covers and welded seams, of types, shapes, and sizes to suit each respective location and installation. Size all junction and pull boxes in accordance with NEC 370-28. Provide stainless steel nuts, bolts, screws, and washer.

## 2.3 CONDUIT BODIES:

- A . Provide galvanized, cast-metal conduit bodies of type, shapes, and sizes to suit respective locations and installation. Construct with threaded conduit entrance ends and removable covers. Provide corrosion-resistant screws.
- B . Aluminum boxes and fitting shall not be permitted.

#### 2.4 CONDUIT CONNECTIONS:

- A . Box connectors 3/4" and larger shall be insulated, throat-type or equal type plastic bushings. Provide double locknuts and insulating plastic bushings for RMC and IMC terminating at panels and boxes.
- B . Where RMC penetrates building, manholes, or vault walls and floors below grade, provide sealing bushings with external membrane clamps as applicable. Provide segmented internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway. Where RMC terminates in manhole, vault, or pull box, provide insulated grounding bushings. Also see Section 16135 – Electrical Boxes and Fittings.
- C . Install OZ type "B" connectors for all conduits 1" and larger.
- D . Provide cable supports in all vertical risers in accordance with NEC 300-19.

#### 2.5 EXPANSION FITTINGS:

- A . Provide expansion joint fittings in all conduit runs crossing structural expansion joints, whether above-grade, in slab-on-grade, or in suspended slabs. Provide OZ type "AX" or approved equivalent, size to the raceway.

#### 2.6 ACCESSORIES:

- A . Provide all accessories including, but not necessarily limited to, bushings, knockout closures, locknuts, offset connectors, etc. of types, shapes, and sizes to suit respective locations and installation. Construct of corrosion-resistant steel.

### PART 3 – EXECUTION

#### 3.1 GENERAL:

- A. Install electrical boxes and fittings in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 METHODS:

- A. Where outlet boxes are subject to weather or moisture, install weatherproof outlet boxes.
- B. Remove knockouts only for entering conduits. Provide knockout closures to cap unused knockout holes where blanks are mistakenly removed.
- C. Do not use condulets in place of elbows or junction boxes. Condulets in sizes 2" or larger shall not be used, unless specifically approved by the electrical engineer.

- D. Install boxes and conduit bodies in readily accessible locations. Install recessed boxes with faces of boxes or rings flush with finished surfaces. Seal all openings between outlet box and adjacent surfaces with plaster, grout, or similar suitable material.
- E. For stud construction, install boxes with rigid supports using metal bar hangers, or 2" X 4", 1" X 6" wood bridging between studs with screws. Welding or nailing boxes directly to metal joist and studs is not acceptable. Boxes set opposite in common wall shall have at least 10" of conduit between them. Securely fasten outlet boxes to structural surfaces to which attached.
- F. For concrete or masonry construction, solidly embed electrical boxes in concrete and masonry. Provide box supports as required to keep outlet boxes flush with finished surfaces.
- G. Coordinate location of all outlet boxes with millwork, back splashes, tackboards, etc.
- H. Install junction boxes or condulets in conduit runs as required at 100 foot maximum intervals on long runs. This shall apply to concrete junction boxes in grade and junction boxes within the building.
- I. Provide electrical connections for installed boxes.

3.3 IDENTIFICATION:

- A. Mark circuit number on exterior side of junction boxes located in ceilings such that circuits numbers are readily identifiable. For outlet boxes in wall, mark circuit numbers on interior sides of outlet boxes.
- B. Identification labels shall be as follows:

Normal Power                      Black with White letters

5END OF SECTION 16135

## SECTION 16180 - OVERCURRENT PROTECTIVE DEVICES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B. This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to overcurrent protective devices.

## 1.2 DESCRIPTION OF WORK:

- A. Extent of overcurrent protective devices is indicated by drawings and schedules and is specified herein.
- B. Type of overcurrent protective devices in this section include the following:
  - 1. Molded Case Circuit Breakers

## 1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. SHOP DRAWINGS: Submit manufacturer's data on overcurrent protective devices including specifications, time-current trip characteristics curves, mounting requirements, installation instructions, etc. Submit dimensioned drawings of overcurrent protective devices.
  - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

## PART 2 – PRODUCTS

## 2.1 GENERAL:

- A. Provide overcurrent protective devices and ancillary components of types, sizes, ratings, and electrical characteristics indicated. Provide enclosures in NEMA ratings as indicated and suitable for applications.

## 2.2 MOLDED CASE CIRCUIT BREAKERS:

## A. MANUFACTURERS:

Subject to compliance with all requirements, provide molded case circuit breakers from one of the following:

- 1. Cutler-Hammer (Westinghouse)
- 2. Square D

**B. MOLDED CASE CIRCUIT BREAKERS:**

1. Provide factory-assembled, molded case circuit breakers as integral components of lighting and appliance panelboards, power panelboards, switchboards, and for individual mounting as indicated. Provide thermal magnetic, molded case circuit breakers of amperages, voltages, types, and short circuit current ratings indicated. Provide bolt-on type breakers only. Construct with quick-break, quick-break mechanism with inverse-time delay and instantaneous trip protection for each pole. Provide breakers rated for ambient temperatures to suit respective applications. Provide mechanical screw type removable copper connector lugs of size to accommodate conductors specified.
2. Provide breakers that have interrupting ratings greater than or equal to the specified fault current. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

**PART 3 - EXECUTION****3.1 GENERAL:**

- A. Install overcurrent protective devices in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

**3.2 IDENTIFICATION:**

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.

END OF SECTION 16180

## SECTION 16452 – GROUNDING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B. This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to grounding.

## 1.2 DESCRIPTION OF WORK:

- A. Extent of grounding work is indicated by drawings and schedules and is specified herein.
- B. Ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, equipment, and separately derived systems in accordance with the NEC and all other applicable codes to provide a permanent, continuous, low impedance, grounding system.
- C. Provide grounding system such that the resistance from the service entrance ground bus, through the grounding electrode to earth is not greater than 5 ohms.

## 1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable.
- B. TESTING: Submit results of ground resistance testing as specified in this section. Include name of testing agency with report. Include test results in operation and maintenance manuals.

## PART 2 – PRODUCTS

## 2.1 GENERAL:

- A. Provide grounding equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system.

## 2.2 GROUNDING CONDUCTORS:

- A. Unless noted otherwise, provide grounding conductors with stranding and insulation types to match phase conductors. Provide conductors with green insulation if possible; otherwise wrap with green tape. Size ground conductors as indicated on drawings. Do not size ground conductors smaller than that allowable by NEC.

## 2.3 GROUND RODS:

- A. Provide copper clad, steel, 3/4" diameter by 10' long, ground rods ( Weaver, Cadweld, or equivalent).

## 2.4 INSULATED GROUNDING BUSHINGS:

- A. Provide plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners (OZ Gedney BLG or equivalent).

2.5 BONDING JUMPERS:

- A. Provide bonding jumpers with hot dip galvanized malleable or ductile iron clamps, hot dip galvanized steel U-bolts, and tinned copper braids (OZ Gedney BJ Series or equivalent).

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install grounding systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 CLEANING:

- A. Thoroughly clean all metal contact surfaces prior to installation of clamp-on connectors.

3.3 EQUIPMENT BONDING AND GROUNDING:

- A. Provide an NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:
  - 1. Non-metallic conduits and ducts.
  - 2. Device and lighting branch circuits.

3.4 ADDITIONAL GROUNDING INSTALLATION REQUIREMENTS:

- A. Provide grounding bushings on all service conduit and conduits installed in concentric/eccentric knock-outs or reducing washer at panelboards, cabinets, and gutters.
- B. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold water piping system. Connection to water piping system shall be made electrically continuous by connecting to the street side of the water main valve and/or installing additional bonding jumpers across the meter, valves or service unions that might be disconnected.

END OF SECTION 16452

## SECTION 16510 - EXTERIOR BUILDING LIGHTING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B. This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to interior and exterior building lighting.

## 1.2 DESCRIPTION OF WORK:

- A. Extent of exterior building lighting work is indicated by drawings and schedules and is specified herein.
- B. Type of lighting fixtures in this section include the following:
  - 1. High Intensity Discharge (HID)

## 1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 16001 - Electrical General Provisions as applicable. Provide fluorescent-lamp ballasts which comply with Certified Ballast Manufacturer's Association standards and carry the CBM label.
- B. SHOP DRAWINGS: Submit manufacturer's data on interior and exterior building lighting fixtures. Submit dimensioned drawings of all lighting fixtures. Identify light fixtures by type and submit in alphabetical order.

## PART 2 – PRODUCTS

## 2.1 GENERAL:

- A. Provide light fixtures of types as indicated on drawings or as approved by addenda. Provide light fixtures complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, wiring, etc. Provide all light fixtures with safety latches where applicable.
- B. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chains, or safety cables.
- C. Provide all exterior fixtures with damp or wet location labels as required by application.
- D. Provide all light fixtures and support accessories as required for a complete system.

## 2.2 HIGH INTENSITY DISCHARGE (HID) LIGHT FIXTURES:

- A. HID BALLASTS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
    - a. Advance Transformer
    - b. General Electric
    - c. Universal
  2. Ballasts: Provide electromagnetic, constant wattage, HID lamp ballasts for each type of HID fixture capable of operating lamps indicated. Provide high power factor (90% of greater) ballasts. Provide HID ballasts for each HID fixture with features in accordance with all manufacturer's written recommendations. Equip all exterior light fixtures with low temperature (-10 degree F.) starting ballasts. Comply with all manufacturer's written recommendations for all lamp-ballast combinations.
- B. HID LAMPS:
1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
    - a. General Electric
    - b. Phillips
    - c. Osram Sylvania
    - d. Venture
  2. Lamps: Provide HID lamps in types, wattages, and sizes as indicated on fixture schedule.

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Install exterior light fixtures in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 PROTECTION AND CLEANING:

- A. Protect installed and non-installed fixtures from damage during construction period.
- B. Thoroughly clean all exterior light fixtures. Do not mar or scar reflectors or diffusers. Repair all nicks and scratches to appearance of original finish. Remove protective plastic coverings on light fixtures at completion of project.

#### 3.3 WIRING METHODS:

- A. Grounding: Provide equipment grounding connections for each lighting fixture.

#### 3.4 COORDINATION:

- A. Refer to drawings for exact location and quantities of light fixtures. Where conflicts occur in the electrical drawings, or where fixtures types do not coordinate with landscaping, notify engineer prior to bid. After bid and award of contract, provide all light fixtures as required to meet the intent of the construction documents. Coordinate fixture layouts and installations with landscaping prior to submitting shop drawings and during construction.

#### 3.5 SPARE PARTS:

- A. LAMPS: Provide 15% spare lamps, but in no case less than one, of each type, wattage, and

size used for the project.

3.6 WARRANTY:

- A. LAMPS: Warranty HID lamps for a period of two months from substantial completion.
- B. ELECTRONIC BALLASTS: Warranty electronic ballasts for parts and labor for complete replacement for a period of five years. Warranty shall include an allowance for nominal replacement labor and replacement of defective product.

END OF SECTION 16510

## SECTION 16551 - EXTERIOR AREA LIGHTING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including Division-16 Specification Sections, apply to work of this section.
- B. This section is a Division 16 General Provisions section, and is part of each Division 16 section making reference to exterior area lighting.

## 1.2 DESCRIPTION OF WORK:

- A. Extent of exterior area lighting work is indicated by drawings and schedules and is specified herein.

## 1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 16001 - Electrical General Provisions and other sections as applicable.
- B. SHOP DRAWINGS: Submit manufacturer's data on exterior area lighting items including but not necessarily limited to poles, brackets, light fixtures, fuse, fuseblocks, etc. Submit dimensioned drawings of all pole and lighting fixtures. Include information with interior and exterior building lighting fixtures.

## PART 2 – PRODUCTS

## 2.1 GENERAL:

- A. Provide exterior lighting fixtures of types as indicated on drawings or as approved by addenda.

## 2.2 LIGHT FIXTURES:

- A. Refer to Section 16510 - Exterior Building Lighting for requirements for exterior light fixtures, lamps, ballasts, etc.

## 2.3 POLES:

- A. Provide poles and all accessories including but not necessarily limited to anchor bolts, templates for anchor bolt pattern, brackets, bolts, etc. Provide handhole and cover at base of each pole. Provide poles which have been primed and painted at the factory. Provide poles, anchor bolts, etc. in sizes as recommended by manufacturer to withstand windloadings.

## 2.4 CONCRETE BASES:

- A. Provide 3000 psi class concrete, forms, steel reinforcement, tie wires, etc. as required. See drawings for details.

## 2.5 GROUND RODS:

- A. See Section 16452 - Grounding for ground rod requirements.

2.6 FUSEHOLDER, FUSES, AND BREAK-A-WAY RECEPTACLES:

- A. Provide fuseholders with break-a-way receptacles equivalent to Bussmann Tron Waterproof Fuseholders and Break-A-Way Receptacles in the base for all phase conductors and materials. Neutral fuse holder will use a shorting fuse insert. Provide Bussmann KTK-R fuses in ratings to suit respective applications and sized in accordance with all manufacturer's recommendations.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install exterior area lighting in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 INSTALLATION METHODS:

- A. Set all poles plumb. Use belt slings or ropes to raise and set poles to protect finish. Repair nicks and scratches to match original surface.
- B. Locate fuseholder at handhole. Provide fuse blanks in all neutral conductors.
- C. Grounding: Provide one ground rod for each light pole. Connect ground rod to pole by means of an NEC-sized grounding conductor and all additional grounding as required.

3.3 CONCRETE BASES:

- A. Provide concrete bases for light poles in accordance with details on drawings. Grout and hand-rub all concrete to a uniform smooth finish.

3.4 SPARE PARTS:

- A. FUSES: Provide three spare fuses for each type and size used.

3.5 WIRING METHODS:

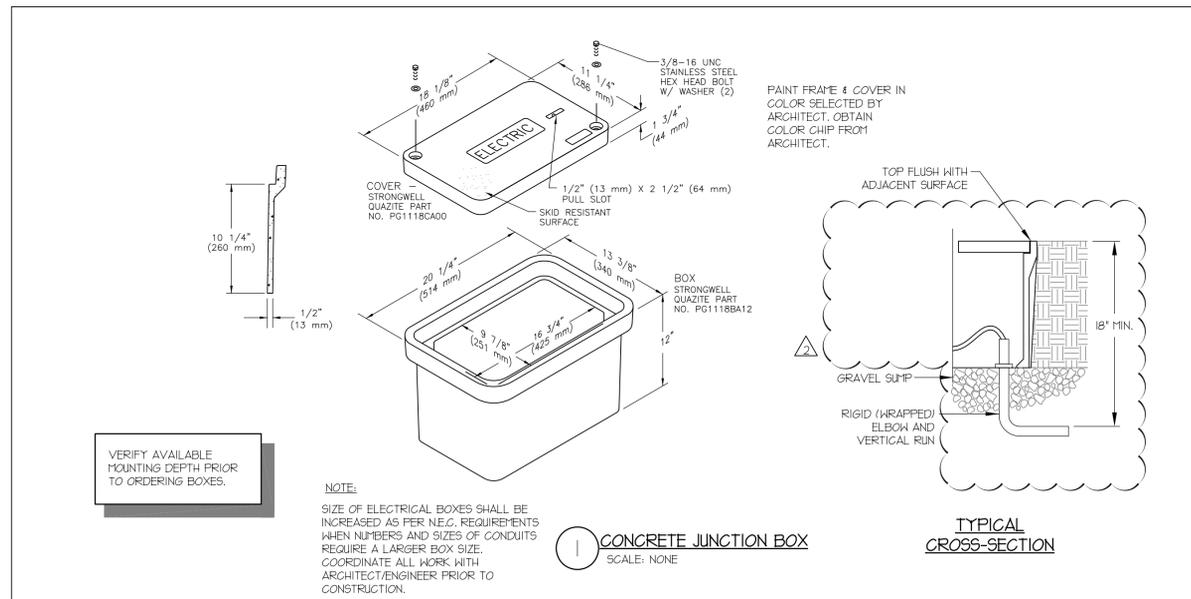
- A. No common neutral multi-wire circuits will be used to feed area lighting. Provide dedicated neutral wire for each circuit indicated.

END OF SECTION 16551

| WIRING DEVICE SYMBOLS |  |                     |   |
|-----------------------|--|---------------------|---|
| SYMBOL                | DESCRIPTION  | MOUNTING            | REMARKS   |
| Ⓢ                     | SINGLE-POLE TOGGLE SWITCH                            | +48"                |   |
| Ⓢ <sup>1</sup>        | SINGLE-POLE TOGGLE SWITCH                            | +48"                | SUBSCRIPT KEYS SWITCH TO FIXTURES CONTROLLED.   |
| Ⓢ <sub>2</sub>        | DOUBLE-POLE TOGGLE SWITCH                            | +48"                |   |
| Ⓢ <sub>3</sub>        | THREE-WAY TOGGLE SWITCH                              | +48"                |   |
| Ⓢ <sub>4</sub>        | FOUR-WAY TOGGLE SWITCH                               | +48"                |   |
| Ⓢ <sub>K</sub>        | KEY-OPERATED SINGLE-POLE TOGGLE SWITCH               | +48"                |   |
| Ⓢ <sub>P</sub>        | SINGLE-POLE TOGGLE SWITCH WITH PILOT LIGHT           | +48"                |   |
| Ⓢ <sub>DIM</sub>      | DIMMER SWITCH  | +48"                | RATE DIMMER SWITCH FOR MAXIMUM POSSIBLE WATTAGE   |
| Ⓢ <sub>TIM</sub>      | TIMER SWITCH   | +48"                |   |
| Ⓢ <sub>2</sub>        | (2) SINGLE-POLE TOGGLE SWITCH                        | +48"                | DUAL LEVEL SWITCH OUTBOARD LAMPS SEPARATELY FROM INBOARD LAMPS.   |
| Ⓢ <sub>LV</sub>       | LOW VOLTAGE MOMENTARY CONTACT SWITCH                 | +48"                |   |
| Ⓢ <sub>3PH</sub>      | 3-POSITION MOMENTARY CONTACT SWITCH                  | +48"                | REFER TO DETAIL UP-ON; CENTER-NEUTRAL; DOWN-OFF   |
| Ⓢ <sub>3PN</sub>      | 3-POSITION MAINTAINED CONTACT SWITCH                 | +48"                | UP-ON; CENTER-OFF; DOWN-ON  |
| Ⓢ <sub>OW</sub>       | OCCUPANCY SENSOR                                     | AS NOTED            | CEILING MOUNTED WITH SUBSCRIPT 'C'; WALL-MOUNTED WITH SUBSCRIPT 'W'   |
| Ⓢ <sub>SP</sub>       | SPLIT-WIRED DUPLEX RECEPTACLE                        | +18"                |   |
| Ⓢ <sub>S</sub>        | SIMPLEX RECEPTACLE                                   | +18"                |   |
| Ⓢ <sub>D</sub>        | DUPLEX RECEPTACLE                                    | +18"                |   |
| Ⓢ <sub>F</sub>        | FOURPLEX RECEPTACLE                                  | +18"                |   |
| Ⓢ <sub>125/250V</sub> | 125/250V RECEPTACLE                                  | +18"                | RANGE -- NEMA 14-50R DRYER -- NEMA 14-30R   |
| Ⓢ <sub>GFI</sub>      | GROUND FAULT CIRCUIT INTERRUPTER DUPLEX RECEPTACLE   | +18"                |   |
| Ⓢ <sub>GFI</sub>      | GROUND FAULT CIRCUIT INTERRUPTER FOURPLEX RECEPTACLE | +18"                |   |
| Ⓢ <sub>E</sub>        | EMERGENCY DUPLEX RECEPTACLE                          | +18"                |   |
| Ⓢ <sub>E</sub>        | EMERGENCY FOURPLEX RECEPTACLE                        | +18"                |   |
| Ⓢ <sub>4</sub>        | MULTI-OUTLET ASSEMBLY                                | 4" ABOVE BACKSPLASH |   |
| Ⓢ <sub>P</sub>        | POWER / TELEPHONE POLE                               | FLOOR/CEILING       |   |
| Ⓢ <sub>CD</sub>       | CORD DROP WITH DUPLEX RECEPTACLE                     | +18"                | REFER TO DETAIL   |
| Ⓢ <sub>SP</sub>       | SPECIAL PURPOSE OUTLET                               | +18"                | SUBSCRIPT IN PARENTHESIS INDICATES NEMA CONFIGURATION IF SHOWN. REFER TO DRAWINGS AND/OR EQUIPMENT SCHEDULES. CONFIRM EXACT CONFIGURATION WITH OWNER PRIOR TO INSTALLATION. |

| GEAR AND CONTROL SYMBOLS |  |                            |  |
|--------------------------|--|----------------------------|--|
| SYMBOL                   | DESCRIPTION  | MOUNTING                   | REMARKS  |
| Ⓢ                        | MANUAL STARTER WITH THERMAL OVERLOAD(S)                        | AT EQUIPMENT               |  |
| Ⓢ                        | ELECTRIC MOTOR   |                            |  |
| Ⓢ                        | NON-FUSED DISCONNECT SWITCH                                    | +60"                       |  |
| Ⓢ                        | FUSED DISCONNECT SWITCH  | +60"                       |  |
| Ⓢ                        | CIRCUIT BREAKER AND ENCLOSURE                                  | +60"                       |  |
| Ⓢ                        | MAGNETIC STARTER   | +60"                       |  |
| Ⓢ                        | COMBINATION MAGNETIC STARTER / NON-FUSED DISCONNECT            | +60"                       |  |
| Ⓢ                        | COMBINATION MAGNETIC STARTER / FUSED DISCONNECT                | +60"                       |  |
| Ⓢ                        | COMB. MAGNETIC STARTER / MOTOR CIRCUIT PROTECTOR (MCP)         | +60"                       |  |
| Ⓢ                        | COMB. VARIABLE FREQUENCY DRIVE / MOTOR CIRCUIT PROTECTOR (MCP) | FLOOR OR WALL AS SPECIFIED | TOP AT +12" IF WALL MOUNTED  |
| Ⓢ                        | REDUCED VOLTAGE STARTER  | FLOOR OR WALL AS SPECIFIED | TOP AT +12" IF WALL MOUNTED  |
| Ⓢ                        | LOAD CENTER (SURFACE-MOUNTED)                                  | TOP AT +12"                | 14"W X 3'D   |
| Ⓢ                        | LOAD CENTER (FLUSH-MOUNTED)                                    | TOP AT +12"                | 14"W X 3'D   |
| Ⓢ                        | LIGHTING AND APPLIANCE PANELBOARD (SURFACE-MOUNTED)            | TOP AT +12"                | 20"W X 6'D   |
| Ⓢ                        | LIGHTING AND APPLIANCE PANELBOARD (FLUSH-MOUNTED)              | TOP AT +12"                | 20"W X 6'D   |
| Ⓢ                        | POWER DISTRIBUTION PANELBOARD                                  | WALL                       | THESE SYMBOLS ARE GENERAL IN NATURE AND MAY VARY IN SIZE AND SHAPE TO SUIT APPLICATION. CROSS HATCHING INDICATES "MAIN PANELBOARD OR SWITCHBOARD" NAME IS INDICATED IN SEMI-QUOTES (I.E. "L2A", "MCP") |
| Ⓢ                        | SWITCHBOARD  | FLOOR                      |  |
| Ⓢ                        | METER BASE   | TOP AT +12"                |  |
| Ⓢ                        | OPEN - STOP - CLOSE SWITCH                                     | +60"                       | FURNISH SWITCH UNLESS FURNISHED BY ANOTHER DIVISION. INSTALL AND CONNECT COMPLETE. REFER TO RELATED SPECIFICATION SECTIONS.  |
| Ⓢ                        | HVAC THERMOSTAT  | +60"                       | PROVIDED BY DIVISION 5000 UNO.   |
| Ⓢ                        | HAND - OFF - AUTO SWITCH                                       | +60"                       |  |
| Ⓢ                        | GROUND FAULT PROTECTION  |                            |  |

| LIGHTING SYMBOLS  |   |                          |   |
|---|---|--------------------------|---|
| SYMBOL  | DESCRIPTION   | MOUNTING                 | REMARKS   |
| 1. LIGHT FIXTURE SYMBOLS ARE GENERAL IN NATURE AND MAY BE SHOWN ON THE DRAWINGS IN VARIOUS SIZES AND SHAPES. REFER TO THE LIGHT FIXTURE SCHEDULE FOR SPECIFICATION INFORMATION. |   |                          |   |
| 2. ARROWS INDICATE AIMING DIRECTION.  |   |                          |   |
| Ⓢ   | ARM-MOUNTED SINGLE-HEAD LIGHT FIXTURE AND POLE      | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | ARM-MOUNTED DOUBLE-HEAD LIGHT FIXTURE AND POLE      | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | POST-TOP SINGLE-HEAD, LIGHT FIXTURE AND POLE        | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | WALL-MOUNTED FIXTURE                                | AS SPECIFIED OR DETAILED | REFER TO ARCHITECTURAL EXTERIOR ELEVATIONS FOR MOUNTING HEIGHT                                      |
| Ⓢ   | LIGHT BOLLARD                                       | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | FLOOD LIGHT   | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | RECESSED WALL FIXTURE OR STEP LIGHT                 | AS SPECIFIED OR DETAILED | REFER TO ARCHITECTURAL EXTERIOR ELEVATIONS FOR MOUNTING HEIGHT                                      |
| Ⓢ   | FLUORESCENT LIGHT FIXTURES                          | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | PARABOLIC - LOUVERED LIGHT FIXTURES                 | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | RECESSED INDIRECT FLUORESCENT LIGHT FIXTURES        | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | WALL-MOUNTED LINEAR FLUORESCENT LIGHT FIXTURE       | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | FLUORESCENT LINEAR WALL WASHER                      | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | RECESSED DOWN LIGHT                                 | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | RECESSED WALL-WASHER OR DIRECTIONAL DOWNLIGHT       | AS SPECIFIED OR DETAILED | IF SHOWN, ARROW INDICATES AIMING DIRECTION  |
| Ⓢ   | SURFACE OR PENDANT-MOUNTED LIGHT FIXTURE            | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | WALL-MOUNTED LIGHT FIXTURE                          | AS SPECIFIED OR DETAILED | REFER TO ARCHITECTURAL EXTERIOR ELEVATIONS FOR MOUNTING HEIGHT                                      |
| Ⓢ   | TRACK OR MONO-POINT LIGHT FIXTURE                   | AS SPECIFIED OR DETAILED | IF SHOWN, ARROW INDICATES AIMING DIRECTION  |
| Ⓢ   | WALL SCENCE   | AS SPECIFIED OR DETAILED |   |
| Ⓢ   | FLUORESCENT EGRESS LIGHT FIXTURE                    | AS SPECIFIED OR DETAILED | THIS IS AN EXAMPLE OF AN EGRESS LIGHT FIXTURE. EGRESS LIGHT FIXTURES ARE HALF-SHADED DIAGONALLY.    |
| Ⓢ   | FLUORESCENT EMERGENCY (NON-EGRESS) LIGHT FIXTURE    | AS SPECIFIED OR DETAILED | THIS IS AN EXAMPLE OF AN EMERGENCY (NON-EGRESS) LIGHT FIXTURE. EMERGENCY FIXTURES ARE FULLY-SHADED. |
| Ⓢ   | CEILING MOUNTED EXIT SIGN                           | CEILING                  |   |
| Ⓢ   | WALL-MOUNTED EXIT SIGN                              | WALL ABOVE DOOR          | DARKENED PORTION OF SIGN INDICATES FACE(S); ARROW(S) INDICATE CHEVRON DIRECTION(S)                  |
| Ⓢ   | WALL-MOUNTED EXIT SIGN W/ EMERGENCY LIGHT FIXTURE   | WALL ABOVE DOOR          |   |
| Ⓢ   | TIME CLOCK  |                          |   |
| Ⓢ   | EMERGENCY LIGHT FIXTURE                             | AS NOTED                 |   |
| Ⓢ   | ELECTRIC PHOTOCELL                                  | N/A                      | MOUNT ON ROOF FACING NORTH SKY  |
| Ⓢ   | LIGHT FIXTURE CALLOUT (LETTER DENOTES FIXTURE TYPE) |                          |   |



| ELECTRICAL SYMBOL SCHEDULE GENERAL NOTES |  |  |
|--|--|--|
| 1.                                       | MOUNT ALL OUTLETS, DEVICES, AND EQUIPMENT AT HEIGHTS INDICATED BELOW, UNLESS NOTED OTHERWISE ON THE DRAWINGS. UNLESS NOTED OTHERWISE, HEIGHTS ARE GIVEN FROM FINISHED FLOOR TO CENTER OF OUTLET BOX.   |  |
| 2.                                       | WHERE OUTLETS, DEVICES, AND EQUIPMENT ARE NOTED BY SUBSCRIPTS, REFER TO ABBREVIATION SCHEDULE FOR DEFINED REQUIREMENTS.  |  |
| 3.                                       | WHERE OUTLETS, DEVICES AND EQUIPMENT ARE NOTED BY THE SUBSCRIPT 'A', MOUNT AT 4" ABOVE COUNTER. IF COUNTER HAS A BACK SPLASH, MOUNT AT 4" ABOVE BACK SPLASH. REFER TO ARCHITECTURAL INTERIOR ELEVATIONS AND COORDINATE WITH CASEWORK SUPPLIER. |  |
| 4.                                       | NOT ALL ELECTRICAL SYMBOLS MAY BE USED.  |  |

| GENERAL SYMBOLS |                           |  |
|-----------------|---------------------------|--|
| SYMBOL          | DESCRIPTION               | REMARKS  |
| (XX)            | KEYED NOTE                |  |
| 1<br>E-1        | DETAIL REFERENCE          | TOP NUMBER INDICATES DETAIL NUMBER; BOTTOM LETTER-NUMBER INDICATES DRAWING SHEET WHERE DETAIL IS SHOWN; WHERE NOT SPECIFICALLY REFERENCED, DETAIL IS GENERAL IN NATURE AND SHALL APPLY WHERE APPLICABLE. |
| 2<br>E-2        | ELEVATION REFERENCE       | TOP NUMBER INDICATES ELEVATION NUMBER; BOTTOM LETTER-NUMBER INDICATES WHERE ELEVATION IS SHOWN.  |
| 3<br>E-3        | SECTION REFERENCE         | TOP NUMBER INDICATES SECTION NUMBER; BOTTOM LETTER NUMBER INDICATES WHERE SECTION IS SHOWN.  |
| 100             | ARCHITECTURAL ROOM NUMBER |  |
| AHU<br>1        | EQUIPMENT NAME / NUMBER   | TOP NUMBER ABBREVIATES EQUIPMENT NAME OR TYPE; BOTTOM NUMBER INDICATES EQUIPMENT NUMBER. REFER TO EQUIPMENT SCHEDULE.  |
| ⚠               | REVISION NUMBER           | USED TO DENOTE CHANGES EITHER ISSUED BY ADDENDUM OR DURING CONSTRUCTION AND TO DENOTE RECORD DRAWING CHANGES.  |
| ⚡               | BREAKLINE                 | USED TO BREAK DRAWINGS.  |

| BRANCH CIRCUITING SYMBOLS |   |   |
|---------------------------|---|---|
| SYMBOL                    | DESCRIPTION   | REMARKS   |
| →                         | 1 CIRCUIT, 2 WIRE BRANCH CIRCUIT HOME RUN TO PANEL                        | ARROWS: NUMBER OF ARROWS INDICATES NUMBER OF CIRCUITS REQUIRED.   |
| →→                        | 2 CIRCUIT, 3 WIRE BRANCH CIRCUIT HOME RUN TO PANEL                        | SHORT CROSS LINES: NUMBER OF SHORT CROSS LINES INDICATES NUMBER OF PHASE, TRAVELER, AND/OR SWITCHED CONDUCTORS REQUIRED IF GREATER THAN 1 (ONE).                                    |
| →→→                       | 3 CIRCUIT, 4 WIRE BRANCH CIRCUIT HOME RUN TO PANEL                        | LONG CROSS LINES: NUMBER OF LONG CROSS LINES INDICATES NUMBER OF NEUTRAL CONDUCTORS REQUIRED FOR MULTI-WIRE HOME RUNS.  |
| →→→                       | MULTIPLE WIRE BRANCH CIRCUITING BETWEEN FIXTURES, SWITCHES, DEVICES, ETC. | EQUIPMENT GROUND AND ISOLATED GROUND CONDUCTORS; EQUIPMENT GROUND AND ISOLATED GROUND CONDUCTORS ARE NOT SHOWN, BUT ARE REQUIRED AS NOTED ON THE DRAWINGS OR IN THE SPECIFICATIONS. |
| →○                        | BRANCH CIRCUITING (UNO) TURNED UP OR TOWARDS OBSERVER.                    |   |
| →●                        | BRANCH CIRCUITING (UNO) TURNED DOWN OR AWAY FROM OBSERVER.                |   |
| →→                        | BRANCH CIRCUITING (UNO) CONTINUATION                                      |   |
| →→→                       | CONDUIT STUB-IN   | GAP AND MARK  |
| →→→                       | INCOMING SERVICE  |   |
| ⊙                         | JUNCTION BOX  | MOUNT AS NOTED. SUBSCRIPT 'F' INDICATES TO PROVIDE A FLOOR BOX WITH BLANK COVERPLATE  |

| ELECTRICAL SHEET INDEX |  |
|------------------------|--|
| EG001                  | SYMBOL SCHEDULE  |
| ES001                  | SITE PLAN  |
| ED001                  | DEMOLITION PLAN  |
| EL601                  | LIGHT FIXTURE SCHEDULE, DETAILS, PANEL BOARD SCHEDULES |

| ABBREVIATION SCHEDULE                    |                               |        |                                    |
|--|-------------------------------|--------|------------------------------------|
| NOTE: NOT ALL ABBREVIATIONS MAY BE USED. |                               |        |                                    |
| A  | ABOVE COUNTER                 | ISO    | ISOLATED                           |
| ADJ                                      | ADJACENT                      | KVA    | KILO VOLT AMPERES                  |
| AFF                                      | ABOVE FINISHED FLOOR          | KVA    | KILOVAHRS                          |
| AHJ                                      | AUTHORITY HAVING JURISDICTION | LFMC   | LIQUID-TIGHT METAL CONDUIT         |
| AL                                       | ALUMINUM                      | LFNC   | LIQUID-TIGHT NON-METAL CONDUIT     |
| C  | CONDUIT                       | MCA    | MINIMUM CIRCUIT AMP'S              |
| CB                                       | CIRCUIT BREAKER               | MLO    | MAIN LUGS ONLY                     |
| CKT                                      | CIRCUIT                       | N.C.   | NORMALLY CLOSED                    |
| C.O.S                                    | CONVENIENCE OUTLETS           | N.I.C. | NOT IN CONTRACT                    |
| CU                                       | COPPER                        | N.L.   | NIGHT LIGHT                        |
| EA                                       | EACH                          | N.O.   | NORMALLY OPEN                      |
| ELEC                                     | ELECTRICAL                    | O.C.   | ON CENTER(S)                       |
| EM                                       | EMERGENCY                     | OCP    | OVER CURRENT PROTECTION            |
| ENT                                      | ELECTRIC METALLIC TUBING      | QTY    | QUANTITY                           |
| EQUIP                                    | ELECTRIC NON-METALLIC TUBING  | R      | REMOVE                             |
| EW                                       | ELECTRIC WATER COOLER         | REQ.   | REQUIREMENTS                       |
| E, EX                                    | EXISTING                      | RMC    | RIGID METAL CONDUIT                |
| EXP                                      | EXPLOSION PROOF               | RNC    | RIGID NON-METALLIC CONDUIT         |
| FA                                       | FIRE ALARM                    | RR     | REMOVE AND RELOCATE                |
| FACP                                     | FIRE ALARM CONTROL PANEL      | SS     | SURGE SUPPRESSION                  |
| FLA                                      | FULL LOAD AMP'S               | SCP    | SECURITY CONTROL PANEL             |
| FMC                                      | FLEXIBLE METAL CONDUIT        | TR     | TAMPER RESISTANT                   |
| FOB                                      | FREIGHT ON BOARD              | TYP    | TYPICAL                            |
| GND                                      | GROUND CONDUCTOR              | TVSS   | TRANSIENT VOLTAGE SURGE SUPPRESSOR |
| HOA                                      | HAND-OFF-AUTO                 | UF     | UNDER FLOOR                        |
| HP                                       | HORSE POWER                   | UG     | UNDERGROUND                        |
| IG                                       | ISOLATED GROUND               | UNO.   | UNLESS NOTED OTHERWISE             |
| IMC                                      | INTERMEDIATE METAL CONDUIT    | W/     | WITH                               |
| INS                                      | INSULATED                     | W/P    | WEATHER PROOF                      |
|  |                               | XFR    | TRANSFORMER                        |

- GENERAL PROJECT NOTES:**
- DIVISION 16000 CONTRACTOR IS RESPONSIBLE FOR READING AND APPLYING WHAT IS IN THE SPECIFICATIONS TO THIS PROJECT. ANYTHING THAT IS NOT INCLUDED ON THE PROJECT THAT IS CALLED OUT IN THE SPECIFICATION SHALL BE LISTED ON THE SUBSTANTIAL COMPLETION PUNCHLIST. THE CONTRACTOR WILL BE REQUIRED TO REMEDY THESE DEFICIENCIES. THERE WILL BE NO EXCEPTIONS.
  - THE CONTRACTOR MAY SCHEDULE A PRE-CONSTRUCTION MEETING, AT THEIR DISCRETION WITH THE ELECTRICAL ENGINEER AND REVIEW THE DRAWINGS AND SPECIFICATIONS. THE MEETING SHALL BE A MAXIMUM OF ONE HOUR AND SHALL TAKE PLACE AT THE ENGINEER'S OFFICE.
  - THE FOLLOWING ITEMS ARE SOME OF THE REQUIREMENTS THAT ARE LISTED IN THE SPECIFICATIONS, THESE ITEMS DO NOT REPRESENT ALL ITEMS AND THE CONTRACTOR IS RESPONSIBLE FOR MEETING ALL REQUIREMENTS OF THE SPECIFICATIONS:
    - INSULATED THROAT CONNECTORS OR PLASTIC BUSHINGS SHALL BE UTILIZED FOR ALL CONDUIT SIZES USED ON THIS PROJECT.
    - A #10 AWG NEUTRAL CONDUCTOR WILL BE PROVIDED FOR ALL FLUORESCENT LIGHTING CIRCUITS.
    - THE CONTRACTOR IS RESPONSIBLE FOR UPSIZING CONDUCTORS FOR VOLTAGE DROP PER THE NEC REGARDLESS OF WHETHER IT IS SHOWN ON THE PLANS OR NOT.
    - THE CONTRACTOR SHALL LABEL ALL ELECTRICAL EQUIPMENT AS IT IS CALLED OUT IN THE SPECIFICATIONS.
    - THE CONTRACTOR SHALL PROVIDE SEISMIC SUPPORT AND BRACING FOR ALL ELECTRICAL EQUIPMENT AS REQUIRED BY LOCAL AND NATIONAL CODE.
  - THE CONTRACTOR SHALL FOLLOW THE PANELBOARD SCHEDULES AS INDICATED IN THE DRAWINGS. EACH CIRCUIT BREAKER HAS BEEN ASSIGNED A SPECIFIC AREA OF THE BUILDING. NO DEVIATION WILL BE ALLOWED WITHOUT THE APPROVAL FROM THE ELECTRICAL ENGINEER.
  - THE CONTRACTOR SHALL INSTALL PROPER WIRE SIZE AS CALLED OUT ON THE PANEL BOARD SCHEDULES. HOWEVER, THE CONTRACTOR IS RESPONSIBLE TO ENSURE THE WIRE IS LARGE ENOUGH FOR VOLTAGE DROP.
  - THE CONTRACTOR SHALL VERIFY ALL MECHANICAL OVERCURRENT DEVICES FOR THE ACTUAL MECHANICAL EQUIPMENT SUPPLIED ON THE JOB, PRIOR TO RELEASE OF ANY ELECTRICAL DISTRIBUTION EQUIPMENT. CONTACT THE ELECTRICAL ENGINEER WITH ANY DISCREPANCIES.
  - THE CONTRACTOR SHALL VISIT THE SITE BEFORE SUBMITTING THE BID, AND SHALL EXAMINE ALL PHYSICAL CONDITIONS WHICH MAY BE MATERIAL TO THE PERFORMANCE OF HIS WORK. NO EXTRA PAYMENTS WILL BE ALLOWED TO THE CONTRACTOR AS A RESULT OF EXTRA WORK MADE NECESSARY BY HIS FAILURE TO DO SO. ANY CASE OF DISCREPANCY OR LACK OF CLARITY SHALL BE PROMPTLY IDENTIFIED TO THE OWNER'S REPRESENTATIVE AND THE ENGINEER FOR CLARIFICATION.
  - THE CONTRACTOR SHALL MAKE SURE THAT ALL BRANCH CIRCUITS THAT ARE AFFECTED BY THIS PROJECT ARE NOT OVERLOADED. PROVIDE ADDITIONAL BRANCH CIRCUITS FROM ELECTRICAL PANELS AS NECESSARY TO COMPLY WITH THE BRANCH CIRCUIT LOADING REQUIREMENTS. PROVIDE ALL MATERIAL AND LABOR AS NECESSARY FOR A COMPLETE OPERATING SYSTEM.
  - PROVIDE UPDATED, TYPED PANELBOARD SCHEDULE(S) TO REFLECT ALL THE CHANGES MADE INCLUDING EXISTING LOADS. THE EXISTING LOADS SHALL BE NAMED THE SAME AS LISTED ON THE EXISTING PANELBOARD SCHEDULE.



| DATE     | REVISIONS  | NO. |
|----------|------------|-----|
| 10-15-08 | REVISIONS  | 1   |
| 10-28-08 | REVISIONS  | 2   |
|          | APPENDIX 2 |     |

UTAH VALLEY UNIVERSITY  
SITE LIGHTING UPGRADE

DRAWN BY BET  
DESIGNED BY DMN  
CHECKED BY RYV

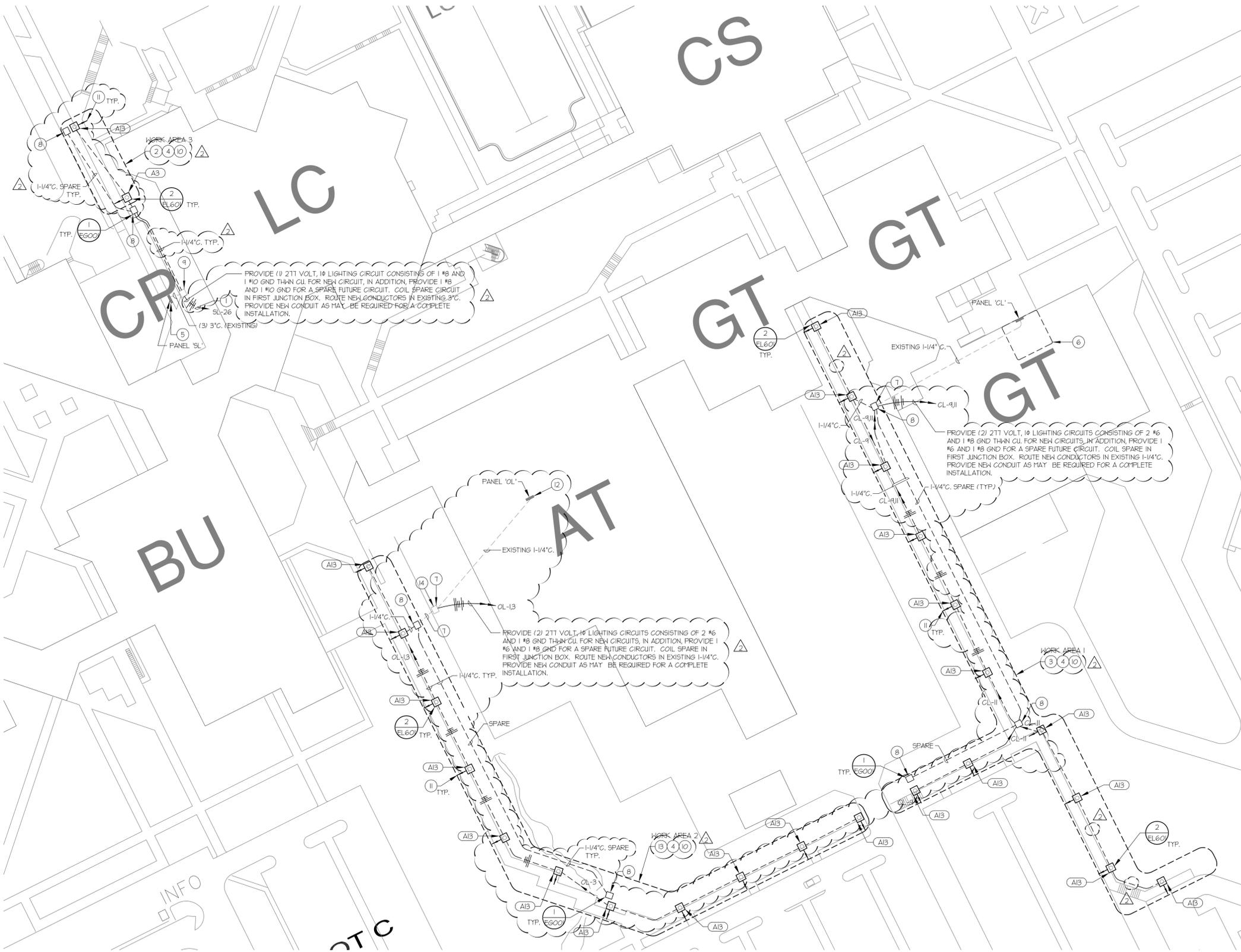
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PROJECT 2008-117

SHEET

EG001

LEGEND / SCHEDULES



**GENERAL NOTES:**

- CONTRACTOR TO PROVIDE CONNECTION OF ALL NEW POLE MOUNTED FIXTURE THROUGH ENERGY MANAGEMENT SYSTEM FOR CONTROL & PROGRAMMING OF ON-OFF TIMES. CONFIRM PROGRAMMING WITH OWNER.

**KEYED NOTES:**

- CIRCUIT SHALL BE ROUTED THROUGH THE EXISTING JUNCTION BOX AND ONE OF THE 3" CONDUITS TO PANEL 'SL' MAY BE USED.
- PROVIDE NEW CONDUIT, WIRE, J-BOXES & CONNECTION OF NEW POLE MOUNTED FIXTURES IN WORK AREA 3. PROVIDE NEW BREAKERS TO MATCH EXISTING WITH EQUIVALENT AIC RATING IN PANEL 'SL' IN BUILDING CP (CENTRAL PLANT), AS VERIFIED PRIOR TO REMOVAL OF EXISTING POLE MOUNTED FIXTURES. REFER TO LIGHTING FIXTURE SCHEDULE, SHEET EL601 FOR ADDITIONAL REQUIREMENTS.
- PROVIDE NEW CONDUIT, WIRE, J-BOXES & CONNECTION OF NEW POLE MOUNTED FIXTURES IN WORK AREA 1. PROVIDE NEW BREAKERS TO MATCH EXISTING WITH EQUIVALENT AIC RATING IN PANEL 'CL' ON 5TH FLOOR OF BUILDING GT (GÜNTHER TRADES), AS VERIFIED PRIOR TO REMOVAL OF EXISTING POLE MOUNTED FIXTURES. REFER TO LIGHTING FIXTURE SCHEDULE, SHEET EL601 FOR ADDITIONAL REQUIREMENTS.
- CONTRACTOR SHALL VISIT THE SITE PRIOR TO BIDDING AND VERIFY THE POLE HEIGHT TO AVOID ANY CONFLICT WITH THE EXISTING TREES.
- APPROXIMATE LOCATION OF PANEL 'SL'.
- APPROXIMATE LOCATION OF PANEL 'CL' IN ELECTRICAL ROOM.
- CONTRACTOR SHALL INTERCEPT EXISTING CONDUIT FOUND DURING DEMOLITION AND PROVIDE NEW CONDUITS AS REQUIRED FOR NEW CIRCUITS. EXISTING 1/4" CONDUIT MAY BE USED IF IN SATISFACTORY CONDITION FOR CIRCUIT ROUTING IN TO PANEL 'CL' AND 'OL'.
- PROVIDE AN NEC SIZED IN-GRADE JUNCTION BOX APPROXIMATE LOCATIONS SHOWN.
- EXISTING IN-GRADE JUNCTION BOX WITH (3) 3/4" TO THE ELECTRICAL ROOM WITH PANEL 'SL'. APPROXIMATE LOCATION SHOWN.
- A LANDSCAPING CONTRACTOR SHALL BE HIRED UNDER THIS CONTRACT TO REPAIR ALL LANDSCAPING AND SPRINKLER SYSTEMS AFFECTED BY THIS PROJECT TO LIKE NEW CONDITIONS. SIDEWALKS AND PAVERS SHALL ALSO BE REPLACED AS REQUIRED. CONFIRM ALL LANDSCAPING REQUIREMENTS WITH OWNER.
- ARROW INDICATES AIMING DIRECTION OF LIGHT FIXTURE.
- APPROXIMATE LOCATION OF PANEL 'OL'.
- PROVIDE NEW CONDUIT, WIRE, J-BOXES & CONNECTION OF NEW POLE MOUNTED FIXTURES IN WORK AREA 2. PROVIDE NEW BREAKERS TO MATCH EXISTING WITH EQUIVALENT AIC RATING IN PANEL 'OL' IN BUILDING AT (AUTOMOTIVE TRADES BUILDING) IN THE AUTOBODY REPAIR AREA, AS VERIFIED PRIOR TO REMOVAL OF EXISTING POLE MOUNTED FIXTURES. REFER TO LIGHTING FIXTURE SCHEDULE, SHEET EL601 FOR ADDITIONAL REQUIREMENTS.
- EXISTING VERTICAL JUNCTION BOX IN CONCRETE SLAB TO BE REUSED. APPROXIMATE LOCATION SHOWN. CONTRACTOR TO UTILIZE EXISTING CONDUIT THAT HAS PREVIOUSLY FEEDING THE HALKMAT LIGHTS IF THE CONDUIT IS 3/4" OR LARGER. IF THE CONDUIT IS 3/4" OR SMALLER THE CONTRACTOR IS TO PROVIDE A NEW 1/4" INTO THE EXISTING JUNCTION BOX AND PROVIDE A NEMA 3R ENCLOSURE OR EXTENSION AS REQUIRED TO COMPLETELY ENCLOSE THE JUNCTION BOX AND CONDUIT AND PROTECT IT FROM THE ELEMENTS.

**BUILDING ABBREVIATION SCHEDULE**

- LC LEARNING RESOURCE CENTER
- BU BUSINESS BUILDING
- CS COMPUTER SCIENCE & ENGINEERING
- AT AUTOMOTIVE TRADES BUILDING
- GT GÜNTHER TRADES BUILDING
- CP CENTRAL PLANT



| NO. | REVISIONS  | DATE     |
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| 1   | REVISED    | 10-15-08 |
| 2   | APPENDIX 2 | 10-28-08 |

UTAH VALLEY UNIVERSITY  
SITE LIGHTING UPGRADE

**ELECTRICAL  
SITE LIGHTING**

DRAWN BY BET  
DESIGNED DMN  
CHECKED RYV

DATE 10/06/08  
FILENAME ES101.DWG

PROJECT  
**2008-117**

SHEET  
**ES101**



**KEYED NOTES:**

- 1 DISCONNECT AND COMPLETELY REMOVE EXISTING CONDUIT, WIRE, POLEBASES, POLES & LIGHT FIXTURES IN AREAS 1, 2 & 3.
- 2 RETURN EXISTING POLES & LIGHT FIXTURES TO OWNER AFTER BEING REMOVED.
- 3 FIELD VERIFY EXACT LOCATION OF PULL BOXES, HANDHOLES, UTILITY VAULTS, SPRINKLER BOXES, UNDERGROUND CONDUITS & UNDERGROUND PIPING PRIOR TO TRENCHING. CONTRACTOR TO REPAIR OR REPLACE DAMAGED ITEMS IF DAMAGE HAPPEN DURING TRENCHING.
- 4 FIELD VERIFY THE EXISTING CIRCUITS PRIOR TO BID. CIRCUITS SHOWN ARE FROM RECORD DRAWINGS AND ARE SHOWN FOR REFERENCE.
- 5 APPROXIMATE LOCATION OF PANEL 'OL'.
- 6 APPROXIMATE LOCATION OF PANEL 'SL'.
- 7 APPROXIMATE LOCATION OF PANEL 'CL' IN ELECTRICAL ROOM.
- 8 COMPLETELY REMOVE EXISTING CONDUCTORS. APPROXIMATE LOCATION OF EXISTING CONDUITS FROM PANEL 'CL' AND 'OL'. CONTRACTOR TO FIELD VERIFY EXACT LOCATION.
- 9 EXISTING IN-GRADE JUNCTION BOX WITH CONDUITS TO PANEL 'SL'.
- 10 EXISTING VERTICAL JUNCTION BOX IN CONCRETE SLAB. APPROXIMATE LOCATION SHOWN.

**GENERAL DEMOLITION NOTES:**

1. UNLESS SPECIFICALLY NOTED OTHERWISE, REMOVE ALL ELECTRICAL ITEMS SHOWN IN DARK & DASHED LINES. ITEMS SHOWN IN LIGHT & SOLID LINES ARE TO REMAIN. DEMOLITION ITEMS ARE SHOWN TO GIVE A BASIC DESCRIPTION OF THE EXTENT OF DEMOLITION WORK, BUT MAY NOT BE INCLUSIVE. PROVIDE DEMOLITION WORK IN ACCORDANCE WITH THE FOLLOWING REQUIREMENTS:
  - A. DISCONNECT AND REMOVE ANY/ALL FIXTURES, DEVICES, EQUIPMENT, ETC. REQUIRED FOR PROPER COMPLETION OF THE WORK WHETHER SHOWN OR NOT.
  - B. RELOCATE, REWIRE, AND/OR RECONNECT ANY/ALL FIXTURES, DEVICES, EQUIPMENT, ETC. THAT FOR ANY REASON OBSTRUCTS CONSTRUCTION.
  - C. LEAVE ALL EXISTING FIXTURES, DEVICES, EQUIPMENT, ETC. IN PORTIONS OF THE SITE NOT BEING REMODELED, IN WORKING CONDITION. RESTORE ALL INTERRUPTED BRANCH CIRCUITS, FEEDERS, ETC.
  - D. REMOVE AND DISPOSE OF ALL RACEWAYS, CONDUCTORS, BOXES, DEVICES, EQUIPMENT, ETC. THAT ARE NOT TO BE REUSED.
  - E. EXISTING RACEWAYS MAY BE REUSED, IF IN PLACE, WHERE POSSIBLE, AND WHERE IN COMPLIANCE WITH THE SPECIFICATIONS AND THE INTENT OF THE CONTRACT DOCUMENTS. UPGRADE AND OR PROVIDE NEW CONDUIT SUPPORTS WHERE NECESSARY FOR ALL RACEWAYS BEING REUSED. INSURE INTEGRITY OF EXISTING RACEWAYS BEFORE REUSE.
  - F. DO NOT PENETRATE STRUCTURAL ELEMENTS OF FLOORS, WALLS, CEILINGS, ROOFS, ETC.
  - G. COORDINATE WITH OWNER WHAT EQUIPMENT SHOULD BE DISPOSED OF AND WHAT EQUIPMENT IS TO BE RETURNED TO OWNER.

**BUILDING ABBREVIATION SCHEDULE**

- LC LEARNING RESOURCE CENTER
- BU BUSINESS BUILDING
- CS COMPUTER SCIENCE & ENGINEERING
- AT AUTOMOTIVE TRADES BUILDING
- GT GUNTHER TRADES BUILDING
- CP CENTRAL PLANT



| NO. | REVISIONS | DATE     |
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**ELECTRICAL SITE DEMOLITION PLAN**  
SCALE: 1" = 60'-0"

UTAH VALLEY UNIVERSITY  
SITE LIGHTING UPGRADE  
ELECTRICAL  
SITE DEMOLITION

|             |           |
|-------------|-----------|
| DRAWN BY    | BET       |
| DESIGNED BY | DMN       |
| CHECKED BY  | RYV       |
| DATE        | 10/26/08  |
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