

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

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SANTA BARBARA • SANTA CRUZ

OFFICE OF DESIGN & CONSTRUCTION SERVICES and PHYSICAL FACILITIES

CONTRACTING SERVICES

Building 439

Santa Barbara, California 93106-1030

Telephone (805) 893-3356

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SENT VIA: ☐ FAX ON THIS DATE
☐ HAND DELIVERY ON THIS DATE
☒ FEDERAL EXPRESS ON THIS DATE
☐ UNITED PARCEL SERVICE ON THIS DATE

HOLDERS OF PLANS AND SPECIFICATIONS:

Bio 2 and Phelps Hall Fan Replacement

Project No. FM080391L/107-18

Addendum No. One

September 16, 2008

Enclosed is **ADDENDUM NO. 1** to the Construction Documents on the above-captioned project.

Bid date is Wednesday, October 1, 2008 at 2:30PM to be held at:

CONTRACTING SERVICES
Facilities Management, Bldg. 439,
Door #E, Reception Counter
University of California, Santa Barbara
Santa Barbara, CA 93106-1030.

Late arrivals shall be disqualified. Please allow time for unforeseen traffic delays, securing a parking permit and potential parking problems.

A handwritten signature in black ink, appearing to read 'Anna Galanis'.

Anna Galanis
Director, Contracting Services

ADDENDUM NUMBER ONE

to the

Construction Documents

September 16, 2008

GENERAL

The following changes, additions or deletions shall be made to the following document(s) as Indicated; all other conditions shall remain the same.

I. PROJECT DIRECTORY

Item No.

1. **Replace** in it's entirety with Attached "Revised Project Directory" Revised per Addendum One, 2 pages.

II SUPPLEMENTARY CONDITIONS

Item No.

1. **Replace** in it's entirety with Attached "Revised Supplementary Conditions" Revised per Addendum One, 3 pages.

III SPECIFICATIONS

Item No.

1. **Replace** in it's entirety with Attached "Revised Table of Contents" Revised per Addendum One, 2 pages.

Item No.

2. Section 01010 – “Summary of Work”, Part 1, “General”, Section 1.01, “Work Required by Contract Documents”, “A”, End of Last Paragraph, **Add** the following sentence:

“At Bio 2, supply fan S1 and S2 shall have their work complete and fans operational by Wednesday, December 10, 2008.”

Item No.

3. Section 16000, “Electrical”: **Replace** in it’s entirety with Attached “Section 16000, “Revised Electrical” Revised per Addendum One, 3 pages.

Item No.

4. Section 16010, “Basic Electrical Requirements”: **Add** in it’s entirety attached “Section 16010, Basic Electrical Requirements, 4 pages.”

Item No.

5. Section 16110, “Raceways”: **Add** in it’s entirety attached “Section 16110, Raceways, 5 pages.”

Item No.

6. Section 16115, “Cable Tray”: **Add** in it’s entirety attached “Section 16115, Cable Tray, 2 pages.”

Item No.

7. Section 16120, “Wires and Cable”: **Add** in it’s entirety attached “Section 16120, Wires and Cable, 4 pages.”

Item No.

8. Section 16135, “Electrical Boxes and Fittings”: **Add** in it’s entirety attached “Section 16135, Electrical Boxes and Fittings, 4 pages.”

Item No.

9. Section 16143, "Wiring Devices": **Add** in it's entirety attached "Section 16143, Wiring Devices, 4 pages."

Item No.

10. Section 16170, "Circuit and Motor Disconnects": **Add** in it's entirety attached "Section 16170, Circuit and Motor Disconnects, 3 pages."

Item No.

11. Section 16452, "Grounding": **Add** in it's entirety attached "Section 16452, Grounding, 2 pages."

Item No.

12. Section 16470, "Circuit Breakers": **Add** in it's entirety attached "Section 16470, Circuit Breakers, 3 pages."

Item No.

13. Section 16475, "Panels": **Add** in it's entirety attached "Section 16475, Panels, 4 pages."

IV LIST OF DRAWINGS

Item No.

1. **Replace** in it's entirety with Attached "Revised List of Drawings" Revised per Addendum One, 1 page.

V DRAWINGS

Item No.

1. **Add** Drawing E1.0, Notes, Symbols, One Line Diagrams, dated 8/21/2008, Attached.

Item No.

2. **Add** Drawing E2.0, Partial Basement Electrical Floor Plans, dated 8/21/2008, Attached.

Item No.

3. **Add** Drawing E3.0, Partial Penthouse Electrical Floor Plans, dated 8/21/2008, Attached.

Item No.

4. **Add** Drawing E4.0, Phelps Hall Electrical Floor Plans, dated 8/21/2008, Attached.

END OF ADDENDUM NO. ONE

REVISED PROJECT DIRECTORY

Project Name: Bio 2 and Phelps Hall Fan Replacement

Project Number: FM080391L/107-18

Location: Bio 2 and Phelps Hall, Building Number 571 and 560

University: The Regents of the University of California

University's
Representative: Vic Waytek, The Palt Company
3130 Skyway Drive, #408
Santa Maria, CA 93455
Telephone: 805/739-1669 FAX: 805/739-1673

ALL BIDDING INQUIRIES SHALL BE DIRECTED ONLY TO UNIVERSITY REPRESENTATIVE

University's
Project Manager: Mark Peppers
University of California, Santa Barbara
Facilities Management, Building 439
Santa Barbara, CA 93106-1030
Telephone: (805) 893-2661 x 1005 FAX: (805) 893-4493

University's Director
Contracting Services: Anna Galanis
University of California, Santa Barbara
Facilities Management, Building 439
Santa Barbara, CA 93106-1030
Telephone: (805) 893-3298 FAX: (805) 893-8592

University's Representative's:
Consultants: The Palt Company
3130 Skyway Drive, #408
Santa Maria, CA 93455
Telephone: 805/739-1669
Fax: 805/739-1673

Address for Stop Notices: Lynn Tran
University of California, Santa Barbara
Student Affairs & Administrative Services Bldg. 568, Room 3201
Accounting Department
Santa Barbara, California 93106

Address for Demand
for Arbitration: Western Case Management Center
6795 N. Palm Avenue, 2nd Floor
Fresno, California 93704

A copy of the Demand for Arbitration must be sent to:

Chair, Construction Review Board
University of California
Office of the General Counsel
1111 Franklin Street, 8th Floor
Oakland, CA 94607-5200

REVISED SUPPLEMENTARY CONDITIONS

1. 2.1 "INFORMATION AND SERVICES PROVIDED BY UNIVERSITY," revise paragraph 2.1.3 to read as follows:

"Contractor will be furnished, free of charge, 4 copies of the Contract Documents for execution of the Work."
2. 3.8 "SUPERINTENDENT," revise paragraph 3.8.4 to read as follows:

The Superintendent may perform the Work of any trade, pick-up materials, or perform any Work not directly related to the supervision and coordination of the Work at the Project site when Work is in progress.
3. 7.3 "CHANGE ORDER PROCEDURES" revise 2nd sentence of paragraph 7.3.2.7 to read as follows:

"Such rental charges shall be at rates, as approved by University Representative, not exceeding competitive rates obtainable from unrelated third parties in the area in which the Work is performed."
4. 7.3 "CHANGE ORDER PROCEDURES" revise paragraph 7.3.9.2.1 to read as follows:

"1 An error or omission in the Contract Documents which does not result in any Extra Work for which Contractor is compensated pursuant to Subparagraph 7.3.5; or . . ."
5. 7.3 "CHANGE ORDER PROCEDURES" revise paragraph 7.3.9.2.2 to read as follows:

"2 University's decision to change the scope of the Work, where such decision is not the result of any default or misconduct of Contractor, and where the change in the scope of the Work does not result in any Extra Work for which Contractor is compensated pursuant to Subparagraph 7.3.5; or . . ."
6. 8.3 "DELAY" add paragraph 8.3.2 to read as follows:

"8.3.2 Unscheduled Power Outages:

 - a. The University may be subject to power outages during the performance of the contract. The Contractor should plan its schedule accordingly and take such other steps as it deems necessary to provide temporary power should outages occur. Any plan to provide temporary power shall be coordinated with and approved, in advance, by the University's Representative.
 - b. The Contractor agrees to bear the risk of any delays to the completion of the Work, or increase costs, attributable to such power outages."

7. MODIFICATION OF ARTICLE 8 – CONTRACT TIME

Rainy weather in excess of the following number of days will be granted a Contract Time extension pursuant to Article 8.4 of the General Conditions:

Five (5) Days –

8. 8.4 "ADJUSTMENT OF THE CONTRACT TIME FOR DELAY", add the following to 8.4.1.6.9

- .3 the Contractor must have employed all reasonable rain mitigation measures to enable the Work to continue on the day; and
- .4 all other conditions of Article 8 must be met.

9. 8.5 "COMPENSATION FOR DELAY" add paragraph 8.5.3 to read as follows:

"8.5.3 Contractor shall not be entitled to receive any compensation for delay for Contract Time extensions resulting from Extra Work. Where Contract Time extensions result from or are granted in change orders which authorize Extra Work, payment by University to Contractor in consideration of any such Extra Work, payment by University to Contractor in consideration of any such Extra Work, pursuant to Subparagraph 7.3.5, shall constitute compensation in full for delay, interruption or disruption resulting from or arising out of any such Extra Work."

10. 8.5 "COMPENSATION FOR DELAY" add paragraph 8.5.4 to read as follows:

"8.5.4 Compensation Delay damages, if any, will be paid to Contractor by University as part of the final payment."

11. MODIFICATION OF GENERAL CONDITIONS, ARTICLE 11 – INSURANCE AND BONDS

Contractor shall furnish and maintain insurance in the amounts below.

The insurance required by 11.1.2.1 and 11.1.2.2 shall be (i) issued by companies with a Best rating of A- or better, and a financial classification of VIII or better (or an equivalent rating by Standard & Poor or Moody's) or (ii) guaranteed, under terms consented to by the University (such consent to not be unreasonably withheld), by companies with a Best rating of A- or better, and a financial classification of VIII or better (or an equivalent rating by Standard & Poor or Moody's). Such insurance shall be written for not less than the following:

Minimum Requirement

11.1.2.1 Commercial Form General Liability
Insurance-Limits of Liability

Each Occurrence-Combined Single Limit for Bodily Injury and Property	<u>\$1,000,000.00</u>
Products-Completed Operations Aggregate	<u>\$1,000,000.00</u>
Personal and Advertising Injury	<u>\$1,000,000.00</u>
General Aggregate	<u>\$2,000,000.00</u>

11.1.2.2 Business Automobile Liability Insurance-
Limits of Liability

Each Accident-Combined Single Limit for Bodily Injury and Property Damage	<u>\$1,000,000.00</u>
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Insurance required by Paragraph 11.1.2.3 shall be issued by companies (i) that have a Best rating of B+ or better, and a financial classification of VIII or better (or an equivalent rating by Standard & Poor or Moody's); or (ii) that are acceptable to the University. Such insurance shall be written for not less than the following:

11.1.2.3 WORKER'S COMPENSATION AND EMPLOYER'S LIABILITY –
(as required by Federal and State of California law).

REVISED TABLE OF CONTENTS
REVISED PER ADDENDUM ONE

PAGE No.

DIVISION 1 -	GENERAL REQUIREMENTS	
Section -01010	Summary of Work -----	1-2
01012	Information & Procedures Instructions (RFI) -----	1-2
01014	Contractor's Use of the Project Site -----	1-2
01051	Project Coordination -----	1-1
01070	Cutting & Patching -----	1-2
01080	Regulatory Requirements -----	1-3
01090	Abbreviations, Symbols, Definition -----	1-1
01200	Project Meetings -----	1-2
01300	Submittals -----	1-3
01310	Contract Schedules -----	1-4
01340	Shop Drawings, Product Data and Samples -----	1-5
01400	Quality Control -----	1-3
01500	Construction Facilities and Temporary Controls -----	1-1
01565	Hazardous Materials Procedures -----	1-1
01600	Material and Equipment -----	1-2
01620	Anchors and Fasteners -----	1-3
01640	Product Options and Substitutions -----	1-3
01700	Project Closeout -----	1-1
01710	Cleanup & Disposal -----	1-2
01720	Contractor's As-Built Documents -----	1-2
01740	Guarantees, Warranties, Bonds, Service, & Maintenance Contracts -----	1-4
DIVISION 2 -	SITEWORK	
Section -02223	Selective Demolition -----	1-5
DIVISION 3 -	CONCRETE	
Section - 03300	Cast in Place Concrete -----	1-18
DIVISION 4 -	NOT USED	
DIVISION 5 -	NOT USED	
DIVISION 6 -	NOT USED	
DIVISION 7 -	NOT USED	
DIVISION 8 -	NOT USED	
DIVISION 9 -	FINISHES	
Section - 09110	Non load Bearing Metal Framing Systems -----	1-5
Section - 09250	Gypsum Board -----	1-8
Section - 09900	Painting -----	1-11

DIVISION 10 -	SPECIALTIES	
Section - 10200	Louvers and Vents-----	1-3
DIVISION 11 -	NOT USED	
DIVISION 12 -	NOT USED	
DIVISION 13 -	NOT USED	
DIVISION 14 -	NOT USED	
DIVISION 15 -	MECHANICAL	
Section -15010	Basic Mechanical Requirements -----	1-15
Section -15171	Variable Frequency Drives -----	1-8
Section -15245	Vibrational Isolation -----	1-4
Section -15870	Air Filters -----	1-3
DIVISION 16 -	ELECTRICAL	
Section -16000	Electrical -----	1-3
Section -16010	Basic Electrical Requirements-----	1-4
Section -16110	Raceways-----	1-5
Section -16115	Cable Tray-----	1-2
Section -16120	Wires and Cable-----	1-4
Section -16135	Electrical Boxes and Fittings-----	1-4
Section -16143	Wiring Devices-----	1-4
Section -16170	Circuit and Motor Disconnects-----	1-3
Section -16452	Grounding-----	1-2
Section -16470	Circuit Breakers-----	1-3
Section -16475	Panels-----	1-4

SECTION 16000

REVISED ELECTRICAL

PART 1 - GENERAL REQUIREMENTS

1.01 CONTRACT DOCUMENTS

- A. The General Provisions of the contract documents shall apply to and form a part of the Specifications for this work.

1.02 SITE VISITS, COORDINATION OF CONTRACT DOCUMENTS, VERIFICATION OF DIMENSIONS

- A. Examine existing conditions as applicable. Become acquainted with specifications and drawings for all portions of the project. Notify University Representative of apparent discrepancies (before bidding, if possible) between specifications and drawings; for inconsistency between the specifications and the existing conditions, secure and follow University Representative's instructions. The drawings serve as working drawings only, indicating diagrammatically the general layout of the systems and their various components and equipment.
- B. No allowance will be made for extra expense due to failure or neglect to follow foregoing directives.

1.03 RULES AND REGULATIONS

- A. Materials and installation shall be in accordance with current rules and requirements of California Code of Regulation and local codes and ordinances including the current California Electric Code.
- B. Where these specifications call for a higher standard than the above mentioned rules, the specifications shall govern.
- C. Should there be direct conflict between the above mentioned rules and these specifications, the rules shall govern.
- D. Nothing in these plans or specifications is to be construed to permit work not conforming to Code.

1.04 SIMILARITY OF MATERIALS

- A. Unless specified otherwise, fixtures, fittings, hangers, and respective type features and equipment, of a similar type or having similar operative or functional features, shall be of the same manufacture throughout the project.

1.05 MANUFACTURERS' DIRECTIONS

- A. Follow manufacturers' directions and recommendations in all cases where the manufacturer furnishes directions.

1.06 MARKING

- A. In general (and except where modified by details or elsewhere herein) before requesting the University Representative to make final inspections, identify switches, controls, pull boxes, and other equipment by means of neat, approved labels, decals, brass tags, engraved bakelite or metal strips, neatly painted signs, or by other approved means. Plastic tape is acceptable for outlet designations only.

1.07 CLOSING IN OF UNREVIEWED WORK

- A. Do not allow or cause any of this work to be covered up or enclosed until it has been reviewed by the University Representative. Should any of this work be enclosed or covered up before such review, uncover the work and make repairs with such materials as may be necessary to restore the work and that of the other trades to its original and proper condition at no additional cost to the University.

1.08 SAFETY PRECAUTIONS

- A. It is intended that within the scope of this work during construction and until final acceptance, strict attention be given to matters pertaining to public safety and to safety of the construction workers and complementing personnel.

1.09 PROTECTION OF EXISTING UTILITIES

- A. Protect existing utility lines where they occur during construction. If such lines are damaged and are still in use and not abandoned, make suitable repairs in a manner meeting University Representative's approval and at no additional cost to the University. Exact locations of existing utilities must be determined by the Contractor.

1.10 AS-BUILTS

- A. Include under this work complete and accurate "as-built" information both during construction and before final acceptance by the University Representative, and costs associated therewith shall be included under this work.

1.11 SUBMITTALS - SUBSTITUTIONS

- A. Bids shall be based on plans and specifications and references exactly as shown - no deviations or substitutions - in order to obtain comparable base bids.
- B. In accordance with Division 1, submit in one package complete systematized lists of equipment and drawings, catalog cuts, brochures, capacity tables and curves, descriptive information, performance data and guarantees and warranties referenced either to applicable specifications paragraphs or to item numbers as shown on plans, or both. Submit six (6) copies.

1.12 SHOP DRAWINGS

- A. Prepare shop drawings of items as required by the University Representative or by plans and specifications; submit eight (8) copies of each to the University Representative as part of the submittal package, sufficiently in advance of requirements, to allow time for review and for resubmission, if necessary.

1.13 SALVAGE

- A. Salvage equipment and material deemed salvageable by University Representative to location designated by University Representative, remove other from site.

1.14 MOUNTING

- A. Provide materials and accessories necessary to properly mount and secure equipment furnished and/or installed under the electrical work. This includes but is not limited to such items as conduit, outlets, junction boxes, switches, lighting fixtures and brackets.

1.15 TESTS

- A. Perform electrical tests as required or directed. Provide materials, labor, and equipment necessary for performances of these tests and at completion of the work, perform a complete "in-service" operation of the entire electrical and power system to show compliance with the drawings and specifications. Replace work showing faults under tests without additional cost to the University.

1.16 CLEANING

- A. During construction and upon completion of the work, remove from the site debris and excess materials, tools, scaffolding, etc., resulting from this work. Clean equipment, including lighting fixtures, free of dust, dirt, grease, paint, etc.

1.17 SHUTDOWN COORDINATION

- A. Coordinate required electrical shutdowns with University Representative. Shutdowns are to occur at University's convenience. Include charges in bid.

END OF SECTION

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16.

1.02 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record documents.
 - 4. Maintenance manuals.
 - 5. Electrical installations.
 - 6. Cutting and patching.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 15 Section "MECHANICAL REQUIREMENTS," for factory-installed motors, controllers, accessories, and connections.
 - 2. Division 16 Section "BASIC ELECTRICAL MATERIALS AND METHODS," for materials and methods common to the remainder of Division 16, plus general related specifications including:
 - a. Access to electrical installations.

1.03 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS".
- B. Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the University Representative.
 - 1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.
 - 2. Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.
 - 3. Product Data: 1 additional copy of each item.

- C. Additional copies may be required by individual sections of these Specifications.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: California Electrical Code (CEC). (NFPA N.E.C. with California amendments).

1.05 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT". In addition to the requirements specified in Division 1, indicate installed conditions for:
1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 2. Provide complete "as built" record drawings. Provide one hard copy and electronic file on disc in Autocad 2006 format.

1.06 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT". In addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, typed, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.02 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate electrical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 - 4. 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.
 - 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

3.03 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING". In addition to the requirements specified in Division 1, the following requirements apply:
 - 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - 2. Uncover Work to provide for installation of ill-timed Work.
 - 3. Remove and replace defective Work.
 - 4. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 5. Install equipment and materials in existing structures.
 - 6. Upon written instructions from the University Representative, uncover and

restore Work to provide for University Representative observation of concealed Work.

7. Protect the structure, furnishings, finishes, and adjacent materials.
8. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
9. Patch existing finishes surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
10. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of experienced "Installer". Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with work similar to that required for this project.
11. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION

SECTION 16110

RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 16. Subcontractor and Subsubcontractor shall be thoroughly familiar with each Section of Division 1.
- B. This section is a Division-16 Basic Electrical Materials and Methods section, and is part of each Division-16 section making reference to electrical raceways specified herein.

1.02 DESCRIPTION OF WORK

- A. Extent of raceway work is indicated by drawings and schedules.
- B. Types of raceways specified in this section include the following:
 - 1. Electrical metallic tubing (EMT).
 - 2. Flexible metal conduit.
 - 3. Liquid-tight flexible metal conduit.
 - 4. Rigid metal conduit.
 - 5. Surface metallic raceway.

1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.
- C. Codes and Standards:
 - 1. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.
 - 2. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL-listed and labeled.

3. CEC Compliance: Comply with applicable requirements of CEC pertaining to construction and installation of raceway systems.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.
- B. Shop Drawings: Submit dimensioned drawings of cable raceway systems surface metallic raceway, showing layout of raceways and fittings, spatial relationships to associated equipment, and adjoining raceways, if any.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of CEC for raceways.
- B. Rigid Steel Conduit: Provide rigid steel, hot dipped, galvanized zinc-coated, threaded type.
 1. Provide zinc coating fused to inside and outside walls.
- C. Flexible Metal Conduit: Formed from continuous length of spirally wound, interlocked zinc-coated strip steel. Maximum length of flexible conduit is three (3) linear feet. Use flexible conduit.
- D. Liquid-tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC). Maximum length of liquid-tight flexible conduit is three (3) linear feet.
- E. Rigid Metal Conduit Fittings: Cast malleable iron, hot dipped galvanized or cadmium plated, threaded steel.
- F. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type. Do not use threaded connectors.
 1. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
 2. 45 deg. or 90 deg. Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and

deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

- G. Liquid-tight Flexible Metal Conduit Fittings: Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or noninsulated throat.
- J. Electrical Metallic Tubing (EMT): Steel set screw or compression type. Pot metal is not acceptable.

2.02 CONDUIT BODIES

- A. Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and CEC requirements. Construct conduit bodies with threaded- conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.
- B. Manufacturers: Subject to compliance with requirements, provide conduit bodies of one of the following:
 - 1. Appleton Electric; Div of Emerson Electric Co.
 - 2. Arrow-Hart Div; Crouse-Hinds Co.
 - 3. Bell Electric Div; Square D co.
 - 4. O-Z/Gedney Div; General Signal Co.
 - 5. Or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Contractor in writing of conditions detrimental to proper completion of the Work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to University Representative's.

3.02 INSTALLATION OF CONDUITS

- A. General: Install conduits in new construction work, in straight runs where practical.
 - 1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical connection. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.
 - 2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200' linear run or wherever structural expansion joints are crossed.
 4. Use roughing-in dimensions of electrically operated unit furnished by supplier. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.
 5. Install plastic bushings at both ends of all control and fire alarm conduits.
 6. Provide nylon pull cord in all empty conduits. Test conduits required to be installed, but left empty, test with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.
 7. Install surface raceways straight and plumb.
- B. Conduit Installation: Follow minimum requirements in areas as follows:
1. Use rigid steel, zinc-coated conduit in mechanical equipment rooms, exposed on roofs and anywhere that conduit is subject to physical damage, and where called for on plans.
 2. Use steel, zinc-coated EMT in classrooms, hall, offices, corridors, labs, and in all indoor dry locations, unless noted otherwise.
 3. Use flexible conduit for final 36" of connection to motors, or control items subject to movement or vibration.
 4. Use liquid-tight flexible conduit where subjected to moisture or exterior location, and for final 36" of connection to mechanical equipment.
- C. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
- D. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.
- E. Size conduits to meet CEC except no conduit smaller than 3/4 inch shall be used, unless noted otherwise.
- F. Fasten conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with bushing. Install locknuts inside and outside enclosure.
- G. Conduits are not to cross pipe shafts, or ventilating duct openings.

- H. Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
- I. Complete installation of electrical raceways before starting installing of cables/wires within raceways.
- J. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.
- K. Install 1/8" nylon pullrope in all empty conduits.
- L. Exposed Conduits:
 - 1. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
 - 2. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
 - 3. Support exposed conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed following: up to 1": 6'-0"; 1- 1/4" and over: 8'-0".
- M. Conduit Fittings:
 - 1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
 - 2. Bushings for terminating conduits smaller than 1-1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.
 - 3. Install insulated type bushings for terminating conduits 1-1/4" and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
 - 4. Bushing of standard or insulated type to have screw type grounding terminal.
 - 5. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs to be specifically designed for their particular application.

END OF SECTION

SECTION 16120

WIRES AND CABLE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Section, apply to this sections.
- B. Requirements of the following Division 16 Sections apply to this section:
 - 1. Basic Electrical Requirements.

1.02 SUMMARY

- A. This Section includes wires, cables, and connectors for power, lighting and related systems rated 600 volts and less.
- B. Related Sections: The following Sections contain requirements that relate to this section:
 - 1. Division 16 Section "Electrical Boxes and Fittings" for connectors for Terminating Cables in boxes and other electrical enclosures.

1.03 SUBMITTALS

- A. Product Data for electrical wires, cables and connectors.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following code:
 - 1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
 - 2. UL Compliance: Provide components which are listed and labeled by UL under the following standards.

UL Std. 83 Thermoplastic-Insulated Wires and Cables.
 - 3. NEMA/ICEA Compliance: Provide components which comply with the following standards:

WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
 - 1. Wire and Cable:
 - American Insulated Wire Corp.
 - Carol Cable Co. Inc.
 - Senator Wire and Cable Co.
 - Southwire Company.
 - Or approved equal.
 - 2. Connectors for Wires and Cable Conductors:
 - AMP
 - 3M Company
 - O-Z/Gedney Co.
 - Square D Company.
 - King Co.
 - Or approved equal.

2.02 WIRES AND CABLES

- A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.
- B. Conductors: . Provide stranded conductors.
- C. Conductor Material: copper for all wires and cables.
- D. Insulation: Provide 600V THHN/THWN insulation for all conductors.
- E. Color Coding for phase identification in accordance with Table 1 in Part 3 below.

2.03 CONNECTORS FOR CONDUCTORS

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 - EXECUTION

3.01 WIRING METHOD

- A. Use the following wiring methods as indicated:

1. Wire: install all wire in raceway.
2. Armored Cable, Type AC: for wiring connections from raceway outlet boxes to lighting fixtures.

3.02 INSTALLATION OF WIRES AND CABLES

- A. General: Install electrical cables, wires, and connectors in compliance with CEC.
- B. Coordinate cable installation with other work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant.
- D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways.
- E. Keep conductor splices to minimum.
- F. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- G. Use splice and tap connectors which are compatible with conductor material.
- H. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- I. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

- A. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.
- B. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.
- C. Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

TABLE 1: Color Coding for Phase Identification:

208y/120Volts

Black
Red
Blue
White
Green

3-Phase

A
B
C
Neutral
Ground

277/480V

Brown
Orange
Yellow
White
Green

3-Phase

A
B
C
Neutral
Ground

END OF SECTION

SECTION 16135

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-16 Basic Electrical Materials and Methods section, and is a part of each Division-16 section making reference to electrical wiring boxes and fittings specified herein.

1.02 DESCRIPTION OF WORK

- A. Extent of electrical box and associated fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings specified in this section include the following:
 - Outlet boxes.
 - Junction boxes.
 - Pull boxes.
 - Bushings.
 - Locknuts.

1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. CEC Compliance: Comply with CEC as applicable to construction and installation of electrical wiring boxes and fittings.
- C. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL- listed and labeled.
- D. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and Pub 250 pertaining to outlet and device boxes, covers and box supports.

PART 2 - PRODUCTS

2.01 FABRICATED MATERIALS

- A. Surface Junction and Device Boxes: Provide galvanized cast metal non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for surface mounting with mounting holes, and with threaded openings in bottom, top or sides as required and with threaded screw holes for fastening devices. Provide corrosion-resistant screws for equipment type grounding.
- B. Cast Box Accessories: Provide box accessories as required for each installation, including mounting brackets, box extensions, switch box supports, which are compatible with boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.
- E. Manufacturers: Subject to compliance with requirements, provide outlet boxes of one of the following:
- Adalet-PLM Div., Scott Fetzer Co.
Appleton Electric; Emerson Electric Co.
Bell Electric; Square D Company.
Midland-Ross Corp.
OZ/Gedney; General Signal Co.
Pass and Seymour, Inc.
Thomas & Betts Co.
Or approved equal.
- F. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, with weatherproof covers suitably configured for each application, including gaskets and corrosion-resistant plugs and fasteners.
- G. Manufacturers: Subject to compliance with requirements, provide raintight outlet boxes of one of the following:
- Appleton Electric; Emerson Electric Co.
Arrow-Hart Div; Crouse-Hinds Co.
Bell Electric; Square D Company
Gould, Inc.
Harvey Hubbell, Inc.
OZ/Gedney; General Signal Co.
Pass and Seymour, Inc.
Or approved equal.
- H. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with

stainless steel nuts, bolts, screws and washers.

- I. Manufacturers: Subject to compliance with requirements, provide junction and pull boxes of one of the following:

Adalet-PLM Div., Scott Fetzer Co.
Appleton Electric; Emerson Electric Co.
Arrow-Hart Div; Crouse-Hinds Co.
Bell Electric; Square D Company
GTE Corporation
Keystone Columbia, Inc.
OZ/Gedney Co.; General Signal Co.
Spring City Electrical Mfg. Co.
Or approved equal.

- J. Bushings, Knockout Closures and Locknuts: Provide corrosion- resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, plastic conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

- K. Manufacturers: Subject to compliance with requirements, provide bushings, knockout closures, locknuts and connectors of one of the following:

Adalet-PLM Div; Scott Fetzer Co.
AMP, Inc.
Arrow-Hart Div; Crouse-Hinds Co.
Appleton Electric Co.; Emerson Electric Co.
Bell Electric; Square D Co.
Midland-Ross Corp.
Midwest Electric; Cooper Industries Inc.
OZ/Gedney Co.; General Signal Co.
Thomas & Betts Co., Inc.
Or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of CEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide knockout closures to cap unused knockout holes where blanks have been removed.

- D. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.
- E. Avoid installing boxes back-to-back in walls. Provide not less than 18" (150 mm) separation.
- F. Avoid installing aluminum products in concrete.
- G. Position recessed outlet boxes accurately to allow for surface finish thickness.
- H. Avoid using round boxes.
- I. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached.
- J. Provide electrical connections for installed boxes.
- K. Subsequent to installation of boxes, protect boxes from construction debris and damage.
- L. Do not install knockout type boxes exposed.

3.02 GROUNDING

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION

SECTION 16143

WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Requirements of the following Division 16 sections apply to this section:
 - 1. Basic Electrical Requirements.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles
 - 2. Ground Fault Circuit Interrupter Receptacles
 - 3. Snap Switches
 - 4. Wall Plates
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 16 Section "Circuit and Motor Disconnects" for devices other than snap switches and plug/receptacle sets used as disconnects for motors.
 - 2. Division 16 Section "Lighting Control Equipment" for controls other than those covered by this section.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following codes.
 - 1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.04 SEQUENCE AND SCHEDULING

- A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are to match existing.
- B. Device Manufacturers: Subject to compliance with requirements, provide products by one of the following.

Hubbell Inc.
General Electric Co.
Pass and Seymour Inc.
Or approved equal.

2.02 WIRING DEVICES

- A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Provide white color devices and wall plates except as otherwise indicated. Verify color selections with University Representative. See Table One, Part 3 below.
- B. Receptacles: Comply with UL 498 and NEMA WD 1. White nylon NEMA 5.20R 125V duplex heavy duty. Commercial spec grade, nylon or polycarbonate.
- C. Ground-Fault Interrupter (GFI) Receptacles: Provide ground-fault circuit interrupter, with integral heavy-duty NEMA 5-20R duplex receptacles arranged to protect receptacles on circuit. Provide unit designed for installation in a 2- 3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 94.3.
- D. Snap Switches: Quiet type AC switches as indicated in Table 1 in Part 3 below. 120/277V 20A white toggle type heavy duty.

2.03 WIRING DEVICE ACCESSORIES

- A. Wall plates: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Provide plates possessing the following additional construction features:
 - 1. Material and Finish: Nylon, smooth.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES AND ACCESSORIES

- A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of CEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interfere installation of wiring devices with other Work.
- C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.
- D. Install galvanized steel wallplates in unfinished spaces.
- E. Install wiring devices after wiring work is completed.
- F. Install wall plates after painting work is completed.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.
- H. Identify receptacles with panel and circuit number with permanent marker, (Magic Marker, etc., or tape marker) in neat lettering, 1/8" high, minimum.

3.02 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.03 FIELD QUALITY CONTROL

- A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.
- B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.
- C. Letter designations are used where symbols alone do not clearly designate on plans locations where specific receptacle types are used.
- D. For snap switches, designation is the same as the symbol used on plans for the device. Type of switch is determined from plan context including type of device or circuit being controlled. Mark switch with panel and circuit number.

TABLE ONE

Devices:	
Multi-Volt Receptacles	Hubbell
Receptacles:	Hubbell Specification Grade nylon CBRF-20 WH
GFI Receptacles:	Hubbell Specification Grade #GF5362W
Light Switches:	Hubbell Specification Grade CSB 120/277V Series (elsewhere)
Plates:	Hubbell P. Series Smooth HIG impact white nylon Hubbell stainless steel.

END OF SECTION

SECTION 16170

CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.
- B. This Section is a Division 16 Basic Electrical Materials and Methods section, and is part of each Division 16 section making reference to wiring devices specified herein.

1.02 DESCRIPTION OF WORK

- A. Extent of circuit and motor disconnect switch work is indicated on drawings and schedules.
- B. Types of circuit and motor disconnect switches in this Section include the following:
 - 1. Equipment disconnects.
 - 2. Appliance disconnects.
 - 3. Motor-circuit disconnects.
- C. Wires/cables, raceways, and electrical boxes and fittings required in connection with circuit and motor disconnect work are specified in other Division 16 Basic Electrical Materials and Methods sections.

1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of circuit and motor disconnect switches of types and capacities required, whose products have been in satisfactory use in similar service for not less than three (3) years.
- B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience with projects utilizing circuit and motor disconnect work similar to that required for this project.
- C. CEC Compliance: Comply with CEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.
- D. UL Compliance: Comply with requirements of UL 98, "Enclosed and Dead-Front Switches." Provide circuit and motor disconnect switches which have been UL-listed and labeled.

- E. NEMA Compliance: Comply with applicable requirements of NEMA Stds. Pub No. KS 1, "Enclosed Switches" and 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data on circuit and motor disconnect switches.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering circuit and motor disconnects which may be incorporated in the work include, but are not limited to, the following (for each type of switch):
 - 1. General Electric Co.
 - 2. Square D Company.
 - 3. Westinghouse Electric Corp.
 - 4. Siemens.

2.02 FABRICATED SWITCHES

- A. Heavy-Duty Safety Switches: Provide surface-mounted, heavy-duty type, NEMA HD sheet-steel enclosed safety switches, of types, sizes and electrical characteristics indicated; incorporating quick-make, quick-break type switches; construct so that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable, and is padlockable in OFF position; construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts, and positive pressure type reinforced fuse clips. Switches are 600V rated minimum.
 - 1. All fuses for safety switches shall be dual element, cartridge type. Fuses shall be by one manufacturer: Bussman "Fusetron" or Chase-Shawmut "Trionic." The Contractor shall furnish and install proper size fuses where required for all fusible equipment and shall furnish to the University Representative one spare fuse for each fuse installed.

PART 3 - EXECUTION

3.01 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECT SWITCHES

- A. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

- B. Install disconnect switches for use with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated.
- C. Unless otherwise indicated, protective devices shall be mounted with top of cabinet or enclosure six feet and six inches (6'-6") (1980 mm) above finished floor, shall be properly aligned, and shall be adequately supported independently of the connecting raceways. All steel shapes, etc., necessary for the support of the equipment shall be furnished and installed where the building structure is not suitable for mounting the equipment directly thereon. Unless otherwise indicated, all branch circuit protective devices enclosures shall be NEMA type I, general purpose type. Branch circuit protective devices installed outdoors or exposed to the weather shall have weatherproof enclosures, NEMA type 3R or type 4.

3.02 GROUNDING

- A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for electrical disconnect switches where indicated.

3.03 FIELD QUALITY CONTROL

- A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

END OF SECTION 16170

SECTION 16452

GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.
- B. Division-16 Basic Materials and Methods section apply to work specified in this section.
- C. Requirements of this section apply to electrical grounding and bonding work specified elsewhere in these specifications.

1.02 SUMMARY

- A. Extent of electrical grounding and bonding work is indicated by drawings and schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.
- B. Types of electrical grounding and bonding work specified in this section include the following:
 - 1. Solidly grounded.
- C. Applications of electrical grounding and bonding work in this section includes the following:
 - 1. Raceways.
 - 2. Enclosures.
 - 3. Equipment.
- D. Refer to other Division-16 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work; not work of this section.

PART 2 - PRODUCTS

2.01 GROUNDING AND BONDING

- A. Materials and Components:
 - 1. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to CEC.

2. Grounding conductors shall be copper.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

- A. General: Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions, and applicable portions of CEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.
- B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.
- C. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug, bus, or bushing.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- E. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.

END OF SECTION

SECTION 16470

CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.
- B. Division-16 Basic Electrical Materials and Methods section apply to work specified in this section.

1.02 SUMMARY

- A. Extent of circuit breaker work, is indicated by drawings and schedules, and as specified herein.
- B. Types of circuit breakers required for the project include the following:
 - 1. Branch circuit breakers
 - 2. Distribution circuit breakers.
- C. Refer to other Division-16 sections for wires/cables, electrical boxes and fittings, and raceway work required in conjunction with installation of circuit breakers.
- D. Wires/cables, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards and enclosures are specified in other Division-16 sections.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's data on circuit breakers complete.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of circuit breakers, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards
 - 1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and CEC Article 384 as applicable to installation, and construction of electrical circuit breakers.
 - 2. UL Compliance: Comply with applicable requirements of UL, "Circuit Breakers". Provide circuit breakers units which are UL-listed and labeled.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide circuit breakers products to match existing equipment (for each type and rating of panel and enclosure):

2.02 CIRCUIT BREAKERS

- A. General: Except as otherwise indicated, provide circuit breaker components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number as required for complete installation. Where types, sizes, or ratings are not indicated, comply with CEC, UL and established industry standards for those applications indicated.
- B. Provide circuit breakers as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for use with copper or conductors; construct unit for connecting feeders with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped. Select units fabricated by same manufacturer as panels, which mate and match properly with panels.
- C. Molded-Case Circuit Breakers: Provide factory-assembled, molded- case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 60 deg. C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which circuit breakers are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF CIRCUIT BREAKERS

- A. Install circuit breakers as indicated, in accordance with manufacturer's written instructions, applicable requirements of CEC standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds.
- C. Provide properly wired electrical connections for circuit breakers.
- D. Provide panel's new typed circuit directory cards upon completion of installation work.

3.03 GROUNDING

- A. Provide equipment grounding connections for circuit breakers. Tighten connections to comply with tightening torques specified in UL to assure permanent and effective grounds.

3.04 FIELD QUALITY CONTROL

- A. Prior to energization, check circuit breakers for electrical continuity of circuits, and for short-circuits.

3.05 ADJUSTING AND CLEANING

- A. Adjust operating mechanism for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finishes.

3.05 DEMONSTRATION

- A. Subsequent to wire and cable hook-ups, energize circuit breakers functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 16475

PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.
- B. Division-16 Basic Electrical Materials and Methods section apply to work specified in this section.

1.02 SUMMARY

- A. Extent of panelboard and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules, and as specified herein.
- B. Types of panels and enclosures required for the project include the following:
 - 1. Lighting and appliance panels.
- C. Refer to other Division-16 sections for wires/cables, electrical boxes and fittings, and raceway work required in conjunction with installation of panelboards and enclosures.
- D. Wires/cables, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards and enclosures are specified in other Division-16 sections.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's data on panelboards and enclosures. Complete with circuit breakers required.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of panelboards and enclosures, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards
 - 1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and CEC Article 384 as applicable to installation, and construction of electrical panelboards and

enclosures.

2. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards", and UL's 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide panel products of one of the following (for each type and rating of panel and enclosure):

Square D Company.
General Electric Company
Gould, Inc.
I.T.E.
Or equal

2.02 PANELS (LOADCENTER)

- A. General: Except as otherwise indicated, provide panels, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with CEC, UL and established industry standards for those applications indicated.
- B. Lighting and Appliance Panels: Provide dead-front safety type lighting and appliance panels as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for use with copper or conductors; construct unit for connecting feeders at top of panel; equip with aluminum bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panels, which mate and match properly with panels.
- C. Panel Enclosures: Provide galvanized sheet metal cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness.

Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panel enclosures keyed alike, with door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for surface mounting.

- D. Molded-Case Circuit Breakers: Provide factory-assembled, molded- case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40 deg. C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF PANELS

- A. Install panels and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of CEC standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements. Coordinate wall depth required to flush mount panels.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.
- C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
- D. Provide properly wired electrical connections for panelboards within enclosures.
- E. Fill out panel's typed circuit directory card upon completion of installation work.

3.03 GROUNDING

- A. Provide equipment grounding connections for panel enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.04 FIELD QUALITY CONTROL

- A. Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

3.05 ADJUSTING AND CLEANING

- A. Adjust operating mechanism for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finishes.

3.05 DEMONSTRATION

- A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

UCSB DRAWING NO. 22-104

1