


TECHNICAL SPECIFICATIONS

FOR

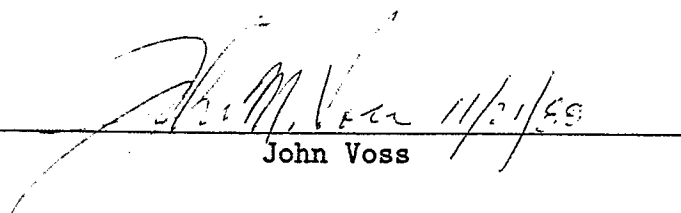
SSRL SPEAR INJECTOR RING

RING AC SERVICES

IS-439-720-10-R0

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TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
01100	STATEMENT OF WORK	01100-1 TO 2
01310	GENERAL REQUIREMENTS: SAFETY, SECURITY, PROTECTION, AND CLEAN UP	01310-1 TO 3
01320	OTHER GENERAL REQUIREMENTS	01320-1 TO 7
01330	SPECIAL REQUIREMENTS	01330-1 TO 3
16100	ELECTRICAL	16100-1 TO 13

DIVISION 1

GENERAL REQUIREMENTS

The following Specification broadly outlines the requirements for the electrical installation at the SSRL 3GEV Ring.

SECTION 01100 -- STATEMENT OF WORK1.1 LOCATION

Perform the work outlined in this specification at the Stanford Linear Accelerator Center, 2575 Sand Hill Road, Menlo Park, San Mateo County, California. The construction site is located near SSRL Bldg 120.

1.2 SCOPE OF WORK

The intent of the specifications is to prescribe the details for the construction and completion of the work which the Subcontractor undertakes to perform in accordance with the terms of the Subcontract. Where the plans or specifications describe portions of the work in general terms, but not in complete detail, it is understood that only the best general practice is to prevail and that only materials and workmanship of the first quality are to be used, based upon submittals provided by the Subcontractor and subject to the approval of the University. Unless otherwise specified, the Subcontractor shall furnish all labor, materials, tools, equipment and incidentals, and do all the work involved in executing the Subcontract in a satisfactory and workmanlike manner.

The Subcontractor shall verify all dimensions and quantities in the field and shall furnish all construction surveys required for correct location and installation of all work.

1.3 DRAWING LIST

All work covered by this specification shall be in strict accordance with the following subcontract drawings:

<u>Number</u>	<u>Title</u>
ID-439-720-11	SPEAR Ring Injector Electrical - Plan, Single Line Wiring Diagrams and Symbols
ID-439-720-12	SPEAR Ring Injector Electrical Sections & Details
ID-439-720-13	SPEAR Ring Injector Electrical Single Line and Wiring Diagram

SECTION 01310 -- GENERAL REQUIREMENTS: SAFETY,
SECURITY, PROTECTION, AND CLEANUP

1.1 SAFETY, SECURITY, PROTECTION, AND CLEANUP - RELATED CLAUSES

See General Conditions clauses titled "Safety and Health", "Cleanup", "Sanitary Conditions", and "Codes and Standards".

All work shall be done in accordance with the requirements of the California Administrative Code, Title 8, Division of Industrial Safety, Safety Orders, and Department of Labor Safety and Health Regulations for Construction (Part 1518) and the U.S. Department of Energy.

All materials and processes used must conform to the applicable Bay Area Air and Water Pollution requirements.

1.2 HAZARD COMMUNICATION STANDARD

THE SUBCONTRACTOR'S ATTENTION IS SPECIFICALLY DIRECTED TO THE FEDERAL O.S.H.A. "HAZARD COMMUNICATIONS" STANDARD (29 CODE OF FEDERAL REGULATION 1910.1200).

The Subcontractor is required to comply with this STANDARD in all respects, including, but not limited to furnishing to the University and appropriate posting at the job site, copies of the Material Safety Data Sheets (MSDS) for all hazardous materials brought onto the University premises.

Copies of the Material Safety Data Sheets shall be furnished to the Contract Administrator and approved by the Environmental Safety Office prior to any such materials being brought to the job site.

1.3 SUBCONTRACTOR RESPONSIBLE FOR SAFETY

It is the Subcontractor's responsibility to provide protection for SLAC property, SLAC personnel, other personnel and visitors, other Government property, and private property.

The Subcontractor is solely responsible for safe working methods and shall insure that SLAC workers and other personnel or visitors inside the buildings and out are not exposed to safety hazards.

1.4 NOISE CONTROL

The Subcontractor shall make use of latest techniques for abatement of construction noise. All construction equipment shall be contained in sound reducing enclosures and shall be fitted with mufflers as required so the noise level within 3 feet of the equipment does not exceed levels recommended by EPA for construction sites in occupied areas. Use pneumatic or electric tools designed for quiet operation.

1.5 PROTECTION OF EXISTING FACILITIES AND WORK IN PROGRESS

Existing facilities, including but not limited to buildings, equipment, materials, surfaces, pipes, conduits and appurtenances which are damaged by any operations under this Subcontract, shall be replaced or repaired, neatly patched and refinished, all as may be necessary to restore the damage to the original condition and to leave the work in a thoroughly complete, operable and finished condition.

Work and materials shall be protected against damage due to construction operations, weather, or other hazards. The Subcontractor shall provide suitable covering of all exposed trenches, excavations, and equipment to protect the work from damage.

Storm drains shall be used for clean water only.

See also General Conditions clauses titled "Protection of Existing Installations, Materials and Work", "Protection of Trees", and "Assumption of Risk Until Final Acceptance".

1.6 SECURITY

The Subcontractor is responsible for the safe keeping of all his materials, tools and equipment.

1.7 CLEANING UP

Each day, the Subcontractor will remove any material tracked, or otherwise introduced into SLAC buildings or other property by the Subcontractor's personnel. If not performed timely, the University will arrange for cleaning services and backcharge the Subcontractor. At the end of each work-day, the Subcontractor shall clean the work areas and remove all loose debris.

All areas used by the Subcontractor shall be restored to their original condition and the area left in a clean condition.

SECTION 01320 -- OTHER GENERAL REQUIREMENTS1.1 VISIT TO THE CONSTRUCTION SITE

All prospective bidders should plan to visit the work site prior to submission of bids. A pre-bid conference will be held at SLAC and all bidders should plan to attend. See Invitation for Bids for time and date. See Instructions to Bidders clause titled "Conditions Affecting the Work" and General Conditions clause titled "Site Investigations and Representations".

1.2 WORKING HOURS

The Subcontractor will be permitted to work in the work areas, and delivery of materials may be made, during normal working hours (7:30 am to 4:30 pm Monday through Friday) and, when authorized in advance by the Contract Administrator, after hours, on holidays, or weekends.

1.3 COOPERATION WITH OTHER SUBCONTRACTORS AND SLAC PERSONNEL

Other Subcontractors and SLAC personnel may be working in or occupying the area within and adjacent to the Subcontractor's work area. The Subcontractor shall cooperate with others in the scheduling of work to avoid undue inconveniences to all concerned.

The Subcontractor shall confine his activity to the areas designated. Other SLAC areas shall not be visited without specific permission and under no circumstances will the Subcontractor's personnel cause interruption of normal SLAC activities in other areas.

See also General Conditions clauses titled "Operations", "Other Work", and "Use and Possession Prior to Completion".

1.4 DIMENSIONS AND CONTROL POINTS

Reference General Provisions clause titled "Specifications and Drawings" and General Conditions clauses titled "Subcontract Drawings and Specifications" and "Base Line and Grades": The Subcontractor shall furnish all construction surveys required for correct location and installation of all work. The drawings are diagrammatic and indicate the general arrangement of the work. Drawings shall not be scaled for dimensions. Control points and dimensions shown on the drawings or otherwise furnished by the University shall be verified in the field by the Subcontractor. The Subcontractor shall be responsible for properly fitting materials and equipment at locations indicated without substantial alterations.

1.5 SUBMITTALS

Shop drawings and other submittals shall be provided to the University for review as required by the various sections of this specification and shall conform to the requirements of the General Conditions clauses titled "Specifications and Standards" and "Materials and Equipment".

Submittals are required for all specified items, as well as for "or equal" items proposed by the Subcontractor. See also the clause titled REQUEST FOR SPECIFIED ITEM SUBSTITUTE below.

A minimum of six (6) complete sets (or other number as specified elsewhere herein) of all submittals, including cover letters, transmittal letters, attachments, etc., shall be provided to the Contract Administrator.

The Subcontractor shall thoroughly review all submittals, including those from lower tiers, for conformance to Subcontract requirements prior to submittal for approval. This review shall include but shall not be limited to confirmation of conformance to dimensional, qualitative, and utilization requirements.

1.6 SUBMITTALS REQUIRED PRIOR TO ISSUANCE OF THE NOTICE TO PROCEED

Within five (5) calendar days, or other time period specified elsewhere herein, after award, and prior to the effective date of the Notice to Proceed, the Subcontractor shall provide the Subcontract Agreement and acceptable Insurance Certificates, and, for Subcontracts over \$25,000, Performance and Payment Bonds.

1.7 TIMELY SUBMISSION OF SUBCONTRACT AGREEMENT, INSURANCE CERTIFICATES, AND PERFORMANCE & PAYMENT BONDS

No time extension will be granted for late submission of the Subcontract Agreement, Insurance Certificates, or Performance or Payment Bonds. In the event that any of the above items are received after the time frame specified, the University, at its sole option, may elect to issue the notice to proceed at that time. In such case, and notwithstanding any other provision in this Subcontract to the contrary, the specified performance period shall be increased by the time frame specified in the Subcontract for submission of these items. THE REQUIRED COMPLETION DATE SHALL THEN BE DETERMINED BY ADDING THE EXTENDED PERFORMANCE PERIOD TO THE AWARD DATE, RATHER THAN TO THE NOTICE TO PROCEED DATE. Nothing herein shall be construed to limit the rights of the University under the Subcontract clauses related to Default or Termination, or any other right of the University under the Subcontract or otherwise.

1.8 SUBMITTALS REQUIRED PRIOR TO INCEPTION OF ON-SITE WORK

Prior to inception of on-site work, the Subcontractor shall submit the following at or before the Project Kickoff Meeting:

1. Name of the Subcontractor's full-time on-site Superintendent.
2. List of Sub-Subcontractors and names of all persons who will be working within the Research Areas or after hours. (The purpose of this list is for issuing badges.)
3. Bar chart schedule showing projected start and finish dates for major milestones. The purpose of this schedule is to provide a basis for planning and coordination as well as a history of progress of the project. The number of milestones and level of detail is subject to the approval of the University.
4. In the event that the Subcontractor intends to request Progress Payments, he shall submit a price breakdown showing items of work and value for each item. The level of detail and value of each item is subject to the approval of the University for the purpose of determining whether the amount requested is commensurate with the progress of the work.

1.9 SUBMITTALS REQUIRED AFTER INCEPTION OF ON-SITE WORK

1. The Subcontractor shall update and resubmit the list of Sub-Subcontractors and individuals whenever personnel are assigned to or reassigned from the project.
2. At the request of the University representative, the Subcontractor shall update the schedule showing actual start date, actual milestone dates to date, projected milestone dates, and projected finish date.
3. The Subcontractor shall revise the number and level of detail of the milestones as indicated by the University representative as being necessary to fulfill the stated purpose of the schedule.
4. Weekly payroll reports.

1.10 SUBMITTALS REQUIRED PRIOR TO PROCESSING PROGRESS PAYMENT REQUESTS

All submittals cited above or required elsewhere herein shall be up to date. See especially General Conditions clause titled "Reports", subclauses titled "Progress Schedule" and "Purchase Orders".

1.11 SUBMITTALS REQUIRED PRIOR TO PROCESSING FINAL PAYMENT

1. Completion of the work
2. Final Inspection Report
3. Final Release and Waiver of Lien
4. As-Built Drawings and other submittals, if required elsewhere herein
5. Guarantee
6. Warranty documents for any equipment
7. Manuals and spare parts lists for any equipment
8. Payroll reports
9. Dosimeter Badges
10. Final Invoice

1.12 REQUEST FOR SPECIFIED ITEM SUBSTITUTE

Any proposed substitution shall be clearly identified as such on all submittals.

In addition, the Subcontractor shall submit a written request for approval of each proposed substitution via letter separately from the related submittal(s). The request must show clearly what is proposed, and must include:

1. Product specifications in the same level of detail or greater than that provided in the specifications,
2. Certifications and other submittals otherwise required for the specified item,
3. Additional information and rationale as necessary to establish that the quality of the proposed substitution and that it is equal to the item specified, without recourse to other information.

This implies no right of the Subcontractor to use other materials or methods unless approved in advance in writing by the University. The determination of the University shall govern as to whether the proposed item is equivalent to that specified, but the burden of proof shall be upon the Subcontractor. See also General Provisions clause titled "Materials and Workmanship".

1.13 MATERIALS AND WORKMANSHIP

Reference General Provisions clauses titled "Materials and Workmanship" and "Inspection and Acceptance".

Only quality workmanship will be accepted. Haphazard or poor practice will be cause for rejection of the work by the University.

Materials and equipment:

1. Must be new, first quality commercial stocks.
2. Shall be free from structural, visual, or operational defects upon completion of the work.
3. Of the same types and kinds shall be essentially the standard product of the same manufacturer throughout the work.
4. Shall be fabricated and installed in accordance with the applicable standards referred to throughout this specifi-

ation, or where standards are not specified, in accordance with best commercial practice.

5. For which detailed specifications or installation instructions are not established hereby but which are required to meet the intent of the work shall be provided by the Subcontractor based on University approval of a submittal by the Subcontractor of proposed items and methods of the class, grade, and type proper for the work.

Each component of a system under this Subcontract shall be compatible with the other parts of component products and with operating conditions as shown, specified, or encountered.

Work noted as deficient during Final Inspection must be repaired and corrected by the Subcontractor, and made ready for reinspection, within five (5) working days, but not later than the required Subcontract completion date.

1.14 MATERIALS ACCESS

Access to the work site for delivery of materials and equipment shall be through the Main Gate at 2575 Sand Hill Road east of the intersection with Interstate Highway 280.

No material deliveries will be accepted by the University on behalf of Subcontractors. All deliveries shall be properly labeled or identified as follows:

--- (Subcontractor) ---
c/o SLAC Jobsite Office, near SSRL Building 120
2575 Sand Hill Road
Menlo Park, CA 94025

See also SECTION 01310 -- SAFETY, SECURITY, PROTECTION, AND CLEANUP, clause titled HAZARD COMMUNICATION STANDARD.

1.15 DISPOSAL OF WASTE MATERIAL

Waste material shall be disposed of by the Subcontractor off the SLAC site. See also General Conditions clause titled "Trash Disposal".

1.16 UTILITIES

Water and electricity are available near the work area at no cost to the Subcontractor. See General Conditions clause titled "Utilities".

The Subcontractor shall provide and install all necessary wire, piping, etc. between the source of the utility and the work area(s). Routing and method of transmission shall be subject to the approval of the University.

1.17 UTILITY AND EQUIPMENT OUTAGES

All required utility outages, including power, domestic water, fire protection, sanitary sewer, gas, ventilation, air conditioning, etc., shall be scheduled 72 hours in advance. Certain electrical outages may require additional notice. All outage requests shall be scheduled and coordinated through the Contract Administrator

1.18 PROPOSED CHANGES

Reference General Provisions clause titled "Changes": The Subcontractor shall furnish an itemized price breakdown in conjunction with any proposed modification of the Subcontract price or performance period.

The breakdown shall specifically identify cost data sources and shall be in sufficient detail to permit independent verification and analysis of all quantities and unit prices of all labor, material, equipment, other direct costs, overhead and other indirect costs, and profit, and shall cover all work involved to accomplish the modification, whether deleted, added, or changed.

Sufficient detail shall normally be the same level of detail used in the preparation of the initial bid. A formal presentation format is not required; legible copies of worksheets, from which totals and subtotals cited in the proposal for modification were derived, are acceptable as a basis for evaluation of the proposal for modification.

If the proposal for modification includes a time extension, a rationale therefore shall be furnished and shall specify the projected impact on any final critical path.

Any amount claimed for Sub-Subcontracts shall be supported by a similar price breakdown.

SECTION 01330 -- SPECIAL REQUIREMENTS

1.1 SUBCONTRACTOR RESPONSIBLE FOR SAFETY

Reference Section 01310 clause titled SUBCONTRACTOR RESPONSIBLE FOR SAFETY:

Flagmen, signs, barricades, fences, lights, fire extinguishers, and similar precautions shall be the responsibility of and shall be provided by the Subcontractor to assure public safety and properly guard against personal injury or property damage.

Special care must be taken when working around the high-voltage lines in the vicinity.

1.2 SUBMITTALS REQUIRED AFTER INCEPTION OF ON-SITE WORK

Reference Section 01320 clause titled SUBMITTALS REQUIRED AFTER TO INCEPTION OF ON-SITE WORK:

As-built drawings (red-lined blueprints) are required.

The Subcontractor shall maintain two complete sets of Subcontract documents at the job site showing all as-built conditions. As the work progresses, the Subcontractor shall record on the drawings in red pencil The actual locations of all items where there is a variance from the drawings.

Approval must be received from the University before any item is relocated. Upon the completion of the work, the Subcontractor shall forward the as-builts to the University.

1.3 DISPOSAL OF WASTE MATERIAL

Reference Section 01320 clause titled DISPOSAL OF WASTE MATERIAL:

Clean fill (including dirt and crushed asphalt and excluding concrete, vegetation, etc., or as otherwise defined by the Uni-

versity) shall be disposed of in the on-site fill area south of the Klystron Gallery.

1.4 TOILET FACILITIES

Toilet facilities are available in Building 120.

1.5 DOSIMETER BADGES

Reference General Conditions clause titled "Identification of Employees": Dosimeter badges that measure exposure to ionizing radiation will be issued by the University to all Subcontractor personnel working in the Research Areas. Although no personal radiation exposure above natural background radiation is anticipated, the badges are required for compliance with Department of Energy regulations and for site security. These badges will be issued at the Sector 30 Gate by the guard on duty. Radiation dosimeters are to be carried at all times while inside the Research Areas. Persons entering the area will be required to show their badge to the guard at the gate house.

The Subcontractor shall maintain a list of badgeholders. A copy of the list shall be submitted to the University representative whenever a change is made.

The Subcontractor is responsible for the return of each dosimeter to the guard at the Sector 30 Gate when each individual completes his activity under this Subcontract. All badges must be returned or otherwise accounted for in writing prior to final payment.

1.6 JOB OFFICE AND YARD

The Subcontractor shall provide a construction job office on site for his use as well for the use of University representatives. The office shall be weatherproof and furnished complete with telephone service paid for by the Subcontractor. See also General Conditions clause titled "Operations" and Section 01300, clause titled "Cooperation with Other Subcontractors and SLAC Personnel".

1.7 HISTORICAL AND SCIENTIFIC SPECIMENS

All articles of historical or scientific value, including but not limited to fossils and archaeological artifacts which may be uncovered by the Subcontractor during the progress of the work, shall become the property of the University. Such findings shall be reported immediately to the University Representative who will determine the method of removal, where necessary, and the final disposition thereof.

DIVISION 16

ELECTRICALSECTION 16100 -- ELECTRICAL WORKPART I -- GENERAL16.1 STATEMENT OF WORK

The work covered by this Division of the specification shall include, but shall not necessarily be limited to the following:

1. Furnish and install a Distribution Panel "4DP140C", 480 Volt, 125 Amp main breaker, 3-phase, 4-wire, 24 poles, NEMA1 enclosure, with breakers as shown on Drawings ID 439-720-11 and ID 439-720-12.
2. Furnish and install the necessary branch circuits from the existing 208 volt distribution panel "2DP140B", "2DP140C", & "2DP140D" to each assigned rolling door AC junction box as shown on drawing ID 439-720-11. Branch circuits shall be in EMT conduits.
3. Furnish and install all single deck and double deck cable trays, as specified on drawing.
4. Furnish and install the necessary branch circuits from existing 208 volt distribution panel "2DP140B", "2DP140C", "2DP140D" for each 30A, 2P, 3W welding receptacle as shown on drawings. Branch circuits inside the shelter shall be in EMT conduits. Distribution of circuits inside the ring tunnel shall be via the 4" x 4" power wireway.
5. Install the 48 lighting fixtures and associated branch circuits from panel 4DP140C as shown on drawings. Branch circuits inside the shelter shall be in EMT conduits. Distribution of circuits inside the ring tunnel shall be via the 4" x 4" power wireway.

6. Install all convenience outlets, computer receptacles, and associated branch circuits from panel 2DP140B inside the shelter as shown on the drawings.
7. Install all convenience outlets and associated branch circuits from panel "2DP140C" and "2DP140D". All branch circuits shall be in conduits from the distribution panels up to 4" x 4" wireway inside the ring tunnel. Distribution of circuits inside the ring tunnel shall be via the wireway.
8. Install 11 fire alarm detectors, 4 manual pull stations, and associated wiring and tie-in with existing fire alarm system located inside the shelter. with the existing fire alarm system located inside Shelter 140.

16.2 WORK NOT INCLUDED

None.

16.3 APPLICABLE DOCUMENTS

A Electrical Codes

The electrical work shall be installed in accordance with the applicable provisions of the State of California Electrical Safety Orders, and the National Electric Code. All materials shall be Underwriters' Laboratories, Inc. listed and shall bear their label or approval. Where any conflict occurs between the provisions of the State of California Electrical Safety Orders and the National Electric Code, the document giving the greatest protection shall govern.

B United States Department of Labor

Part 1910, Occupational Safety and Health Standards.

C Standards and Specifications

Reference to federal, state, association (ANSI, ASTM and NEMA) standards and specifications, hereinafter contained in this specification, shall be construed to mean the latest edition thereto unless specifically stated otherwise.

16.4 GOVERNMENT-FURNISHED EQUIPMENT AND MATERIAL

None

PART II -- PRODUCTS16.5 MATERIALS AND EQUIPMENTA General

1. Materials shall be new, first quality commercial stock.
2. Materials and equipment shall be free from structural, visual or operational defects upon completion of the work.
3. Electrical materials and equipment covered by the regular inspection service of Underwriters' Laboratories, Inc., shall be U.L. approved and listed in the "Electrical Construction Materials List" and shall be U.L. labeled.
4. Other materials and equipment shall be fabricated and installed in accordance with the applicable standards referred to throughout the specifications.

B Materials Lists and Shop Drawings

Manufacturer's descriptive literature, material lists, equipment data and shop drawings shall be submitted for University approval in accordance with the General Requirements.

C Conduit and Fittings

1. Rigid steel conduit and fittings for outdoor installation, 480/277 volt circuits and below grade shall be hot-dipped, galvanized or sherardized and shall conform to F.S. W-C-575A, minimum size. Sizes of 2 1/2" and 3 1/2" will not be permitted. Bends for 1 1/4" and larger shall be factory ells. A minimum size of 3/4 " EMT or RSC conduit shall be used unless otherwise noted.

D 600 Volt Conductors

1. Wires and cables noted herein, unless otherwise specified, shall be furnished and installed by the Subcontractor.
2. All insulated wire shall conform to the latest requirements of NEC and shall meet all ASTM specifications. All wire shall be new and have the size, grade of insulation, voltage and

manufacturer's name permanently marked on the outer covering at intervals not exceeding 2'. Conductors shall be standard American Wire Gauge sizes, soft-drawn copper. Conductors 12 AWG and larger shall be stranded. Type THWN/THHN insulated wire shall be furnished for lighting and receptacle circuits. Conductor 6 AWG and larger shall be type THW.

3. The minimum wire size shall be 12 AWG, unless otherwise noted.
4. All conductors shall be color-coded in accordance with PART III, Section 16.9.
5. Conductors shall be installed in the conduits on cable trays in accordance with the drawings.
6. Fire Alarm conductors shall be solid copper, No. 14 AWG, type THHN, sized as indicated on the drawings.

E Connectors

All joints in conductors and all connections to panelboards and wiring devices shall be made using solderless connectors unless otherwise specified.

In general, the following types, or approved equal, will be accepted:

8 AWG and smaller:	Buchanan, Pressure type, with Insulator
6 AWG and larger:	Burndy, Type QDA.

Cable connections to the ground loop shall be compression type:

T & B ground connectors	5300 Series
T & B "C" taps	5400 Series.

F Terminal Lugs

Solderless-type lugs shall be used for all terminations, except Size 12 AWG wire may be formed around binding posts or terminals. The following types, or approved equal, will be accepted:

8 and 10 AWG:	Buchanan, "Perminal" with locking tongue
6 AWG and larger:	Burndy, Type QDA

G Plugs, Convenience Outlets and Receptacles

120 volt convenience receptacles shall be duplex T slot grounding, 20 Amp 3-wire Hubbell 5362 installed in metallic box complete with suitable cover plate.

H 277/480 Volt Power Distribution and Lighting Panel

The essential requirements of the 480 volt, 3-phase, 4-wire service, surface-mounted panelboard, shall be as follows:

1. Provided with a main, non-automatic circuit breaker, ground bus, and neutral bus.
2. Each branch circuit breaker shall meet all applicable NEMA and Underwriters' Laboratories, Inc., specifications and shall be:
 - a. Of the same manufacturer.
 - b. Of the thermal-magnetic molded type.
 - c. Provided with common trip elements where multiple units are employed.
 - d. Provided with ON-TRIP-OFF visual indication.
 - e. Provided with a clearly identified trip rating.
 - f. Capable of being removed from the panelboard without disturbing the buses or other circuit breakers in any way.
 - g. Capable of interrupting a symmetrical current of 25,000 Amperes minimum.
 - h. Molded case circuit breakers shall be furnished according to the respective single line diagrams.
3. Bus bars shall be hard-rolled, sawed, electrolytic copper of 98% electrical conductivity.
4. The cabinet shall be:
 - a. Of code gauge sheet steel with 4" raceways on the sides, top and bottom.
 - b. Provided with suitable barriers and adjustable supports.
 - c. Provided with a double lockable concealed-hinge cover.

5. Each branch circuit shall be provided with a fixed identification on the inside panel surface.
6. A typewritten circuit directory with clear plastic panel cover giving a complete description of each circuit shall be mounted on the inside of the door panel.

I Power Distribution Wireway

1. Above ground power distribution wireways shall be NEMA 12 rated, two-piece surface metal raceway with base and cover, Hubbel G-3000 or equivalent.
2. Underground or in trench wireways shall be one-piece metal, waterproofed raceway.
3. Surface metal raceways shall be used to provide power and lighting services.
4. The two piece surface metal raceway shall consist of a base section having a nominal material thickness of .040". The base and cover shall be manufactured of cold rolled steel, and painted with ANSI 61 gray finish which is capable of being overpainted in the field if required. A full complement of fittings for the surface metal raceway shall be available. A full line of combination device covers and mounting brackets must be available to facilitate the installation of single gang devices within the constraints of the raceway.
5. The surface metal raceway and fittings shall meet all requirements of the National Electrical Code and shall be UL listed.

J Earthquake Restraints

All transformers, distribution panels and other miscellaneous equipment shall be mounted to resist earthquake forces as follows:

1. All equipment mounted in overhead locations shall be mounted in such a manner that with normal working stress levels, the mounting will resist an earthquake force equivalent to 100% of the equipment weight in any direction.
2. All equipment mounted at ground level locations shall be mounted in such a manner that with normal working stress levels, the mounting will resist an earthquake force equivalent to 60% of the equipment weight in any direction.
3. All pendant light fixtures shall be restrained laterally to prevent swaying. In addition to ordinary local requirements, restraints shall be sized to restrain earthquake forces equivalent to 100% of the fixtures' weight acting in any direction.

4. Prior to final acceptance of any electrical or lighting system, the bracing and supports shall be inspected and approved by the University representative.

K 600 Volt Molded Case Circuit Breakers and Disconnect Switches

1. All AC circuit breakers shall be of the thermal-magnetic type with quick-make-and-break toggle action. Multiple units shall have common trip elements. All operating parts shall be enclosed within a molded plastic case. A visual indication of the ON-TRIP-OFF positions and the trip rating shall be provided and clearly identified. The ABC trip ratings are given on the drawings and in the panel schedules.

The following table lists the minimum interrupting capacity (I.C.) in rms amperes for the several voltage levels:

<u>Voltage</u>	<u>Poles</u>	<u>IC Amperes Symmetrical</u>	<u>Circuit Breakers Type</u>
480	3	35,000 (480V)	G.E. Co. THJK, THKM
480/277	3	25,000 (480V)	G.E. Co. THED
* 277	1	65,000 (277V)	G.E. Co. THED
120/208	2,3	18,000 (240V)	G.E. Co. THED
120	1	14,000 (120/240V)	G.E. Co. THED
# 120/208	2,3	10,000 (240V)	G.E. Co. THQB
# 120	1	10,000 (120/240V)	G.E. Co. THQB

* For 20-30 Amps circuits only.

(Bolt-on type and only when circuit is fed by less than 25KVA, 1-phase or 75KVA, 3-phase rated transformer).

2. Safety disconnect switches shall be heavy duty, fused or non-fused as required and shall be contained in an enclosure as follows:

Indoor: NEMA I
Outdoor: NEMA IV

L Electrical Work for Mechanical Equipment

1. All power wiring shall be furnished as a part of this section.
2. Electric motors, 1/2 HP and larger, shall be the squirrel-cage induction type, NEMA Design B, in NEMA standard frame, rated 460 volts, 3 phase, 60 Hz. The enclosure shall be Totally Enclosed Fan Cooled (TEFC) type with cast iron junction box, cast iron end bells, factory regreasable ball bearing.
3. All electrical devices furnished under this section shall conform to NEMA Standards for the intended application.

M Fire Alarm System

1. Work Included:

- a. All labor, materials, equipment, tools, transportation, services and operations necessary to furnish and install the fire alarm system work as shown on the drawings and specified herein.
- b. All major and accessory work and materials required to achieve a complete, compatible and operable installation.
- c. Conduit, branch circuit wiring and related work for power service shall be installed as outlined in this specification.

2. Shop Drawings

Shall be submitted showing the following:

- a. Complete wiring diagrams for all system panels and components.
- b. Equipment summary and identification of all components and all system components listing descriptive names, product numbers and related data, including dimensions.

3. General

- a. Fire Protection materials and equipment shall be:
 - i. U.L. approved, listed in the U.L. "Fire Protection Equipment List" and U.L. labeled; or
 - ii. F.M.L. approved and listed in the "List of Approved Equipment, Fire Protection Devices and Devices Involving Fire".
- b. Other materials and equipment shall be fabricated and installed in accordance with the applicable standards referred to throughout the specifications.
- c. Conduit and conductors shall be installed as specified under paragraphs 16.6 and 16.7.

4. Special Conditions

- a. Any shutdown of existing detection system required for tie-in of new work shall be coordinated with the University Representative.

- b. The work performed under this section shall be coordinated with work performed under other sections of this Subcontract and equipment shall be compatible with Pyrotronics System 3 equipment.

5. System Performance and Operation

- a. Activation of a manual station, flow switch or ionization type detector shall cause the following:

Sound evacuation horn, provide visual indication of associated zone at local panel, and transmit an alarm signal to the existing system in Building 120.

- b. Activation of a flow switch will cause the following:

Sound a trouble buzzer at the local fire alarm panel, provide visual indication of the associated zone at the local panel and transmit a common trouble signal to the existing Pyrotronics System in Building 120.

- c. Switches shall be provided for silencing horns and bypassing controlled circuits.

- d. Open, short circuits, or grounds in wiring shall actuate trouble signal and pilot lights at the Fire Alarm panel and transmit a common signal to the existing Pyrotronics System in Building 120.

6. Materials

- a. Materials shall conform with the specifications and codes listed in paragraph 16.3 of these specifications.
- b. Conductors shall be solid copper THHN 600V insulation.

7. Equipment

- a. Ionization detectors shall be plug-in type with adjustable sensitivity Pyrotronics Model DI-3 with the proper base for surface flush mounting as required.
- b. Manual station, single action Pyrotronics Model MS-51.