Delgado Community College
Purchasing Department
501 City Park Avenue, Bldg. 37
New Orleans, Louisiana 70119
(504) 762-3027

Invitation to Bid

Bid Name:
Service Contract 40006-067 – Electrical Systems Maintenance

Due by & to be opened on:
April 24, 2025 at 2:00PM CST

Contact Person:
Tracey Sheffield
Purchasing Director
(504) 762-3029

_____
NAME OF COMPANY

_____
ADDRESS

_____
CITY, STATE, ZIP

_____
PHONE NUMBER FAX NUMBER EMAIL

_____
SIGNATURE OF COMPANY REPRESENTATIVE

_____
NAME (PRINTED) & TITLE OF COMPANY REPRESENTATIVE

***** This form must be completed and submitted with your bid***

I. GENERAL INFORMATION

1. Any questions regarding this Invitation to Bid shall be in writing and shall be addressed to Tracey Sheffield at the following address:

Delgado Community College
O'Keefe Administration Building
501 City Park Avenue, Building 37
New Orleans, La 70119
Email: tsheff@dcc.edu
Fax: (504) 762-3089

Any additional information resulting from such inquiries shall be distributed to all bidders via addenda. The College will not be responsible for any other explanation of the documents.

Sealed bids may be submitted by mail or in person. Mailed bids and hand carried bids shall go to the address in item #1 and delivered directly to the Purchasing Office. Do not leave hand carried bids at the front desk. The bid name, number & license number shall be on the outside of the packaging, including express mail. Please note that express mail or USPS carriers may not deliver directly to 501 City Park Avenue. The bidder/proposer is solely responsible for ensuring that its courier service provider makes inside deliveries to 501 City Park Avenue.

3. Each bidder is solely responsible for the accuracy and completeness of its bid. Errors or omissions may be grounds for rejection, or may be interpreted in favor of the College.

4. Each bidder is solely responsible for the timely delivery of its bid. Delgado Community College will not be responsible for any delays in the delivery of bids, whether delayed in the mail, or for any reason whatsoever.

5. Only the issue of a purchase order or a signed acceptance of a proposal constitutes acceptance on the part of the College.

6. Assuming there is no prompt payment discount provision, payment will be made within 30 days from receipt of products in satisfactory condition, or within 30 days from receipt of invoice, whichever is later.

7. Proposer or bidder, contractor, etc. certifies, by signing and submitting a proposal for $25,000 or more, that their company, any subcontractors, or principals are not suspended or debarred by the General Services Administration (GSA) in accordance with the requirements in OMB Circular A-133. (A list of parties who have been suspended or debarred may be viewed via the internet at www.epls.gov .)

I. BID FORM

Service Contract No: 40006-67

ELECTRICAL WORK: MAINTENANCE AND REPAIRS OF ELECTRICAL SYSTMES

Outside Hourly Labor Rates

Item No.	Labor Category	Straight Time	Overtime	Holiday	Urgent
1.	Professional Engineer	$_____	$_____	$_____	$_____
2.	General Foreman	$_____	$_____	$_____	$_____
3.	Lineman	$_____	$_____	$_____	$_____
4.	Journeyman Lineman	$_____	$_____	$_____	$_____
5.	Operator	$_____	$_____	$_____	$_____
6.	Apprentice	$_____	$_____	$_____	$_____
7.	Ground Man First Class	$_____	$_____	$_____	$_____

Inside Hourly Labor Rates

Item No.	Labor Category	Straight Time	Overtime	Holiday	Urgent
8.	General Foreman	$_____	$_____	$_____	$_____
9.	Electrician	$_____	$_____	$_____	$_____
10.	Journeyman Lineman	$_____	$_____	$_____	$_____
11.	Apprentice	$_____	$_____	$_____	$_____

Equipment Rental

Note: Pickup, delivery and any attachments are included in price of rental equipment

	Description	Hourly	Daily	Weekly
12.	Bucket Truck	$_____	$_____	$_____
13.	Digger Derrick	$_____	$_____	$_____
14.	Mid -Sized Excavator	$_____	$_____	$_____
15.	Mini Excavator	$_____	$_____	$_____

Bidder must bid on all categories on the Bid Form or your Bid will be rejected

Materials			
16.	Percentage Discount off MSRP	_____	**Bidder must Bid on all categories on the Bid Form or your Bid will be rejected**

Materials:

Material pricing must show MSRP (list) price and final discounted price which must match the discount on the bid form. Receipts must be provided as proof of purchase. All invoices submitted must include a cost breakdown sheet before payment is rendered.

Materials used for each project shall meet all code requirements necessary to complete the project and be of good quality. The College expects the contractor to use sensible purchasing practices to procure good quality materials at the most competitive price points. For any repair job where materials are needed which are in excess of $10,000 per job, the College retains the right to procure them and provide them to the Contractor.

Contractor is responsible to supply all necessary tools and for the transportation of personnel and equipment required to complete any project.

Note 1: **OVERTIME RATE** will be used for work done outside of the hours of 8:00am – 4:30pm Monday through Friday.

Note 2: **HOLIDAY RATE** will be used if work is done on any recognized State or Federal Holiday. The rate is allowable and does not depend if Delgado is open or closed on these recognized Holidays.

Note 3: **URGENT RATE** will be used for work done where the College requires the Contractor to be on-site within two (2) hours from the time the College Representative makes initial contact with the Contractor.

Note 4: Neither travel time or lunch breaks are paid for under any labor/job rate. Labor rates start when contractor is on site and are only paid upon the actual hours worked.

Note 5: Contractor is required to show cost breakdown for parts/materials and receipts are required.

Note 6: The % off MSRP List price is the same for all parts/materials, regardless of where the parts/materials are procured from.

Note 7: All deliveries shall be made FOB (Free on Board) Destination to the College unless otherwise specified by the College. All freight charges are to be clearly state on the bid form. The College will not be responsible for freight charges not clearly stated as part of the bid".

Note 8: The College reserves the right to procure any parts/materials and provide them to the contractor.

Addendum No:	_____	**Dated:**	_____	**Addendum No:** _____	**Dated:**
Addendum No:	_____	**Dated:**	_____		

Bidder declares and represents that he; a) has carefully examined the Bidding Documents, b) has a clear understanding of the Bidding Documents, c) has not received, relied on, or based his bid on any verbal instructions contrary to the Bidding Documents , d) has personally inspected and is familiar with the project site, and hereby proposes to provide all labor, materials, tools, appliances and facilities as required to perform, in a workmanlike manner, all work and services under this contract, all in accordance with the Bidding Documents as prepared by the College Purchasing Office and Facility Services.

By signing below, the Bidder agrees that he/she complies with all bid requirements, instructions, specifications, terms and conditions and special conditions as stated in the bid, and has reviewed and received any and all addenda, if applicable.

Signature _____

Title_____

Company_____

Bid must be submitted on this form and completed in its entirety. Failure to do so will automatically disqualify your bid.

II. INSTRUCTIONS & REQUIREMENTS FOR BIDDERS

Delgado Community College is seeking bids to provide annual maintenance & repair of electrical systems in multiple buildings on the following Campuses on an as needed basis:

City Park Campus
615 City Park Ave
New Orleans, LA 70119

West Bank Campus
2600 General Meyer Ave
New Orleans, LA 70114

Maritime Center
13200 Old Gentilly Road
New Orleans, LA 70129

Sidney Collier Site
3727 Louisa Street
New Orleans, LA 70126

River City Site
709 Churchill Parkway
Avondale, LA 70094

QUALIFICATIONS:

Vendors/Contractors Bidding this contract shall have at least ten (10) years of experience as a contractor in the field of Electrical Maintenance, and shall be required to perform the work set forth in the specifications. Each vendor shall present documentation verifying their experience in Electrical Maintenance. Bidder must complete **Attachment B, References Form** and submit with their bid. Vendor is required to be licensed and certified by Louisiana State Licensing Board for the installation, repair and replacement of electrical systems at a minimum a Category V, Electrical Work. Service personnel shall be qualified by training. The Vendor shall be required to provide at the College's request proof of training of Service Personnel. A minimum of two years of field experience is required for Operators, Grounds Men First Class and Apprentices. All others must meet the industry standards for years of experience as required for those positions.

PRE-BID/JOBSITE VISIT:

A **non-mandatory pre-bid jobsite visit** is scheduled on **April 9, 2025 at 10:00AM CST**. Bidders are to meet in the Facilities Office in Building 10 at Delgado Community College's City Park Campus located at 615 City Park Avenue, New Orleans, LA 70119. Provisions of site inspection are included. Although not required, it is strongly recommended that bidders attend the pre-bid meeting to ascertain the scope of the work to be performed.

ADDENDA:

Any questions arising from the specifications or the pre-bid conference must be addressed in writing to the individual indicated in Section I, General Information, and will be answered via an Addendum. All questions must be submitted no later than **April 15, 2025 by 12:00PM CST**.

Any interpretation, correction or change of the Bidding Documents will be made by addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes. The Bidder must acknowledge all issued addenda in the space provided on the Bid Form. Failure to acknowledge addenda will render the bid informal and will cause its rejection.

Bid Documents and Addenda may be downloaded from:
https://wwwcfprd.doa.louisiana.gov/osp/lapac/dspBid.cfm?search=department&term=39

BID SUBMITTAL:

Bids must be sealed with the **Bidder's name, license number (if applicable) along with the name and number of the bid clearly written on the front of the envelope or shipping package** and are to be delivered to the person and location in Section I, General Information by the date and time stated on the title page. Bids received without this information or after the due date and time will be automatically disqualified.

In accordance with R.S. 37:2163A, Contractors' License number in the appropriate classification(s) must appear on the bid envelope submitted on all projects in the amount of $50,000 or more (and $1.00 or more if hazardous materials are involved.

Bids must be submitted on the forms furnished for this purpose and must be filled out in ink or typewritten and signed in ink. Do not erase, correct, or write over any prices or figures necessary for this proposal. If any corrections are necessary, each must be initialed by bidder. Failure to comply with the above requirements will cause your bid to be disqualified.

Effective August 15, 1997, in accordance with L.R.S. 39:1594 (Act 121), the person signing the bid must be:

a) A current corporate officer, partnership member or other individual specifically authorized to submit a bid as reflected in the appropriate records on file with the Secretary of State; or

b) An individual authorized to bind the vendor as reflected by an accompanying corporate resolution, certificate, or affidavit.

By signing the bid, the bidder certifies compliance with the above.

MODIFICATION OR WITHDRAWAL OF BID:

A bid may not be modified, withdrawn, or canceled by the Bidder for a period of thirty (30) calendar days for the period following the time and bid date designated for the receipt of bids, and Bidder so agrees in submitting his bid, except in accordance with R.S. 39:1594,F.

Prior to the time and date designated for receipt of bids, bids submitted early may be modified or withdrawn only by notice to Delgado Community College Purchasing Office at the place and prior to the time designated for receipt of bids.

Withdrawn bids may be resubmitted up to the time designated for the receipt of bids provided that they are then fully in conformance with these Instructions to Bidders.

BIDDER REPRESENTATION:

By signing and submitting a bid, Bidder acknowledges that he/she has visited the site, read and understands the Bidding Documents and his bid is made in accordance therewith.

The Bidder is advised to carefully consider all College physical features and activities and occupancies by faculty, staff and students, and to plan activities so as not to disrupt the normal operations and activities of the College except as expressly permitted by the College in writing. The Bidder shall be especially aware of existing electric, gas, water, telephone and/or other utilities and facilities which may be in the way of or adjacent to the Work, and shall take appropriate action to protect these utilities during the Work.
Every effort has been made to accurately show all pertinent surface and subsurface features accurately. For self-assurance, the Bidder may examine available drawings and documents related to College premises. Such examinations may be made only in the offices of the College Facility Services as part of the Mandatory Pre-Bid Conference.

The Bidder agrees that his/her bid is based solely upon the materials, systems and equipment described in the Bidding Documents as advertised and as modified by addenda. The bid submitted is not based on any verbal instructions contrary to the Bidding Documents and addenda.

INSURANCE:

Bidders are to comply with the insurance requirements as stated in Section V of the bid. The provided **indemnification form** (*see Attachment A*) must be completed and submitted with your bid. Failure to comply with these requirements will result in disqualification of your bid.

The successful bidder will be responsible for ensuring that Delgado receives the required **insurance certificate** after the notice of award (as per terms and conditions) in a timely manner in order to meet the required work expectancy timeframe. No work may commence until a proper certificate is received.

END OF SECTION III

III. TERMS AND CONDITIONS

GENERAL TERMS & CONDITIONS:

- A response to a bid invitation is our only indication of your interest in college business. Failure to respond to six (6) consecutive bid invitations may cause your name to be removed from the bidders' list.

- It shall be specifically agreed and understood that the Bidders may attend the Bid opening. Subject to any State or College safety regulations.

- No information will be given out as to opinions concerning the ultimate outcome while consideration of the award is in progress.

- Effective September 1, 1991, in accordance with Act 1029 of the 1991 Regular Legislative Session, Delgado Community College will not be responsible for any sales tax, either state or local.

- Delgado Community College reserves the right to reject any and all bids and to waive any informality.

- It shall be distinctly agreed and understood that the price quoted must be a firm price, and not be subject to change at time of the shipment of goods or delivery of services.

- All shipping, handling, materials, labor or any other charges necessary to compete this job must be included in amount bid. Items not listed but necessary for completion of the job shall be furnished as part of the bid. Additional costs disclosed later will be at the expense of the vendor.

- All deliveries shall be made FOB Destination to the College unless otherwise specified by the College. All freight charges are to be included in the unit price. The College will not be responsible for freight charges not clearly stated as a part of this bid.

- The College reserves the right to award the above items separately, grouped, or on an all-or-none basis, and to reject any or all bids and to waive any informalities including technicalities in specifications that preclude competition.

- The College shall have the right to reject any or all bids not accompanied by any data required by the Bidding Documents or a bid in any way incomplete or irregular.

- The Bid will be awarded on the basis of the lowest total cost as determined by the College.

- List of distributors: The Vendor signing the bid shall be designated as the Prime Vendor on any contract/agreement resulting from this bid. If additional Vendors are authorized to receive orders for items covered under this proposal, the Vendor must submit, with bid, a list of those additional authorized distributors.

- Bidder must be a Louisiana licensed contractor who is licensed to perform the work as outlined in the specifications. The Bidder must be fully qualified under any State or local licensing law for Contractors in effect at the time and at the location of the work before submitting his bid. The Contractor shall be responsible for determining that all of his Sub-bidders or prospective Subcontractors are duly licensed in accordance with law.

- Bidder must be able to provide a project timeline if requested by Delgado Community College

- If item(s) or services bid do not fully comply with specifications, including brand and/or product number or work, bidder must state in what respect the item(s)/services or work deviate. Failure to note exceptions on the bid form will not relieve the successful bidder from supplying the actual products or services requested.

CONTRACT TERM & AGREEMENT:

The term of the agreement will begin on July 1, 2025 through June 30th, 2026 .with the option to renew for up to two (2) twelve (12) month periods if mutually agreeable. Contract extensions may not exceed thirty-six (36) months total.

Escalation Clause; Prior to any renewal term, the contractor may request a price increase for that renewal term based on documented increase costs. The price increase may not be greater than the Consumer Price Index (All Urban Consumers, Current Series) average increase for the prior 12 months. Price increases will only be considered after the Vendor has successfully completed (12) months of service and may only be implemented at the beginning of a renewal term. The College reserves the right to approve or disapprove the price increase.

The Form of Agreement between the College and Contractor for the work set forth herein will be the issuance of a purchase order.

ADDITIONAL SITES:

The College reserves the right to add or subtract sites to this contract during the course of the agreement The College will notify the Vendor/Contractor and the prices charged will be at the same rates, terms and conditions as stated on the Vendor/Contractor's submitted Bid.

PAYMENTS:

Contractor will be paid after work is satisfactorily completed and upon recommendation of the College Representative.

Payment for services shall be made to the Contractor once a month after receipt by the College of an invoice (or invoices) by which the Bidder certifies, and the College agrees, that all the invoiced work was performed in accordance with the specifications. Invoices will not be paid prior to 30 days from receipt of invoice or completion of services/receipt of project.

All invoices should be submitted to the College's Office of Accounts Payable and clearly indicate the Purchase Order Number assigned by the Delgado Purchasing office. Invoices must be accompanied by a service ticket(s) or reference the service ticket(s) if the ticket(s) was already submitted to Facilities & Planning. The service ticket must reference who requested the work, why the work was needed, and what work was performed. Lump sum invoices will not be processed. All work must be itemized and include a breakdown per the unit pricing and material markup, if applicable, per the bid. Note that the College only pays for actual time worked. Travel time and lunch breaks are not paid by the College

INSURANCE:

Vendor compliance with the attached insurance and indemnification requirements is mandatory. A completed copy of the ***indemnification agreement*** *(Attachment A)* must be submitted with the bid. Failure to do so will result in immediate disqualification of the bid. Upon award, a certificate of insurance must be submitted to Delgado Community College, delineating Delgado Community College as the certificate holder prior to the commencement of any work.

TERMINATION OF AGREEMENT:

Termination of this agreement for cause – DCC may terminate this agreement for cause based upon the failure of Contractor to comply with the terms and/or conditions of the Agreement, or failure to fulfill its performance obligations pursuant to this agreement, provided that DCC shall give the Contractor written notice specifying the Contractor's failure. If within thirty (30) days after receipt of such notice, the Contractor shall not have corrected such failure or, in the case of failure which cannot be corrected in thirty (30) days, have begun in good faith to correct such failure and thereafter proceeded diligently to complete such correction, then DCC may, at its option, place the Contractor in default and the Agreement shall terminate on the date specified in such notice.

The Contractor may exercise any rights available to it under Louisiana law to terminate for cause upon the failure of DCC to comply with the terms and conditions of this agreement, provided that the Contractor shall give DCC written notice specifying the DCC's failure and a reasonable opportunity for DCC to cure the defect.

Termination for non-appropriation of funds - The continuance of this contract is contingent upon the appropriation of funds to fulfill the requirements of the contract by the legislature. If the legislature fails to appropriate sufficient monies to provide for the continuation of the contract, or if such appropriation is reduced by the veto of the Governor or by any means provided in the appropriations act or Title 39 of the Louisiana Revised Statutes of 1950 to prevent the total appropriation for the year from exceeding revenues for that year, or for any other lawful purpose, and the effect of such reduction is to provide insufficient monies for the continuation of the contract, the contract shall terminate on the date of the beginning of the first fiscal year for which funds are not appropriated.

Termination for Convenience - The College may terminate the Contract at any time by giving thirty (30) days written notice to the Contractor. The Contractor shall be entitled to payment for work performed (monthly charges to be prorated) to the extent work has been performed satisfactorily. If, for any reason, the Contractor desires to terminate the Contract, he may do so upon giving written notice of sixty (60) days to the College. Contractor shall perform all work satisfactorily as contracted until the determined termination date

Cancellation Conditions - In any of the following cases, the College shall have the right to immediately cancel the contract agreement due to:
The interruption of operation in any of the contacted facilities or the College beyond its control; failure of the Contractor to maintain a satisfactory performance bond or adequate insurance coverage; wherever the contractor is guilty of misrepresentation; wherever the contract agreement was obtained by fraud, collusion, conspiracy, or other unlawful means, or the contract agreement conflicts with any statutory and constitutional provision of the State of Louisiana or the United States. In case of default by the Contractor, the College reserves the right to purchase any or all items or services in default on open market, charging the Contractor with any excessive costs. Until these excessive costs are paid to the College, the Contractor shall not do business with the College again.

Implementation of Termination - The Contractor shall terminate all work under the Contract to the extent and on the date specified in the Notice of Termination or reduction of work and until such date shall, continue to perform all work required in the specification and be compensated for such work.

In the event of termination or reduction in the scope of work by the College, the College shall pay the Contractor for all work satisfactorily performed up to the effective date of termination or reduction in the scope of work, in accordance with the prices included in Contractor's bid less all partial payments made on account prior to the effective date of termination or reduction in the scope of work.

Upon termination as above, the Contract Administrator shall make final determination of the amount due the Contractor for work performed.

INQUIRIES, INTERPRETATION OR CORRECTION TO BIDDING

Any questions arising from either the specifications and/or jobsite visit must be addressed in writing and will be answered via an Addendum.

Any interpretation, correction or change of the Bidding Documents will be made by addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.

DISCRIMINITORY PRACTICES:

Delgado Community College of the State of Louisiana is an equal opportunity employer and looks to its contractors, subcontractors, vendors, and suppliers to take affirmative action to affect this commitment in its operations.

Both the College and the bidder shall abide by the requirements of Title VII of the Civil Rights Act of 1964, and shall not discriminate against employees or applicants due to race, color, religion, sex, handicap or national origin. Furthermore, both parties shall take affirmative action to provide for positive posture in employing and upgrading persons without regard to race, color, religion, sex, handicap, or national origin, and shall take affirmative action as provided in the Vietnam Era Veteran's Readjustment Act of 1974. Both parties shall abide by the requirements of Title VI of the Civil Rights Act of 1964 and the Vocational Rehabilitation Act of 1974 to ensure that services are delivered without discrimination due to race, color national origin or handicap. Both parties shall comply with the requirements of the Americans with Disabilities Act of 1990 which bans discrimination in employment or in delivery of services on the basis of sexual orientation.

SUBCONTRACTORS:

All subcontractors must be identified and approved in writing in advance by the College. Contractor shall promptly pay all laborers, materialmen, subcontractors and suppliers for work performed pursuant to this contract.

It is the Contractor's responsibility to ensure that his subcontractors are properly licensed and insured and adhere to all rules and responsibilities as outlined in the bid documents.

SUBSTITUTIONS AND EQUIVALENTS:

SERVICES: Any materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

No substitution will be considered unless written request for approval has been submitted by the Contractor and has been received by the College Representative prior to beginning work.

Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including model numbers, drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitute would require shall be included.

It shall be the responsibility of the Contractor to include in his request all changes required to the work if the proposed substitute is used. Approval, if granted, is given contingent upon Contractor being responsible for any costs which may be necessary to modify the space or facilities needed to accommodate the materials and equipment approved.
If the College approves a proposed substitution, such approval will be set forth in writing. Contractor shall not rely upon approvals made in any other manner.

MATERIALS: Any manufacturer's names, trade names, brand names, or catalog numbers used in the specifications for material purchase are for the purpose of describing and establishing general quality levels. Such references are not intended to be restrictive. Bids will be considered for any brand that meets or exceeds the quality of the specifications listed for any item.

Vendor must state the brand/model he or she is bidding on each item. It shall be the sole responsibility of the Vendor to prove equivalency. Vendor shall submit with the bid all illustrations, drawings, descriptive literature, and specifications necessary to determine equivalency. Failure to do so will eliminate your bid from consideration. The decision of the College as to equivalency shall be final.

If a vendor wishes to submit an alternate bid in addition to the brand/model requested, he or she may submit one (1) alternate bid. The alternate bid must be a separate submission, must be clearly marked as an alternate, and must include all applicable forms (i.e., jobsite visit). In addition, a separate, signed cover sheet must be submitted with the alternate. **Applicable if materials are being purchased in addition to the services requested in the bid.*

END OF SECTION IV

V. INSURANCE REQUIREMENTS FOR VENDORS

The Contractor/Vendor shall purchase and maintain for the duration of the contract/work insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Contractor/Vendor, its agents, representatives, employees or subcontractors.

A. MINIMUM SCOPE AND LIMITS OF INSURANCE

1. Workers Compensation

Workers Compensation insurance shall be in compliance with the Workers Compensations law of the State of Louisiana. Employers Liability is included with a minimum limit of $500,000 per accident/per disaster/per employee. If work is to be performed over water and involves maritime exposure, applicable LHWCA, Jones Act, or other maritime law coverage shall be included and the Employers Liability increased to a minimum of $1,000,000.

2. Commercial General Liability

Commercial General Liability insurance, including Personal and Advertising Injury Liability, shall have a minimum limit per occurrence of $1,000,000 and a minimum general aggregate of $2,000,000. The Insurance Services office (ISO) Commercial General Liability occurrence coverage form CG 00 01 (current form approved for use in Louisiana), or equivalent, is to be used in the policy. Claims made form is unacceptable.

3. Automobile Liability

Automobile Liability Insurance shall have a minimum combined single limit per occurrence of $1,000,000. ISO form number CA 00 01 (current form approved for use in Louisiana), or equivalent, is to be used in the policy. This insurance shall include third-party bodily injury and property damage liability for owned, hired and non-owned automobiles.

B. DEDUCTABLES AND SELF-INSURED RETENTIONS

Any deductibles or self-insured retentions must be declared to and accepted by the Agency. The Contractor/Vendor shall be responsible for all deductibles and self- insured retentions.

C. OTHER INSURANCE PROVISIONS

The policies are to contain, or be endorsed to contain the following provisions:

1. General Liability and Automobile Liability Coverage's

a. The Agency, its officers, agents, employees and volunteers shall be named as an additional insured as regards to negligence by the contractor/vendor. ISO Form CG 20 10 (current form approved for use on Louisiana), or equivalent, is to be used when applicable. The coverage shall contain no special limitations on the scope of protection to the Agency.

b. The Contractor's/Vendor's insurance shall be primary as respects to the Agency, its officers, agents, employees and volunteers. Any insurance or self-insurance maintained by the Agency shall be excess and non-contributory of the Contractor's insurance.

c. The Contractor's/Vendor's insurance shall apply separately to each insured against whom claim is made or suit brought, except with respect to the policy limits.

2. Workers Compensation and Employers Liability Coverage

The insurer shall agree to waive all rights of subrogation against the Agency, its officers, agents, employees and volunteers for losses arising from work performed by the Contractor for the Agency.

3. All Coverages

a. Coverage/Vendor shall not be cancelled, suspended, or violated by either party (the Contractor/Vendor or the insurer) or reduced in coverage or in limits except after 30 days written notice has been given to the Agency. Ten-day written notice of cancellation is acceptable for non-payment of premium. Notifications shall comply with the standard cancellation provisions in the Contractor's/Vendor's policy.

b. Neither the acceptance of the completed work nor the payment thereof shall release the Contractor/Vendor from the obligations of the insurance requirements or the indemnification agreement.

c. The insurance companies issuing the policies shall have no recourse against the Agency for payment of premiums or for assessments under any form of the policies.

d. Any failure of the Contractor/Vendor to comply with reporting provisions of the policy shall not affect coverage provided to the Agency, its officers, agents, employees and volunteers.

D. ACCEPTABILITY OF INSURERS

All required insurance shall be provided by a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located. Insurance shall be placed with insurers with an A.M. Best's rating of **A-: VI or higher**. This rating requirement may be waived for workers compensations only.
If at any time an insurer issuing any such policy does not meet the minimum A.M Best rating, the Contractor/Vendor shall obtain a policy with an insurer that meets the A.M Best rating and shall submit another Certificate of Insurance as required in the contract.

E. VERIFICATION OF COVERAGE

Contractor/Vendor shall furnish the Agency with Certificates of Insurance reflecting proof of required coverage. The Certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. The Certificates are to be received and approved by the Agency before work commences and upon any contract renewal thereafter.

In addition to the Certificates, Contractor/Vendor shall submit the declarations page and cancellation provision endorsement for each insurance policy. The Agency reserves the right to request complete certified copies of all required insurance policies at any time.

Upon failure of the Contractor/Vendor to furnish, deliver and maintain such insurance as above provided, this contract, at the election of the Agency, may be suspended, discontinued or terminated. Failure of the Contractor/Vendor to purchase and/or maintain any required insurance shall not relieve the Contractor/Vendor form any liability or indemnification under the contract.

F. SUBCONTRACTORS

Contractor/Vendor shall include all subcontractors and as insureds under its policies OR shall be responsible for verifying and maintaining the Certificates provided by each subcontractor. Subcontractors shall be subject to all of the requirements stated herein. The Agency reserves the right to request copies of subcontractor's Certificates at any time.

G. WORKERS COMPENSATION INDEMNITY

In the event the Contractor/Vendor is not required to provide or elects not to provide workers compensation coverage, the parties hereby agree that Contractor/Vendor, its owners, agents and employees will have no cause of action against, and it will not assert a claim against the State of Louisiana, its departments, agencies, agents and employer, whether pursuant to the Louisiana Workers Compensation Act, or otherwise under any

circumstance. The parties also hereby agree that the State of Louisiana, its departments, agencies, agents, and employees shall in no circumstance be, or considered as, the employer or statutory employer of the Contractor/Vendor, its owners, agents and employees. The parties further agree that the Contractor/Vendor is a wholly independent contractor and is exclusively responsible for its employees, owners, and agents. Contractor/Vendor hereby agrees to protect, defend, indemnify and hold the State of Louisiana, its departments, agencies, agents and employees harmless form any such assertion or claim that may arise from the performance of this contract.

H. INDEMNIFICATION/HOLD HARMLESS AGREEMENT

Contractor/Vendor agrees to protect, defend, indemnify, save and hold harmless, the State of Louisiana, all State Departments, Agencies, Boards and Commissions, its officers, agents servants, employees and volunteers, from and against any and all claims, damages, expenses, and liability arising out of injury or death to any person or the damage, loss or destruction of any property which may occur, or in any way grow out of, any act or omission of the Contractor/Vendor, its agents, servants, and employees, or any and all costs, expenses and/or attorney fees incurred by the Contractor/Vendor as a result of any claims, demands, suits or causes of action, except those claims, demands suits, or causes of action arising out of the negligence of the State of Louisiana, all State Departments, Agencies, Boards, Commissions, its officers, agents, servants, employees and volunteers.

Contractor/Vendor agrees to investigate, handle, respond to, provide defense for and defend any such claims, demands, suits, or causes of action at its sole expense and agrees to bear all other costs and expenses related thereto, even if the claims, demands, suits, or causes of action are groundless, false or fraudulent.

END OF SECTION V

VI. TECHNICAL SPECIFICATIONS

SECTION 01000

GENERAL CONDITIONS

The general conditions of these Specifications, including amendments and additions thereto, apply to each and every heading included in these Specifications with the same force as though repeated in full under each heading respectively.

1.1 SCOPE

This contract provides for Yearly Service for Electrical Work: Maintenance and Repairs.

The extent of the work will be established by the College on an as needed basis. Expected work is of the type and complexity associated with a large College.

All work shall meet National Electrical Code (NEC), National Electrical Manufacturers Association (NEMA), and National Fire Protection Association (NFPA) code requirements. The work shall also meet College Standards.

All work will be coordinated with the contractor and College Representative prior to the work beginning. **Contractors must sign in in the Facilities Office on City Park Campus or at the Campus Police substation at alternate sites prior to beginning any work and must sign out before leaving. Invoices will not be paid unless there is signatory proof of attendance and completion of the work.**

Standard (Non-Urgent Projects):

For all Standard (Non-Urgent) Projects, a written estimate shall be provided by the contractor for each project to the College Representative before work begins. The written estimate shall include separate labor, equipment rental and material costs to complete the project which must match rates as bid in response to these Specifications. The College Representative will approve this written estimate in writing, by fax or email, before the work begins. **The College Representative reserves the right to separately bid out standard projects.**

Urgent Projects:

Urgent Projects are those that are deemed by the College to be any projects where the contractor must be on-site within two (2) hours from the time the College Representative first (1st) contacts the contractor.

For Urgent Projects, the contractor should give a written estimate for the work to be completed to the College Representative, if time permits. However, if time does not permit, an oral estimate by the contractor is acceptable for Urgent Projects **ONLY**. The College Representative may allow work to begin with only an oral approval to proceed based on information available at the time. However, **all oral estimates** shall be followed up in writing the first (1st) work day after approval to proceed is given by the College Representative.

Pricing Model:

In order to determine the lowest responsive, responsible bidder, bids will be tabulated based on the below model.

AWARD MODEL **ELECTRICAL WORK: MAINTENANCE AND REPAIRS OF ELECTRICAL SYSTEMS**					
Outside Hourly Labor Rates (36%)					
Item No.	**Labor Category**	**Straight Time**	**Overtime**	**Holiday**	**Urgent**
1.	Professional Engineer	3%	1%	1%	1%
2.	General Foreman	2%	1%	1%	1%
3.	Lineman	2%	1%	1%	1%
4.	Journeyman Lineman	2%	1%	1%	1%
5.	Operator	2%	1%	1%	1%
6.	Apprentice	2%	1%	1%	1%
7.	Ground Man First Class	2%	1%	1%	1%

Inside Hourly Labor Rates (40%)					
Item No.	**Labor Category**	**Straight Time**	**Overtime**	**Holiday**	**Urgent**
8.	General Foreman	4%	2%	2%	2%
9.	Electrician	4%	2%	2%	2%
10.	Journeyman Lineman	4%	2%	2%	2%
11.	Apprentice	4%	2%	2%	2%

Equipment Rental (24%) **Note: Pickup, delivery and any attachments are included in price of rental equipment**					
	Description	**Hourly**	**Daily**	**Weekly**	
12.	Bucket Truck	2%	2%	2%	
13.	Digger Derrick	2%	2%	2%	

14.	Mid -Sized Excavator	2%	2%	2%	
15.	Mini Excavator	2%	2%	2%	
Materials					
16.	Percentage Discount off MSRP	_____			

Materials:

For any materials that may be needed, a cost estimate of the materials must be presented in writing first and approved by the College's Project Manager. Only materials needed and used for the specific job will be allowed. The College will not pay for the stocking of any materials. The Contractor must provide receipts/invoices of the materials purchased and pricing must show the MSRP (list) price and final discounted price for comparison and proof of the discount off of list as stated in the Bid Documents. All invoices submitted must include a cost breakdown sheet before payment is rendered.

Failure to agree to these terms may result in non-payment of those items or place the Contractor in default of the Contractual agreement. All materials that may be needed are subject to the limits of the State's Procurement Code. The College also reserves the right to supply any needed materials.

Materials used for each project shall meet all code requirements necessary to complete the project and be of good quality. The College expects the contractor to use sensible purchasing practices to procure good quality materials at the most competitive price points. The College reserves the right to purchase any materials required and provide to the contractor.

Contractor is responsible to supply all necessary tools and for the transportation of personnel and equipment required to complete any project.

1.2 NON-MANDATORY SITE INVESTIGATION

It is recommended that prospective bidders visit the site to make measurements, review existing conditions, and if required, review the Building Plans on file in the Facility Services Office if the prospect warrants same. A thorough understanding of the project per these Technical Specifications and/or accompanying drawings is imperative.
Opportunity for the site visit and inspection is provided in Section III "INSTRUCTIONS & REQUIREMENTS FOR BIDDERS.

1.3 REVIEW OF DOCUMENTS

The Contractor shall carefully study and compare the field conditions, Drawings and Specifications and shall at once report to the College Representative errors, inconsistencies or omissions discovered.

1.4 PROJECT MEETINGS

If called by the College Representative, a Pre-Service Conference between the Contractor, his on-site representative and the College Representative will be held in order to clarify and direct College policy and specific items of concern as pertain to the Contract. Progress meetings will be scheduled at the discretion of the College Representative.

1.5 COORDINATION

Coordinate service schedule with the College Representative so as not to interfere with the ongoing operation of the College. If for any reason, shut down of utilities is required on this project, it is imperative that the College Representative be consulted.

1.6 TRAFFIC CONTROL

Coordinate the schedule of delivery vehicles which will interfere with normal campus traffic. When deliveries are made from the street curb, provide sufficient properly attired and equipped flagmen to safely control and maintain the flow of traffic. It is the policy of the Delgado Community College to provide full access to all disabled individuals in all areas possible. Because of this commitment, contractors, vendors or servicing agencies are cautioned to ensure that their staff is made aware of this commitment. When parking on the campus of this College, it shall be the responsibility of the contractor, vendor or

servicing agency to ensure that no sidewalks or access ways are blocked at any time. If temporary blocking is required, the Contractor shall assume the responsibility for the safe transit of all disabled persons.

1.7 PROTECTION

Protect adjacent buildings and building elements from damage during site work. Protect the site, including trees, shrubs, vegetation, and lawn areas; where damage does occur, restore to original condition replacing damaged vegetation and lawn with equal size and species. Store construction materials with care; distribute the weight to not endanger the building structure.

1.8 SAFETY

Provide sufficient signs continuous barricades to identify the work site and restrict entry. Where necessary, equip barricades with warning lights for night use. Provide measures necessary to ensure and maintain security at the work site; protect from theft, vandalism, personal injury, and property damage. Erect and maintain temporary enclosures and barriers to prevent unauthorized access to the site. Provide fire protection equipment during the construction period, including not less than two (2) ten (10) pound capacity multipurpose A-B-C dry chemical extinguishers (10A:40BC). Where indicated on the Drawings, provide a temporary fence to isolate the construction site and restrict unauthorized entry. Use chain link fence material, 6'-0 minimum height, on steel or wood posts spaced a 6'-0 maximum and embedded 2'-6 minimum below existing grade; include personnel and/or equipment access gates. Coordinate fence installation with underground utilities - see 1.11; before installation, confirm fence location and layout with the College Representative.

1.9 WARRANTY

Warranty all workmanship and material for a period of one (1) year from date of acceptance. During this period, the College will notify the Contractor of any discrepancy for prompt correction at no expense to the College. At the discretion and initiation of the College Representative, a one-year warranty review meeting with the Contractor will be held to review warranty items which remain incomplete.

1.10 TEMPORARY UTILITIES

The Contractor may use reasonable amounts of the utility services available to the site at no charge from the-College. The College will not provide utility service beyond that existing. Coordinate tie-in and disconnect to the existing utilities with the College Representative. Locate temporary facilities so as not to interfere with the College's use of the Project site and/or surrounding areas. Relocate non-complying facilities at no expense to the College.

1.11 TEMPORARY SANITARY FACILITIES

Existing facilities in the building may be used by construction personnel during work on this project.

SECTION 16050

BASIC METHODS AND REQUIREMENTS (ELECTRICAL)

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the College standards Capacities and ratings of motors, transformers, cable, switchboards, switchgear, panelboards, motor control centers, and other items and arrangements for the specified items are shown on drawings.

B. Electrical service entrance equipment (arrangements for temporary and permanent connections to the College) shall conform to the College requirements. Coordinate fuses, circuit breakers and relays with the College system, and obtain College approval for sizes and settings of these devices.

C. Wiring ampacities specified are based on copper conductors with the conduit and raceways accordingly sized. Aluminum conductors must be approved by College Representative and must be designated for specific usage.

D. All energized electrical work shall be in compliance with VHA Directive 2006-056.

1.02 MINIMUM REQUIREMENTS

A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL) and National Fire Protection Association (NFPA) are minimum installation requirement standards.

1.03 TEST STANDARDS

A. All materials and equipment shall be listed, labeled or certified by a nationally recognized testing laboratory to meet Underwriters Laboratories, Inc., where test standards have been established. Equipment and materials which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory.

1.04 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such

B. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Components shall be compatible with each other and with the total assembly for the intended service.
3. Constituent parts which are similar shall be the product of a single manufacturer.

C. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

1. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses.

1.05 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with Section 01000, GENERAL CONDITIONS, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.06 EQUIPMENT PROTECTION

A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.

1.07 WORK PERFORMANCE

A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to all state and local ordinances and other references required by contract.

B. Job site safety and worker safety is the responsibility of the contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:

1. Electricians must use full protective equipment insulated while working on energized systems in accordance with NFPA 70E.
2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.
3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the College Representative.

D. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01000.

1.08 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Working spaces shall not be less than specified in the NEC for all voltages specified.
B. Inaccessible Equipment:

1. Where the College determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to Delgado

1.09 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

B. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

1.10 SUBMITTALS

A. The College's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.

B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the College to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

C. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

D. REQUIREMENTS

1. Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
2. The manuals shall include:

    a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
    b. A control sequence describing start-up, operation, and shutdown.
    c. Description of the function of each principal item of equipment.

d. Installation and maintenance instructions.
e. Safety precautions.
f. Diagrams and illustrations.
g. Testing methods.
h. Performance data.
i. Lubrication schedule including type, grade, temperature range, and frequency.
j. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
k. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

SECTION 16111

CONDUIT SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.02 RELATED WORK

A. Bedding of conduits:

B. Mounting board for telephone closets:

C. Sealing around penetrations to maintain the integrity of fire rated construction:
D. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building:
E. Identification and painting of conduit and other devices:

F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 16450, GROUNDING.

1.03 SUBMITTALS

A. Shop Drawings:

1. Size and location of main feeders;
2. Size and location of panels and pull boxes
3. Layout of required conduit penetrations through structural elements.
4. Specific item proposed and its area of application shall be identified on the catalog cuts.

B. Certification: Prior to final inspection, deliver to the College Representative four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

C. Underwriters Laboratories, Inc. (UL):

1-03 .....Flexible Metal Conduit
5-01 .....Surface Metal Raceway and Fittings
6-03 .....Rigid Metal Conduit
50-03 .....Enclosures for Electrical Equipment
360-03 .....Liquid-Tight Flexible Steel Conduit

467-01 .....Grounding and Bonding Equipment
514A-01.....Metallic Outlet Boxes
514B-02.....Fittings for Cable and Conduit
514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-02 .....Schedule 40 and 80 Rigid PVC Conduit
651A-03.....Type EB and A Rigid PVC Conduit and HDPE Conduit
797-03 .....Electrical Metallic Tubing
1242-00.....Intermediate Metal Conduit

D. National Electrical Manufacturers Association (NEMA):

TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and Tubing
FB1-03 .....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

PART 2 - PRODUCTS

2.01 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 13 mm (1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm (1/2 inch) flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:

1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
4. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
5. Flexible galvanized steel conduit: Shall Conform to UL 1.
6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
8. Surface metal raceway: Shall Conform to UL 5.

C. Conduit Fittings:

1. Rigid steel and IMC conduit fittings:

   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   b. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
   c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
   d. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
   e. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall

for positive ground. Tightening of set screws with pliers is prohibited.

e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2. Rigid aluminum conduit fittings:

   a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
   b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
   c. Set screw fittings: Not permitted for use with aluminum conduit.

3. Electrical metallic tubing fittings:

   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
   d. Indent type connectors or couplings are prohibited.
   e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

4. Flexible steel conduit fittings:

   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp type, with insulated throat.

5. Liquid-tight flexible metal conduit fittings:

   a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

6. Direct burial plastic conduit fittings:

   a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
   b. As recommended by the conduit manufacturer.

7. Surface metal raceway fittings: As recommended by the raceway manufacturer.
8. Expansion and deflection couplings:

   a. Conform to UL 467 and UL 514B.
   b. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.

c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

D. Conduit Supports:

1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
3. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:

1. UL-50 and UL-514A.
2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
4. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

F. Wireways: Equip with hinged covers, except where removable covers are shown.

G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with “CAUTION BURIED ELECTRIC LINE BELOW”.

PART 3 – EXECUTION

3.01 PENETRATIONS

A. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section, FIRESTOPPING SYSTEMS, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

B. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section, SEALANTS AND CAULKING.

3.02 INSTALLATION, GENERAL

A. In accordance with UL, NEC, as shown, and as hereinafter specified.

B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems,

except where specifically "accepted" by NEC Article 517.

C. Install conduit as follows:

1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically and electrically continuous.
6. Independently support conduit at 8'.0" on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
7. Support within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Conduit installations under fume and vent hoods are prohibited.
10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
11. Do not use aluminum conduits in wet locations.
12. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

D. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the College Representative

F. Furred or Suspended Ceilings and in Walls:

1. Conduit for conductors 600 volts and below:

    a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.

2. Align and run conduit parallel or perpendicular to the building lines.
3. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.
4. Tightening set screws with pliers is prohibited.

3.04 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated, exposed conduit is only permitted in mechanical and electrical rooms.

B. Conduit for conductors above 600 volts:

1. Rigid steel or rigid aluminum.
2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.

C. Conduit for Conductors 600 volts and below:

1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.

D. Align and run conduit parallel or perpendicular to the building lines.

E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

F. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.

G. Painting:

1. Paint exposed conduit per College Representative.
2. Paint all conduits containing cables rated over 600 volts safety orange.

3.05 DIRECT BURIAL INSTALLATION

A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 1500 mm (5 feet) from the buildings):

1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
4. Tops of conduits shall be as follows unless otherwise shown:
   a. Not less than 750 mm (30 inches) below road and other paved surfaces.
5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
   a. Cut the trenches neatly and uniformly.
   b. Do not kink the conduits.

6. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.
7. Where metal conduit is shown, install threaded heavy wall rigid steel galvanized conduit or type A20 rigid steel galvanized conduit coated with .5 mm (20 mil) bonded PVC, or rigid steel or IMC, PVC coated or standard coated with bituminous asphaltic compound.
8. Warning tape shall be continuously placed 300 mm (12 inches) above conduits or electric lines.

B. Exterior routing of lighting systems and other branch circuits (600 volts and less-under buildings

slab on grade to 1500 mm (5 feet) from the building):

1. Pre-coated rigid galvanized steel conduit in accordance with the College standards

3.06 HAZARDOUS LOCATIONS

A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.

B. Install UL approved sealing fittings, that prevent passage of explosive vapors, in hazardous areas equipped with explosive proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.07 WET OR DAMP LOCATIONS

A. Unless otherwise shown, use conduits of rigid steel or IMC.

B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.

C. Unless otherwise shown, use rigid steel or IMC conduit within 1500 mm (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall include an outer factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating. Shall be properly marked with red dye.

3.08 MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.

B. Provide liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.09 EXPANSION JOINTS

A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.

3.10 CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items. Shall be properly marked with red dye.

E. Fasteners and Supports in Solid Masonry and Concrete:

2. Existing Construction:

   a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
   b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).
   c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted.

G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

I. Attachment by wood plugs, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION

A. Boxes for Concealed Conduits:

1. Flush mounted.

2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.

D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes.)

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches)

END

SECTION 16127

CABLES, LOW VOLTAGE (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of the low voltage power and lighting wiring.

B. Definitions: The term HCF Type AC cable, as used in this specification, shall mean Type AC cable in accordance with the National Electrical Code with an insulated equipment grounding conductor, an internal bonding strip of copper or aluminum and the outer metal armor or sheath of the assembly shall be approved and identified as an acceptable grounding return path.

1.02 RELATED WORK

A. Excavation and backfill for cables that are installed in conduit:

B. Sealing around penetrations to maintain the integrity of time rated construction:

C. Conduits for cables and wiring: Section 16111, CONDUIT SYSTEMS.

1.03 SUBMITTALS

A. Manufacturer's Literature and Data: Showing each cable type and rating.

B. Certificates: Two weeks prior to final inspection, deliver to the College Representative four copies of the certification that the material is in accordance with the specifications and has been properly installed.

C. Where Type AC cable is used, manufacturer's literature shall indicate that the outer metal sheath is approved and identified as an acceptable grounding return path.

1.04 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.

B. American Society of Testing Material (ASTM):

D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape

C. Federal Specifications (Fed. Spec.):

A-A-59544-00 .....Cable and Wire, Electrical (Power, Fixed Installation)

D. National Fire Protection Association (NFPA):

70-05 .....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

4-01 .....Armored Cable
44-02 .....Thermoset-Insulated Wires and Cables
83-03 .....Thermoplastic-Insulated Wires and Cables
467-01 .....Electrical Grounding and Bonding Equipment
486A-01.....Wire Connectors and Soldering Lugs for Use with Copper Conductors
486C-02 .....Splicing Wire Connectors
486D-02.....Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
486E-00 .....Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-01 .....Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
514B-02 .....Fittings for Cable and Conduit
1479-03 .....Fire Tests of Through-Penetration Fire Stops

PART 2 - PRODUCTS

2.01 CABLE AND WIRE (POWER AND LIGHTING)

A. Cable and Wire shall be in accordance with Fed. Spec. A-A-59544, except as hereinafter specified.

B. Single Conductor:

1. Shall be annealed copper.
2. Shall be stranded for sizes No. 8 AWG and larger, solid for sizes No. 10 AWG and smaller.
3. Shall be minimum size No. 12 AWG, except where smaller sizes are allowed herein.

C. Insulation:

1. THW, XHHW, or dual rated THHN-THWN shall be in accordance with UL 44, and 83.
2. Direct burial: UF or USE shall be in accordance with UL 493.
3. Isolated power system wiring: Type XHHW with a dielectric constant of 3.5 or less.

D. Color Code:

1. Secondary service, feeder and branch circuit conductors shall be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

a. The lighting circuit “switch legs” and 3-way switch “traveling wires” shall have color coding

unique and distinct (i.e. pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Field coordinate for a final color coding with the College Representative

2. Use solid color compound or solid color coating for No. 12 AWG and No. 10 AWG branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 AWG and larger shall be color-coded using one of the following methods:

    a. Solid color compound or solid color coating.
    b. Stripes, bands, or hash marks of color specified above.
    c. Color as specified using 19 mm (3/4 inch) wide tape. Apply tape in half overlapping turns for a minimum of 75 mm (three inches) for terminal points, and in junction boxes, pull boxes, troughs, manholes, and hand holes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring shall be in accordance with the NEC.

2.02 ARMORED CABLE: HCF TYPE AC

A. Cable assembly shall in accordance with Fed Spec J-C-30B, NEC and UL 4.

B. Assembly shall include an insulated green equipment grounding conductor, sized in accordance with the NEC in addition to an internal bonding strip of copper or aluminum in intimate contact with the armor for its entire length. Minimum size bonding strip shall be No. 16 AWG. The outer metal armor or sheath of the assembly shall be approved and identified as an acceptable grounding return path.

C. Armored Cable Fittings:

1. Fed Spec W-F-406E and UL 514B, except only steel or malleable iron material is acceptable.
2. Clamp type with insulating throat.

D. Supports:

1. Parts and hardware: Zinc-coated or equivalent corrosion protection.
2. Individual hangers: Straps, hangers or similar fittings shall be used and installed at intervals so as not to damage the cable. Staples are not permitted to be used for supports.
3. Cable trays: In lieu of individual hangers, a single cable tray may be used to support all armored cable runs within an area.
4. Color Coding: Color coding for conductors shall be in accordance with paragraph 2.1D above.

2.03 SPLICES AND JOINTS

A. In accordance with UL 486A, C, D, E and NEC.

B. Branch circuits (No. 10 AWG and smaller):

1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.

C. Feeder Circuits:

1. Connectors shall be indent, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material.
2. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
4. Plastic electrical insulating tape: ASTM D2304 shall apply, flame retardant, cold and weather resistant.

2.04 CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.

B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.05 COMMUNICATION AND SIGNAL WIRING

A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.

B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.

C. Multi-conductor cables shall have the conductors color coded.

2.06 WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

B. Shall not be used on wire for isolated type electrical power systems.

2.07 FIREPROOFING TAPE

A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.

B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.

C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.

D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.

E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

2.08 WARNING TAPE

A. The tape shall be standard, 76 mm (3 inch) wide, 4-Mil polyethylene detectable type.

B. The tape shall be red with black letters indicating “CAUTION BURIED ELECTRIC LINE BELOW”.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with the NEC, and as specified.

B. Install all wiring in raceway systems, except where direct burial or HCF Type AC cables are used.

C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

D. Wires of different systems (i.e. 120V, 277V) shall not be installed in the same conduit or junction box system.

E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

F. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.

G. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.

H. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes made of nonmetallic material for pulling feeders.
3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the College Engineer.
4. Pull in multiple cables together in a single conduit.

I. No more than (3) single-phase branch circuits shall be installed in any one conduit.

J. The wires shall be derated in accordance with NEC Article 310. Neutral wires, under conditions defined by the NEC, shall be considered current-carrying conductors.

3.02 ARMORED CABLE SYSTEM INSTALLATION, GENERAL

A. Installation: Shall be in accordance with UL, NEC, as shown on drawings and as hereinafter specified.

B. Install HCF Type AC cable as follows:

1. Flattened, dented, deformed, or opened armor is not permitted. If damaged during installation, damaged cables shall be replaced with new undamaged material.
2. Assure that cable installation does not encroach into the ceiling height head room, walkways, or doorways.
3. Cut square with manufacturer's armor stripping tool and remove burrs.
4. Remove enough armor from cable to permit sufficient conductor to extend into the enclosure.
5. Cable shall be mechanically and electrically continuous.
6. Secure cable to cabinets, junction boxes, and outlet boxes with fittings approved for grounding.
7. Cables shall be run parallel or perpendicular to the building lines.

C. Bends: Bends shall be made so that the cable is not damaged. The radius of the curve of the inner edge of any bend shall not be less than five times the diameter of the cable.

D. Concealed Work Installation: Cables installed above furred or suspended ceilings or in walls shall be supported as specified below.

E. Exposed Work Installation: Cables may be run exposed only in unfinished areas such as electrical closets or mechanical rooms. Where installed exposed, cables shall closely follow the surface of the building finish and be supported as specified below.

F. HCF Type AC cable shall not be installed embedded in concrete.

G. Cable Identification: HCF Type AC cable shall be marked in accordance with the NEC except the cable shall have ready identification of the manufacturer by distinctive external markings on the cable sheath throughout its entire length.

H. Cable Supports, Installation:

1. The cable shall be secured by approved straps, hangers, or similar fittings designed and installed as to not damage the cable.
2. Independently support the cable or install in cable trays. Do not use other supports i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical piping, or mechanical ducts.
3. Where independent supports are used for the cable, support at intervals not exceeding 1350 mm (4 1/2 feet) and within 300 mm (one foot) of each outlet box, junction box, cabinet, or fitting.
4. Where cable trays are used to support the cables, each cable shall be securely fastened to transverse members of the cable trays. Cable trays shall be independently supported in accordance with manufacturer's recommendations and NEC.

5. Through Metal Framing: Cable shall be supported in accordance with the NEC where run through metal framing members.
6. Fished Cables: Cables may be fished in existing structures only. Supports are not required where cables are fished through existing walls or above non-removable ceilings. Where cables are installed in new structures, appropriate supports shall be provided.

I. Penetrations:

1. Fire Stops: Where HCF Type AC cable passes through fire partitions, fire walls or smoke partitions, install a fire stop that provides an effective barrier against the spread of fire, smoke and gasses as specified in Section, FIRESTOPPING SYSTEMS, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between cables and openings with the fire stop material. Penetrations shall meet the requirements of UL 1479.
2. Waterproofing: Where Type AC cable passes through floors, floors shall be core drilled and appropriately sized sleeves shall be installed for the cables. Sleeves shall terminate not less than 75 mm (3 inches) above floor slabs and not less than 75 mm (3 inches) below the ceiling of the floor below. Completely seal clearances between the cable and sleeve and make watertight.

3.03 INSTALLATION IN MANHOLES

A. Install and support cables in manholes on the steel racks with porcelain or equal insulators. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

B. Fireproofing:

1. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
2. Use tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
3. Secure the tape in place by a random wrap of glass cloth tape.

3.04 SPLICE INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure.

B. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.

END

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the furnishing, installation and connection of wiring devices.

1.03 SUBMITTALS

Include electrical ratings, dimensions, mounting details, construction materials, grade and termination information.

A. Manuals: Two weeks prior to final inspection, deliver four copies of the following to the College Representative: Technical data sheets and information for ordering replacement units.

B. Certifications: Two weeks prior to final inspection, submit four copies of the following to the College Representative: Certification by the Contractor that the devices comply with the drawings and specifications, and have been properly installed, aligned, and tested.

PART 2 - PRODUCTS

2.01 RECEPTACLES

A. General: All receptacles shall be listed by Underwriters Laboratories, Inc.

1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.

B. Duplex receptacles shall be single phase, 20 ampere, 120 volts, 2-pole, 3-wire, and conform to the NEMA 5-20R configuration in NEMA WD 6. The duplex type shall have break-off feature for two-circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal.

1. Bodies shall be ivory in color.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be unswitched.
3. Duplex Receptacles on Emergency Circuit:

    a. Bodies shall be red in color. Wall plates shall be red with the word "EMERGENCY" engraved in 6 mm, (1/4 inch) white letters.

4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit suitable for mounting in a standard outlet box.

a. Ground fault interrupter shall be hospital grade and consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. It shall be rated for operation on a 60 Hz, 120 volt, 20-ampere branch circuit. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliamp) on the load side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second. Devices shall meet UL 943.

5. Safety Type Duplex Receptacles:

a. Bodies shall be gray in color.
b. Shall be hospital grade, as above with the following additional requirements.

1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
2) Screws exposed while the wall plates are in place shall be the tamperproof type.

c. Shall be installed in the following locations:

1) Housekeeping quarters, buildings, waiting areas and lobbies where children might be present.

6. Isolated Ground Type Duplex Receptacles:

a. Bodies shall be orange in color.
b. Shall be hospital grade and UL listed as “Isolated Ground”.

7. Duplex Receptacles (not hospital grade): Shall be the same as hospital grade duplex receptacles except for the "hospital grade" listing and as follows.

a. Bodies shall be brown phenolic compound supported by a plated steel mounting strap having plaster ears.
b. Shall be NEMA WD 1 heavy duty type.

C. Receptacles; 20, 30 and 50 ampere, 250 volts: Shall be complete with appropriate cord grip plug. Devices shall meet UL 231.

D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

E. Lamp Receptacles for Outlet Box Mounting:

1. For use on standard 75 mm (3 inch) and 100 mm (4 inch) outlet boxes.
2. Keyless, porcelain body and skirt supporting a medium screw shell socket, and integral 3-wire grounding receptacle shall have screw terminals and a minimum rating of 600 watts.

3. Porcelain neck shall have shade holder groove.

2.02 TOGGLE SWITCHES AND DIMMERS

A. Toggle switches shall be totally enclosed tumbler type with bodies of phenolic compound. Toggle handles shall be ivory in color unless otherwise specified. The rocker type switch is not acceptable and will not be approved.

1. Switches installed in hazardous areas shall be explosion proof type in accordance with the NEC and as shown on the drawings.
2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self-grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
3. Shall be color coded for current rating, listed by Underwriters Laboratories, Inc., and meet the requirements of NEMA WD 1, Heavy-Duty and UL 20.
4. Ratings:

    a. 120 volt circuits: 20 amperes at 120-277 volts AC.
    b. 277 volt circuits: 20 amperes at 120-277 volts AC.

5. The switches shall be mounted on the striker plate side of doors.
6. Incorporate barriers between switches with multigang outlet boxes where required by the NEC.
7. Switches connected to isolated type electrical power systems shall be double pole.
8. All toggle switches shall be of the same manufacturer.

B. Dimmers: Incandescent modular dimming systems.

1. Incandescent dimming system shall be 2000 watt modular type, with capability for "slaving" larger loads from the "master". System shall have capability of adding additional "slaves", controlled from the original basic dimmer "master". All units shall track with "master". Control units shall be identified by phase type as shown on the drawings. Dimmers shall have low and intensity adjustment and built-in transient voltage protection and fused on the load side. All remote mounted units shall be completely enclosed in integral metal housing. "Master", "Slaves" and controls shall be of the same manufacturer. All dimmers shall be listed by Underwriters Laboratories, Inc.

C. Dimmers: Incandescent lamp loads. Wall-mounted incandescent dimmers shall be specification grade with capability of raising and lowering the lighting from completely off at extreme counter-clockwise rotation, to full intensity. Dimmers shall include an “off” position. Dimmers shall maintain full load rating even when two or more units are installed adjacent to one another. All wall-mounted dimmers shall be of the same manufacturer.

D. Dimmers: Fluorescent lamp loads. Wall-mounted fluorescent lamp dimmers shall be specification grade with large control knob and shall be capable of raising and lowering the lighting from completely off at extreme counter-clockwise rotation, to full intensity. Dimmers shall include an “off” position. Dimmers shall have low end intensity adjustment and maintain full load rating even when two or more units are installed adjacent to one another. All wall-mounted dimmers shall be of the same manufacturer. Dimming ballast shall be provided for each F32 rapid start lamp or pair of lamps. Dimmers shall have adequate capacity for the load served and the environment in which installed.

2.03 WALL PLATES

A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.

B. Color shall be ivory unless otherwise specified.

C. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD1.

D. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

F. Wall plates for data, telephone or other communication outlets shall be as specified in the associated specification.

2.04 SURFACE MULTIPLE-OUTLET ASSEMBLIES

A. Assemblies shall conform to the requirements of NFPA 70 and UL 5.

B. Shall have the following features:

1. Enclosures:

    a. Thickness of steel shall be not less than 1 mm (0.040 inch) steel for base and cover. Nominal dimension shall be 40 by 70 mm (1-1/2 by 2-3/4 inches) with inside cross sectional area not less than 2250 square mm (3.5 square inches). The enclosures shall be thoroughly cleaned, phosphatized and painted at the factory with primer and the manufacturer's standard baked enamel or lacquer finish.

2. Receptacles shall be duplex, hospital grade. See paragraph 'RECEPTACLES' in this section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
3. Unless otherwise shown on drawings, spacing of the receptacles along the strip shall be 600 mm (24 inches) on centers.
4. Wires within the assemblies shall be not less than No. 12 AWG copper, with 600 volt ratings.
5. Installation fittings shall be designed for the strips being installed including bends, offsets, device brackets, inside couplings, wire clips, and elbows.
6. Bond the strips to the conduit systems for their branch supply circuits.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with the NEC and as shown as on the drawings.

B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the green equipment grounding conductor.

END

SECTION 16150

MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION:

This section specifies the furnishing, installation and connection of motors.

1.03 SUBMITTALS

A. In accordance with Section 16050, BASIC METHODS AND REQUIREMENTS (ELECTRICAL), submit the following:

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, horsepower, RPM, enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and application data.

D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the Resident Engineer:

1. Certification that the motors have been properly applied, installed, adjusted, lubricated, and tested.

1.04 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. National Electrical Manufacturers Association (NEMA):

MG 1-98 .....Motors and Generators

MG 2-01 .....Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators

C. National Fire Protection Association (NFPA):

70-02 .....National Electrical Code (NEC)

PART 2 – PRODUCTS

2.01 MOTORS

A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.

B. Voltage ratings shall be as follows:

1. Single phase:

   a. Motors connected to 120-volt systems: 115 volts.
   b. Motors connected to 208-volt systems: 200 volts.
   c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.

2. Three phase:
   a. Motors connected to 208-volt systems: 200 volts.
   b. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
   c. Motors, 74.6 kW (100 HP) or larger, connected to 240-volt systems: 230 volts.
   d. Motors, 74.6 kW (100 HP) or larger, connected to 480-volt systems: 460 volts.
   e. Motors connected to high voltage systems: Shall conform to NEMA Standards for connection to the nominal system voltage shown on the drawings.

C. Number of phases shall be as follows:

1. Motors, less than 373 W (1/2 HP): Single phase.
2. Motors, 373 W (1/2 HP) and larger: 3 phase.
3. Exceptions:

   a. Hermetically sealed motors.
   b. Motors for equipment assemblies, less than 746 W (one HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.

F. Motor Enclosures:

1. Shall be the NEMA types shown on the drawings for the motors.

2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being

installed.

3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

G. Additional requirements for specific motors, as indicated in other sections, shall also apply.

H. Energy-Efficient Motors (Motor Efficiencies): All permanently wired poly-phase motors of 746 Watts or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 746 Watts or more with open, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

Minimum Efficiencies Open Drip-Proof				Minimum Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM	Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

I. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.

J. Premium efficiency motors shall be used where energy cost/kW x (hours use/year) > 50.

PART 3 – EXECUTION

3.01 INSTALLATION

Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

3.02 FIELD TESTS

Megger all motors after installation, before start-up. All shall test free from grounds.

END

SECTION 16155

MOTOR STARTERS

PART 1 - GENERAL

1.0 DESCRIPTION

All motor starters and motor control stations including installation and connection (whether furnished with the equipment specified in other Divisions or otherwise) shall meet these specifications.

1.02 RELATED WORK

A. Other sections which specify motor driven equipment, except elevator motor controllers.

1.03 SUBMITTALS

A. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with specifications.
2. Include electrical ratings, dimensions, weights, mounting details, materials, running over current protection, size of enclosure, over current protection, wiring diagrams, starting characteristics, interlocking and accessories.

B. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams and information for ordering replacement parts.

    a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance and operation.
    b. Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.
    c. Elementary schematic diagrams shall be provided for clarity of operation.

2. Two weeks prior to the project final inspection, submit four copies of the final updated maintenance and operating manual to the College Representative. (Update manual to include any information necessitated by shop drawing approval).

C. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certifications to the College Representative:

1. Certification by the manufacturer that the controllers have passed the factory 24-hour operational test. (This certification must be furnished to the College Representative prior to shipping the controller to the job site.)
2. Certification by the manufacturer that high voltage motor controller(s) conforms to the

requirements of the drawings and specifications. (This certification must be furnished to the College Representative prior to shipping the controller to the job site.).

3. Certification that the equipment has been properly installed, adjusted, and tested.

1.04 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

B. Institute of Electrical and Electronic Engineers (IEEE):

519-92 .....Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
C37.90.1-02 .....Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

C. National Electrical Manufacturers Association (NEMA):

ICS 1-00 .....Industrial Control and Systems General Requirements
ICS 1.1-03 .....Safety Guidelines for the Application, Installation and Maintenance of Solid State Control
ICS 2-00 .....Industrial Control and Systems, Controllers, Contactors and Overload Relays Rated 600 Volts DC
ICS 6-01 .....Industrial Control and Systems Enclosures
ICS 7-00 .....Industrial Control and Systems Adjustable-Speed Drives

ICS 7.1-00 .....Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems

D. National Fire Protection Association (NFPA):

70-02 .....National Electrical Code (NEC)

E. Underwriters Laboratories Inc. (UL):

508-99 .....Industrial Control Equipment

PART 2 - PRODUCTS

2.01 MOTOR STARTERS, GENERAL

A. Motor starters shall be in accordance with the requirements of the IEEE, NEC, NEMA (ICS 1, ICS 1.1, ICS 2, ICS 6, ICS 7 and ICS 7.1) and UL.

B. Shall have the following features:

1. Separately enclosed unless part of another assembly.

2. Circuit breakers and safety switches within the motor controller enclosures shall have external operating handles with lock-open padlocking provisions and shall indicate the ON and OFF positions.
3. Motor control circuits:

    a. Shall operate at not more than 120 volts.
    b. Shall be grounded except as follows:

        1) Where isolated control circuits are shown.
        2) Where manufacturers of equipment assemblies recommend that the control circuits be isolated.

    c. Incorporate a separate, heavy duty, control transformer within each motor controller enclosure to provide the control voltage for each motor operating over 120 volts.
    d. Incorporate over current protection for both primary and secondary windings of the control power transformers in accordance with the NEC.

4. Overload current protective devices:

    a. Overload relay (thermal or induction type.)
    b. Overload relay (solid state type.)
    c. One for each pole.
    d. Manual reset on the door of each motor controller enclosure.
    e. Correctly sized for the associated motor's rated full load current.
    f. Check every motor controller after installation and verify that correct sizes of protective devices have been installed.
    g. Deliver four copies of a summarized list to the Resident Engineer, which indicates and adequately identifies every motor controller installed. Include the catalog numbers for the correct sizes of protective devices for the motor controllers.

5. Hand-Off-Automatic (H-O-A) switch is required unless specifically stated on the drawings as not required for a particular starter. H-O-A switch is not required for manual motor starters.

6. Incorporate into each control circuit a 120-volt, solid state time delay relay (ON delay), minimum adjustable range from 0.3 to 10 minutes, with transient protection. Time delay relay is not required where H-O-A switch is not required.

7. Auxiliary contacts, pilot lights, pushbuttons and other devices and accessories as shown on the drawings or otherwise required.

8. Enclosures:

    a. Shall be the NEMA types shown on the drawings for the motor controllers.
    b. Shall be the NEMA types which are the most suitable for the environmental conditions where the motor controllers are being installed.
    c. Doors mechanically interlocked to prevent opening unless the breaker or switch within the enclosure is open. Provision for padlock must be provided.
    d. Enclosures shall be primed and finish coated at the factory with the manufacturer’s prime coat and standard finish.

C. Motor controllers incorporated with equipment assemblies shall also be designed for the specific requirements of the assemblies.

D. For motor controllers being installed in existing motor control centers or panelboards, coordinate with the existing centers or panelboards.

E. Additional requirements for specific motor controllers, as indicated in other sections, shall also apply.

F. Provide a disconnecting means or safety switch near and within sight of each motor. Provide all wiring and conduit required to facilitate a complete and code complied installation.

G. Refer to paragraph, MOTOR CONTROL STATIONS, in this section for additional requirements.

2.02 MANUAL MOTOR STARTERS

A. Shall be in accordance with applicable requirements of 2.1 above.

B. Manual motor starters.

1. Starters shall be AC, general-purpose Class A, manually operated type with full voltage controller for induction motors, rated in horsepower.
2. Units shall include overload and low voltage protection, red pilot light, NC auxiliary contact and toggle operator.

C. Fractional horsepower manual motor starters.

1. Starters shall be AC, general-purpose Class A, manually operated with full voltage controller for fractional horsepower induction motors.
2. Units shall include thermal overload protection, red pilot light and toggle operator.

D. Motor starting switches.

1. Switches shall be AC, general-purpose Class A, manually operated type with full voltage controller for fractional horsepower induction motors.
2. Units shall include thermal overload protection, red pilot light, low voltage protection, NC auxiliary contact and toggle operator.

2.03 MAGNETIC MOTOR STARTERS

A. Shall be in accordance with applicable requirements of 2.1 above.

B. Starters shall be AC, general-purpose, Class A magnetic controllers for induction motors rated in horsepower. Minimum size 0.

C. Where combination motor starters are used, combine starter with protective or disconnect device in a common enclosure.

D. Provide phase loss protection for each starter, with contacts to de-energize the starter upon loss of any phase.

2.04 REDUCED VOLTAGE MOTOR CONTROLLERS

A. Shall be in accordance with applicable portions of 2.1 above.

B. Shall be installed where shown for motors on the contract drawings.

C. Shall have closed circuit transition for the types which can incorporate such transition.

D. Shall limit inrush currents to not more than 70 percent of the locked rotor currents.

E. Provide phase loss protection for each starter, with contacts to de-energize the starter upon loss of any phase.

2.05 HIGH VOLTAGE MOTOR CONTROLLERS

A. Shall be in accordance with applicable portions of 2.1 above.

B. Shall have the following additional features:

1. Metal enclosed, free-standing, air break, reduced voltage, primary reactor, drawout type combined with fused disconnect switch.
2. Shall include the following components:

    a. Three pole, air break, drawout type, start contactor.
    b. Three pole, air break, drawout type, run contactor. Primary reactor with taps for 50, 65 and 80 percent of line voltage.
    c. Definite time transfer relay.
    d. Three current limiting, power type fuses.
    e. Control power transformer, protected with current limiting fuses.
    f. Three current transformers and over current protective devices.
    g. Zero-sequence current transformers and associated devices for ground fault protection.
    h. Under voltage protection.
    i. Protection against single phasing.
    j. Stator thermal protection.
    k. Indicating type ammeter and selector switch.
    l. Red and green indicating lights.

3. A separate enclosure for each motor controller.
4. Shall be isolated by an externally operated mechanism. The secondary of the control power transformer shall also be opened by that device.
5. Suitable and adequate compartments and barriers for high voltage components. Isolate the power bus from the normally accessible compartments.
6. High voltage line receptacles shall be shuttered automatically when conductors are in the disconnected position and the disconnection shall be clearly indicated.
7. Interlocks shall include prevention of the following:

a. Inadvertent operation of the isolating mechanism under load.
b. Opening of the high voltage compartment before the controller is isolated.
c. Closing of the line contactor while the door is open.

8. Current and potential transformers for operating remote recording watt-hour and demand meters and the indicating meters at the motor controller.
9. Lock-open padlocking provisions.
10. Furnish accessories as recommended by the manufacturer of the motor controllers to facilitate convenient operation and maintenance of the controllers.

C. Interrupting ratings shall be not less than the maximum short circuit currents available where the controllers are being installed or as indicated on the drawings.

2.06 VARIABLE SPEED MOTOR CONTROLLERS

A. Shall be in accordance with applicable portions of 2.1 above.

B. Shall be solid state, micro processor-based with adjustable frequency and voltage, three phase output capable of driving standard NEMA B design, three phase alternating current induction motors at full rated speed. The drives shall utilize a full wave bridge design incorporating diode rectifier circuitry with pulse width modulation (PWM). Other control techniques are not acceptable. Silicon controlled rectifiers (SCR) shall not be used in the rectifying circuitry. The drives shall be designed to be used on variable torque loads and shall be capable of providing sufficient torque to allow the motor to break away from rest upon first application of power.

C. Shall be rated for input power of 480 volts, three phase, 60 Hz. Unit shall be capable of operating within voltage parameters of plus 10 to minus 10 percent of line voltage, and be suitably rated for the full load amps of the maximum watts (HP) within its class.

D. Each controller shall be factory tested at maximum watts (HP), rated full load current and at an ambient temperature of 40 degrees C for a period of not less than 24 hours. If a component fails, it shall be replaced and the test restarted for the full time period. A certified copy of the factory Test Report shall be furnished to the College Representative prior to shipping the controller to the job site.

E. Controllers shall have the following features:

1. Isolated power for control circuits.
2. Manually re-settable motor overload protection for each phase.
3. Adjustable current limiting circuitry to provide soft motor starting. Maximum starting current shall not exceed 200 percent of motor full load current.
4. Independent acceleration and deceleration time adjustment, manually adjustable from 2 to 30 seconds. (Set timers to the equipment manufacturer's recommended time in the above range.)
5. Provide 4 to 20 ma current follower circuitry for interface with mechanical sensor devices.
6. Automatic frequency adjustment from 20 Hz to 60 Hz.
7. Provide circuitry to initiate an orderly shutdown when any of the conditions listed below occur. The controller shall not be damaged by any of these electrical disturbances and shall automatically restart when the conditions are corrected:

a. Incorrect phase sequence.
b. Single phasing.
c. Over voltage in excess of 10 percent.
d. Under voltage in excess of 10 percent.
e. Running over current above 110 percent (shall not automatically reset for this condition.)
f. Instantaneous overcurrent above 150 percent (shall not automatically reset for this condition).
g. Surge voltage in excess of 1000 volts.

h. Short duration power outages of 12 cycles or less (i.e., distribution line switching, generator testing, and automatic transfer switch operations.)

8. Provide automatic shutdown on receipt of a power transfer warning signal from an automatic transfer switch. Controller shall automatically restart motor after the power transfer.

F. Minimum efficiency shall be 95 percent at 100 percent speed and 85 percent at 50 percent speed.

G. The displacement power factor of the controller shall not be less than 95 percent under any speed or load condition.

H. Controllers shall include a door interlocked fused safety disconnect switch or door interlocked circuit breaker switch which will disconnect all input power.

I. Include a by-pass starter with circuitry to protect and isolate the variable speed controller. When the variable speed controller is in the by-pass mode, the solid-state components shall be isolated from the power supply on both the line and motor side.

J. The following accessories are to be door mounted:

1. AC Power on light.
2. Ammeter (RMS motor current).
3. HAND-OFF-AUTOMATIC switch.
4. Manual speed control in HAND mode.
5. System protection lights indicating that the system has shutdown and will not automatically restart.
6. System protection light indicating that the system has shutdown but will restart when conditions return to normal.
7. Manual variable speed controller by-pass switch.
8. Diagnostic shutdown indicator lights for each shutdown condition.
9. Provide two N.O. and two N.C. dry contacts rated 120 volts, 10 amperes, 60 HZ for remote indication of the following:

a. System shutdown with auto restart.
b. System shutdown without auto restart.
c. System running.

10. Incorporate into each control circuit a 120-volt, time delay relay (ON delay), adjustable from 0.3-10 minutes, with transient protection. Provide transformer/s for the control circuit/s.

11. Controller shall not add any current or voltage transients to the input AC power distribution system nor shall transients from other devices on the AC power distribution system affect the controller. Controllers shall be protected to comply with IEEE C37.90.1 and UL-508. Line noise and harmonic voltage distortion shall not exceed the values allowed by IEEE 519. Include Harmonic filter within the enclosure of the VFD.

2.07 MOTOR CONTROL STATIONS

A. Shall have the following features:

1. Designed for suitably fulfilling the specific control functions for which each station is being installed.
2. Coordinate the use of momentary contacts and maintained contacts with the complete motor control systems to insure safety for people and equipment.
3. Each station shall have two pilot lights behind red and green jewels and a circuit to its motor controller. Connect the lamps so they will be energized as follows:

    a. Red while the motor is running.
    b. Green while the motor is stopped.

4. Where two or more stations are mounted adjacent to each other, install a common wall plate, except where the designs of the stations make such common plates impracticable.
5. Identify each station with a permanently attached individual nameplate, of laminated black phenolic resin with a white core and engraved lettering not less than 6 mm (1/4-inch) high. Identify the motor by its number or other designation and indicate the function fulfilled by the motor.

B. Components of Motor Control Circuits:

1. Shall also be designed and arranged so that accidental faulting or grounding of the control conductors will not be able to start the motors.
2. Use of locking type STOP pushbuttons or switches, which cause motors to restart automatically when the pushbuttons or switches are released, will not be permitted.

2.08 PROVIDE INTERNALLY INTEGRATED SURGE PROTECTIVE DEVICES FOR EACH CONTROLLER:

A. Integral Surge Suppressor:

1. SPD (Surge Protective Devices) shall be Component Recognized and listed in accordance with UL 1449 Second Edition to include Section 37.3 highest fault category testing on devices intended for service entrance use. SPD shall also be UL 1283 listed.
2. SPD shall be UL 67 listed, installed by and shipped from the electrical distribution equipment manufacturer's factory.
3. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G, in WYE systems, and L-L, L-G in DELTA systems.
4. SPD shall be modular in design. Each mode shall be fused with a 200kAIC; UL recognized surge rated fuse and incorporate a thermal cutout device.
5. SPD shall be integrally mounted to the bus bars of the switchboard.
6. Audible diagnostic monitoring shall be by way of audible alarm. This alarm shall activate upon a

fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided as well.

7. SPD shall meet or exceed the following criteria:

   a. Maximum surge current capability (single pulse rated) per phase shall be:

      1) Service Entrance Switchboard 250 kA.
      2) Distribution Panelboards 160 kA
      3) Branch Panelboards 160 kA
      4) Service Entrance MCC 240 kA specified.
      5) Distribution Class MCC 160 kA

   b. UL 1449 Second Edition Listed and Recognized Component Suppression Voltage Ratings (SVR's) for Service Entrance and Distribution Location equipment shall not exceed the following:

   c. Voltage Let-Thru values for Solidly Grounded Systems:

VOLTAGE	L-N	L-G	N-G
208Y/120	400V	400V	400V
480Y/277	800V	800V	800V

8. PD shall have a minimum EMI/RFI filtering of –50Db at 100 kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology.

9. PD shall have the following diagnostic features: transient counter, status lights on each phase, and one set of 1 NO and 1 NC auxiliary dry contacts for alarming.

10. SPD shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if transients destroy them during the warranty period. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install motor control equipment in accordance with manufacturer's recommendations, the NEC, NEMA and as shown on the drawings.

B. Install Variable Speed Motor Controllers in accordance with manufacturers recommendations, the NEC, as shown on the drawings and in accordance with NEMA ICS 7.1.C.

C. Furnish and install heater elements in motor starters to match the installed motor characteristics.

3.02 SPARE PARTS

Two weeks prior to the final inspection, provide one complete set of spare fuses (including heater elements) for each starter/controller installed on this project.

END

SECTION 16160

PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the furnishing, installation and connection of panelboards.

1.02 RELATED WORK

A. PAINTING: Identification and painting of panelboards.

B. BASIC METHODS AND REQUIREMENTS (ELECTRICAL): General electrical requirements and items that are common to more than one Section of Division 16.

C. CONDUIT SYSTEMS: Conduits and outlet boxes.

D. CABLES, LOW VOLTAGE (600 VOLTS AND BELOW): Cables and wiring.

E. GROUNDING: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.03 SUBMITTALS

A. Submit in accordance with BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, wiring diagrams accessories and weights of equipment. Complete nameplate data including manufacturer's name and catalog number.

C. Certification: Two weeks prior to final inspection, submit four copies of the following to the College Representative.

1. Certification that the material is in accordance with the drawings and specifications has been properly installed, and that the loads are balanced.

1.04 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

A. National Electrical Manufacturers Association (NEMA):

PB-1-2006.....Panelboards
AB-1-2002 .....Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures

B. National Fire Protection Association (NFPA):

70-2005 .....National Electrical Code (NEC)
70E-2004 .....Standard for Electrical Life Safety in the Workplace

C. Underwriters Laboratories, Inc. (UL):

50-2003 .....Enclosures for Electrical Equipment
67-2003 .....Panel boards
489-2006 .....Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. Panelboards shall be in accordance with UL, NEMA, NEC.
B. Panelboards shall be standard manufactured products. All components of the panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.

C. All panelboards shall be hinged “door in door” type with:

1. Interior hinged door with hand operated latch or latches as required to provide access to circuit breaker operating handles only, not to energized ports.
2. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips or other fasteners requiring a tool for entry, hand operated latches are not acceptable.
3. Push inner and outer doors shall open left to right.

D. All panelboards shall be completely factory assembled with molded case circuit breakers. Include one-piece removable, inner dead front cover independent of the panelboard cover.

E. Panelboards shall have main breaker or main lugs, bus size, voltage, phase, top or bottom feed, and flush or surface mounting as scheduled on the drawings.

F. Panelboards shall conform to NEMA PB-1, NEMA AB-1 and UL 67 and have the following features:

1. Non-reduced size copper or aluminum bus bars, complete with current ratings as shown on the panel schedules connection straps bolted together and rigidly supported on molded insulators.
2. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type. Single-phase, three-wire panelboard busing shall be such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two-or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be

plated. Mains ratings shall be as shown.

3. Mechanical lugs furnished with panelboards shall be cast, stamped or machined metal alloys of sizes suitable for the conductors indicated to be connected thereto.
4. Neutral bus shall be either 100% or 200% rated as required by panel type and location and will be mounted on insulated supports.
5. Grounding bus bar equipped with screws or lugs for the connection of grounding wires.
6. Buses braced for the available short circuit current, but not less than 22,000 amperes symmetrical for 120/208 volt and 120/240 volt panelboards, and 14,000 amperes symmetrical for 277/480-volt panelboards.
7. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.
8. Protective devices shall be designed so that they can be easily replaced.
9. Where designated on panel schedule "spaces", include all necessary bussing, device support and connections. Provide blank cover for each space.
10. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with sub-feed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panels, and with cable connections to the second section. Panelboard sections with tapped bus or crossover bus are not acceptable.
11. Series rated panelboards are not permitted.

2.02 CABINETS AND TRIMS

A. Cabinets:

1. Provide galvanized steel cabinets to house panelboards. Cabinets for outdoor panels shall be factory primed and suitably treated with a corrosion-resisting paint finish meeting UL 50 and UL 67.
2. Cabinet enclosure shall not have ventilating openings.
3. Cabinets for panelboards may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.

2.03 MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

A. Breakers shall be UL 489 listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.

B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar.

1. Molded case circuit breakers for lighting and appliance branch circuit panelboards shall have minimum interrupting rating as indicated but not less than:

    a. 120/208 Volt Panelboard: 22,000 amperes symmetrical.
    b. 120/240 Volt Panelboard: 22,000 amperes symmetrical.
    c. 277/480 Volt Panelboard: 14,000 amperes symmetrical.

2. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100-ampere frame or less. Magnetic trip shall be adjustable from 3X to 10X for breakers with 600 ampere frames and higher. Breaker trip setting shall be set in the field based on the approved protective device study as specified in Section 16051, Factory setting

shall be HI, unless otherwise noted.

C. Breaker features shall be as follows:

1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.

    a. Line connections shall be bolted.
    b. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals as indicated on the drawings.

8. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
9. Shunt trips shall be provided where indicated
10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory.

2.04 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.

B. Enclosures are to be of the NEMA types shown on the drawings. Where the types are not shown, they are to be the NEMA type most suitable for the environmental conditions where the breakers are being installed.

PART 3 - EXECUTION

3.01. INSTALLATION

A. Installation shall be in accordance with the Manufacturer's instructions, the NEC, as shown on the drawings, and as specified.

B. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of cabinets with designated closet space.

C. Paint the panelboard system voltage, and feeder sizes as shown on the riser diagram in 1 inch block lettering on the inside cover of the cabinet door. Paint the words "LIFE SAFETY BRANCH", "CRITICAL BRANCH", or "EQUIPMENT SYSTEM" as applicable and the panel designation in one inch block letters on the outside of the cabinet doors.

D. Install a typewritten schedule of circuits in each panelboard after being submitted to and approved

by the College Representative. Schedules, after approval, shall be typed on the panel directory cards and installed in the appropriate panelboards, incorporating all applicable contract changes pertaining to that schedule. Include the room numbers and items served on the cards.

E. Mount the panelboard fully aligned and such that the maximum height of the top circuit breaker above finished floor shall not exceed 1980 mm (78 inches). For panelboards that are too high, mount panelboard so that the bottom of the cabinets will not be less than 150 mm (6 inches) above the finished floor.

F. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.

G. Directory-card information shall be typewritten to indicate outlets, lights, devices, and equipment controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

H. Where new panels are to be installed in existing backboxes, backboxes shall have rust and scale removed from inside. Paint inside of backboxes with rust preventive paint before the new panel interior is installed. Provide new trim and doors for these panels. Covers shall fit tight to the box with no gaps between the cover and the box.

I. Provide ARC flash identification per NFPA 70E.

END

SECTION 16170

DISCONNECT SWITCHES (MOTOR AND CIRCUIT)

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the furnishing, installation and connection of low voltage disconnect switches.

1.02 RELATED WORK

A. General electrical requirements and items that is common to more than one section of Division 16: Section 16050, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

C. Cables and wiring: Section 16127, CABLES, LOW VOLTAGE (600 VOLTS AND BELOW).

D. Motor rated toggle switches.

E. Requirements for personnel safety and to provide a low impedance path for possible ground fault.

1.03 SUBMITTALS

A. Shop Drawings:

1. Include sufficient information, clearly presented to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, enclosure types, fuse type and class.
3. Show the specific switch and fuse proposed for each specific piece of equipment or circuit.

B. Manuals:

1. Provide complete maintenance and operating manuals for disconnect switches, including technical data sheets, wiring diagrams, and information for ordering replacement parts. Deliver four copies to the College Representative two weeks prior to final inspection.
2. Identify terminals on wiring diagrams to facilitate maintenance and operation.
3. Wiring diagrams shall indicate internal wiring and any interlocking.

C. Certification: Two weeks prior to final inspection, deliver to the College Representative four copies of the certification that the equipment has been properly installed, adjusted, and tested.

1.04 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. National Electrical Manufacturers Association (NEMA):

KS l-01 .....Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

C. National Fire Protection Association (NFPA):

70-05 .....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

98-98 .....Enclosed and Dead-Front Switches
198C-89 .....High-Interrupting-Capacity Fuses, Current Limiting Types
198E-94 .....Class R Fuses
977-99 .....Fused Power-Circuit Devices

PART 2 - PRODUCTS

2.01 LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

A. Shall be quick-make, quick-break type in accordance with UL 98, NEMA KS 1 and NEC.

B. Shall have a minimum duty rating, NEMA classification General Duty (GD) for 240 volts and NEMA classification Heavy Duty (HD) for 277/480 volts.

C. Shall be horsepower rated.

D. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the OFF position.
3. An arc chute for each pole.
4. External operating handle shall indicate ON and OFF position and shall have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground Lugs: One for each ground conductor.
9. Enclosures:

    a. Shall be the NEMA types shown on the drawings for the switches.
    b. Where the types of switch enclosures are not shown, they shall be the NEMA types which are most suitable for the environmental conditions where the switches are being installed. Unless otherwise indicated on the plans, all outdoor switches shall be NEMA 3R.
    c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel (for the type of enclosure required).

2.02 LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

Shall be the same as Low Voltage Fusible Switches Rated 600 Amperes and Less, but no fuses.

2.04 MOTOR RATED TOGGLE SWITCHES

Refer to Section 16155 for motor rated toggle switches.

2.05 IDENTIFICATION SIGNS

A. Install nameplate identification signs on each disconnect switch to identify the equipment controlled.

B. Nameplates shall be laminated black phenolic resin with a white core, with engraved lettering, a minimum of 6 mm (1/4-inch) high. Secure nameplates with screws.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install disconnect switches in accordance with the NEC and as shown on the drawings.

B. Fusible disconnect switches shall be furnished complete with fuses.

3.02 SPARE PARTS

Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fusible disconnect switch installed on the project. Deliver the spare fuses to the College Representative

END

SECTION 16251

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the furnishing, complete installation, and connection of automatic transfer switches.

1.02 RELATED WORK

A. BASIC METHODS AND REQUIREMENTS (ELECTRICAL): General electrical requirements and items that is common to more than one section of Division 16.

B. ELECTRICAL SYSTEM PROTECTION DEVICE STUDY: Requirements for coordinated electrical system.

C. Section 16127, CABLES, LOW VOLTAGE (600 Volts and Below): Cables and Wiring.

D. GROUNDING: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.

1.03 QUALITY ASSURANCE

A. Contractor shall provide emergency maintenance and repair services at the project site within __2__ hour maximum response time from time of call.

B. Automatic transfer switch, bypass/isolation switch and annunciation control panels shall be products of same manufacturer.

C. Comply with OSHA – 29 CFR 1910.7 for the qualifications of the testing agency.

1.04 SUBMITTALS

A. Submit in accordance with BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings (including withstand), dimensions, weights, mounting details, conduit entry provisions front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, and accessories.
3. Complete nameplate data, including manufacturer's name and catalog number.
4. A copy of the markings that are to appear on the transfer switches when installed.

C. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating and maintenance manuals including technical data sheets, wiring diagrams and information, such as telephone number, fax number and web sites, for ordering replacement parts.
2. Two weeks prior to final inspection, submit four copies of a final updated maintenance and operating manual to the College Representative.

    a. Include complete "As installed" diagrams, which indicate all items of equipment and their interconnecting wiring.
    b. Include complete diagrams of the internal wiring for each of the items of equipment, including "As installed" revisions of the diagrams.
    c. The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation and testing.

D. Certifications:

1. Submit, simultaneously with the shop drawings, a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 (Prototype testing).
2. Additionally when transfer switches are used with power air circuit breakers having short-time trip elements without instantaneous trip elements provide a certified test report showing that the sample has passed the additional withstand requirements of this specification. Method of test shall be in accordance with UL 1008. Main contact separation as measured by an oscillograph voltage trace across the contacts will not be allowed during this test. Welding or burning of contacts is unacceptable.
3. Two weeks prior to final inspection, submit four copies of the following to the College Representative:

    a. Certification that no design changes have been made to the switch or its components since last certified by UL or as tested by an independent laboratory.
    b. Certification by the manufacturer that the equipment conforms to the requirements of the drawings and specifications.
    c. Certification by the Contractor that the equipment has been properly installed, adjusted, and tested.
    d. A certified test report from an independent laboratory that a representative sample has passed the ANSI surges withstand test for transfer switches which incorporate solid-state components.

1.05 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only:

B. Institute of Electrical and Electronic Engineers (IEEE):

446-95 .....Recommended Practice for Design and Maintenance of Emergency and Standby Power Systems

C37.90.1-02 .....IEEE Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

C. National Electrical Manufacturers Association (NEMA):

250-03 .....Enclosure for Electrical Equipment (1000 Volts Maximum).
ICS 6-01 .....Industrial Control and Systems Enclosures IC3 4 Industrial Control and Systems: Terminal Blocks
MG 1-03 .....Motors and Generators, Revision 1

D. National Fire Protection Association (NFPA):

70–05 .....National Electrical Code (NEC)
99-05 .....Health Care Facilities
110 .....Emergency and Standby Power Systems

E. Underwriters Laboratories, Inc. (UL):

50-03 .....Enclosures for Electrical Equipment
508-02 .....Industrial Control Equipment
891-03 .....Dead-Front Switchboards
1008-03 .....Transfer Switch Equipment

PART 2 - PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCHES

A. General:

1. Comply with UL, NEMA, NEC, ANSI and NFPA.
2. Automatic transfer switches are to be electrically operated, mechanically held open contact type, without integral overcurrent protection. Transfer switches utilizing automatic or non-automatic molded case circuit breakers as switching mechanisms are not acceptable.
3. The unit shall be completely factory-assembled and wired so that only external circuit connections are required in the field. The unit shall include, but not be limited to, operating mechanism, main contacts, auxiliary contacts, timers, pilot lights, switches, and auxiliary sensing devices.
4. Each transfer switch shall be equipped with bypass/ isolation switch. The switch shall be part of the transfer switch.

B. Ratings, Markings and Tests:
1. Ratings:

   a. Phase, voltage, ampere rating, number of poles, withstand rating shall be as shown on the drawings. The ampere rating shall be for 100 percent continuous load current.
   b. Transfer switches are to be rated for total system transfer on emergency systems.
   c. Ratings shall be with non-welding of contacts during the performance of withstand and closing tests.
   d. Maximum automatic transfer switch rating: 800 amperes

2. Markings:

   a. Markings shall be in accordance with UL 1008.
   b. Markings for the additional withstand test hereinafter specified shall be included in the nameplate data.

3. Tests:

   a. Transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device.
   b. Where used with molded case circuit breakers or power air circuit breakers with long-time and instantaneous trip, transfer switch withstand and closing rating shall equal or exceed the available short circuit current shown on the drawings, but shall not be less than the following:

Switch Rating (Amperes)	Withstanding Amperes (RMS Symmetrical)	Circuit Power Factor
Up to 100	22,000	Per UL
101 to 260	35,000	Per UL
261 to 400	42,000	Per UL
410 to 600	50,000	Per UL
601 to 1200	65,000	Per UL
1201 to 4000	85,000	Per UL

4. Additional Withstand Test:

   a. See paragraph 1.4.D.1 for certification of "Withstand Test."
   b. Where used with power air circuit breakers with long-time and short-time trips without instantaneous trip, transfer switch withstand rating shall be based on the available short circuit current (RMS symmetrical) for a duration of ten cycles.

5. Surge Withstand Test:

   a. Transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with ANSI C37.90.1.

C. Housing:

1. Enclose transfer switches in steel cabinets in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings. NEMA ICS 6 Type as indicated on the drawings.

2. Doors: Shall have three-point latching mechanism.
3. Padlocking Provisions: Provide chain for attaching a padlock. Attach chain to the cabinet by welding or riveting.
4. Finish: Cabinets shall be given a phosphate treatment, painted with rust inhibiting primer, and finish painted with the manufacturer's standard enamel or lacquer finish.

2.02 FEATURES

A. Transfer switches shall include the following features:

1. Operating Mechanism:
   a. Actuated by an electrical operator.
   b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in both normal and emergency position.
   c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
   d. Shall not include a neutral position.
   e. Contact transfer time shall not exceed six cycles.
   f. Do not use as a current carrying part. Components and mechanical interlocks shall be insulated or grounded.

2. Contacts:

   a. For switches 400 amperes and larger, protect main contacts by separate arcing contacts and magnetic blowouts for each pole. Arc quenching provisions equivalent to magnetic blowouts will be considered acceptable.
   b. Current carrying capacity of arcing contacts shall not be used in the determination of the transfer switch rating, and shall be separate from the main contacts.
   c. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.

3. Manual Operator:

   a. Capable of operation in either direction under no load.
   b. Capable of operation by one person.

   c. Provide a warning sign to caution against operation when energized.

4. Replaceable Parts:

   a. Include the main and arcing contact individually or as units, relays, and control devices.
   b. Switch contacts and accessories are to be replaceable from the front without removing the switch from the cabinet and without removing main conductors.

5. Sensing Relays:

   a. Provide voltage-sensing relays in each phase of the normal power supply.
   b. Provide adjustable voltage and frequency sensing relays in one phase of the auxiliary power supply.

6. Controls:

   a. Control module shall provide indication of switch status –emergency, normal, and be equipped with alarm diagnostic circuitry.
   b. Control module shall control operation of the transfer switch. The sensing and the logic shall be controlled by a microprocessor equipped with digital communication and battery backup. The control shall comply with IEEE 472.

2.03 ACCESSORIES

A. Transfer switches shall include the following accessories:

1. Indicating Lights of different colors:

   a. Green Signal light for normal source position.
   b. Red Signal light for emergency source position.

2. Laminated black phenolic nameplates with white letters to indicate transfer switch position.

B. Manual Test Switch for simulating normal source failure.

C. Engine starting contacts.

D. Time delay relay to accomplish the function as specified.

E. Auxiliary Contacts:

1. Provide contacts for connection to elevator controllers, one closed when transfer switch is connected to normal, and one closed when transfer switch is connected to emergency.
2. Provide additional contacts as necessary to accomplish the functions shown on the drawings, specified, and designated in other sections of these specifications and one spare normally open and normally closed contact.
3. Contacts shall have a minimum rating of ten amperes and be positive acting on pickup and dropout.

F. Remote Indicators:

1. Provide remote pilot lamps to show transfer switch position.
2. Provide remote manual test switch to simulate normal source failure.
3. Provide remote contact to bypass retransfer time delay to normal source.

G. In-Phase Band Monitor: Monitor shall control the operation of the transfer switch. It shall monitor the voltage and frequency of the normal and emergency voltage.

H. Auxiliary Relay: Provide an auxiliary pre-signal relay on all automatic transfer switches, which will feed elevator loads for use as elevator control.

2.04 TRANSFER SWITCH OPERATION

A. A voltage decrease in one or more phases of the normal power source to less than 70 percent of normal shall initiate the transfer sequence. The transfer switch shall start the engine-generator unit after a time delay of two or three seconds to permit override of momentary dips in the normal power source. The time-delay shall be field adjustable from zero to fifteen seconds.

B. The transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator unit have attained 90 percent of rated value.

C. The transfer switch shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to 90 percent or more of normal voltage, and after a time delay. The time delay shall be field adjustable from five to twenty-five minutes (preset for twenty-five minutes). Should the emergency source fail during this time, the transfer switch shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the generator shall continue to run for five minutes unloaded before shut down. Time delay shall be adjustable from zero to fifteen minutes.

D. Engine Start: A voltage decrease, at any transfer switch, in one or more phases of the normal power source to less than 70 percent of normal shall start the engine-generator unit after a time delay of two to three seconds. The time delay shall be field adjustable from zero to fifteen seconds.

E. Transfer to Emergency (Emergency System Loads): Transfer switches for emergency system loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator unit have attained 90 percent of rated value. Only those switches with deficient normal source voltage shall transfer.

F. Transfer to Emergency (Equipment System Loads): Transfer switches for equipment system loads shall transfer their loads to the generator on a time delayed staggered basis, after the emergency system switches have transferred. Total delayed transfer time of an equipment system switches shall not exceed two minutes. Time-delay relays shall be field adjustable zero to two minutes.

G. Retransfer to Normal (All Loads): Transfer switch shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to 90 percent or more of normal voltage, and after a time delay. The time delay shall be field adjustable from five to twenty-five minutes (preset for twenty-five minutes). Should the emergency source fail during this time, the transfer switch shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the generator shall continue to run for five minutes unloaded before shut down. Time delay shall be adjustable from zero to fifteen minutes.

H. Exercise Mode: Transfer to emergency power source shall be accomplished by remote manual test switches on a selective basis.

2.05 BYPASS/ISOLATION SWITCHES (bp/is)

A. Provide two-way bypass/isolation manual type switches. The BP/IS shall permit load by-pass to either normal or emergency power source and complete isolation of the transfer switch, independent of transfer switch position. The switches shall conveniently and electrically bypass and isolate automatic transfer switches, which could not otherwise be safely maintained without disruption of critical loads. Bypass and isolation shall be possible under all conditions including where the automatic transfer switch may be removed from service. Bypass/Isolation switches shall comply with NFPA 110, and shall be factory tested.

B. Operation: The bypass/isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds or less. Provide a lock, which must energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.

1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.

    a. Assure continuity of auxiliary circuits necessary for proper operation of the system.
    b. A red indicating lamp shall light when the automatic transfer switch is bypassed.
    c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.

2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
    a. Interlocking: Provide interlocking as part of the bypass/ isolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
    b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.
    c. Visual verification: The isolation blades shall be visible in the isolated position.

3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine generator with the isolation contacts closed, and the load bypassed without interruption of power to the load.

C. Ratings: The electrical capabilities and ratings of the bypass/isolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

D. Enclosure Construction: Enclosure construction shall be in accordance with UL standards. The bypass/isolation switch shall be mounted in a separate enclosure or separate compartment from the automatic transfer switch. NEMA ICS 6 enclosure rating shall match automatic transfer switch.

E. Diagrams: The manufacturer shall provide specific information on the interconnection and installation of the bypass/isolation switch and automatic transfer switch.

F. The bypass/isolation switch shall also meet all the requirements as specified for an automatic

transfer switch.

2.06 SPARE PARTS

A. Provide six control fuses for each automatic transfer switch of different rating.

B. Provide six pilot lamps of each type used.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install automatic transfer switch(s) in accordance with the NFPA and as shown on the drawings.

B. Level and anchor the automatic transfer(s) switch to floor or wall.

C. Ground equipment as shown on the drawings and as required by NFPA 70.

3.02 START UP AND TESTING

A. After the complete system has been installed, and before energizing the system, check all components of the system, including insulation resistance, phase to phase and phase to ground, complete electrical circuitry and safety features according to the manufacturer's written instructions

B. After energizing circuits, test the interlocking sequence and operation of the complete system, including time delays of transfer from normal source to emergency and back to normal source, pick-up and voltage drop, and function of bypass/isolation switch in the presence of the Resident Engineer prior to the final inspection.

C. When any defects are detected, correct the defects and repeat the test as requested by the College Representative, at no additional cost to the College.

3.03 DEMONSTRATION

At the final inspection in the presence of a College Representative, demonstrate that the complete auxiliary electrical power system operates properly in every respect. Coordinate this demonstration with the demonstration of the engine-generator set.

3.04 TRAINING

Furnish the services of a competent, factory-trained engineer or technician for one four-hour period for instructing College personnel in operation and maintenance of the equipment, including review of the operation and maintenance manual, on a date requested by the College Representative. Coordinate this training with that of the generator training.

END

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies general grounding and bonding requirements of electrical and telecommunication installations for personnel safety, equipment operations and to provide a low impedance path for possible ground fault currents.

B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, lightning protection system and telecommunications system grounding electrodes.

C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

1.02 RELATED WORK

A. BASIC METHODS AND REQUIREMENTS (ELECTRICAL): General electrical requirements and items that are common to more than one section of Division 16.

B. CABLES, LOW VOLTAGE (600 VOLTS AND BELOW): Low Voltage power and lighting wiring.

1.03 SUBMITTALS

A. Submit in accordance with Section 16050, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the College Representative:

1. Certification that the materials and installation is in accordance with the drawings and specifications.
2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.04 APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

A. American Society for Testing and Materials (ASTM):

B1-2001 .....Standard Specification for Hard-Drawn Copper Wire
B8-2004 .....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-1983 .....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C. National Fire Protection Association (NFPA):

70-2005 .....National Electrical Code (NEC)
99-2005 .....Health Care Facilities

D. Telecommunications Industry Association, (TIA)
J-STO-607-A-2002 .....Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

E. Underwriters Laboratories, Inc. (UL):

44-2005 .....Thermoset-Insulated Wires and Cables
83-2003 .....Thermoplastic-Insulated Wires and Cables
467-2004 .....Grounding and Bonding Equipment
486A-486B-2003 .....Wire Connectors

PART 2 - PRODUCTS

2.01 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.

D. Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STO-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper

grounding conductor unless indicated otherwise.

E. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.02 GROUND RODS

A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.

B. Quantity of rods shall be as required to obtain the specified ground resistance.

2.03 SPLICES AND TERMINATION COMPONENTS

Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.04 TELECOMMUNICATION SYSTEM GROUNG BUSBARS

A. Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as follows:

1. Room Signal Grounding: 300 mm x 100 mm (12 inches x 4 inch).
2. Master Signal Ground: 600 mm x 100 mm (24 inches x 4 inch).

2.05 GROUND CONNECTIONS

A. Below Grade: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.

C. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

2.06 EQUIPMENT RACK AND CABINET GROUND BARS

Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

2.07 GROUND TERMINAL BLOCKS

At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.08 SPLICE CASE GROUND ACCESSORIES

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (6 AWG) insulated ground wire with shield bonding connectors.

2.09 COMPUTER ROOM GROUND

Provide 50mm2 (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form an equipotential grounding grid. The equipotential grounding grid shall form a 600mm (24 inch) mesh pattern. The grid shall be bonded to each of the access floor pedestals.

PART 3 - EXECUTION

3.01 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
3. Isolation transformers and isolated power systems shall not be system grounded.

C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 INACCESSIBLE GROUNDING CONNECTIONS

Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.03 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.

B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium or high voltage conductors, sized per NEC except that minimum size shall be 25 mm² (2 AWG). Bond the equipment grounding conductors to the switchgear ground bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions of medium or high voltage cable splices and terminations, and equipment enclosures.

C. Pad Mounted Transformers:

1. Provide a driven ground rod and bond with a grounding electrode conductor to the

transformer grounding pad metal steel.

2. Ground the secondary neutral.

D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

E. Outdoor Metallic Fences around Electrical Equipment: Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.

F. Metallic Conduit: Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.

3.04 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

B. Metallic Piping, Building Steel, and Supplemental Electrode(s):

1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
2. Provide a supplemental ground electrode and bond to the grounding electrode system.

C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.

D. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:

1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.

E. Transformers:

1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.

F. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

H. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

M. Raised Floors: Provide bonding of all raised floor components.

N. Panelboard Bonding: The equipment grounding terminal buses of the normal and essential branch circuit panelboards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than 16 mm^2 (10 AWG). These conductors shall be installed in rigid metal conduit.

3.05 CORROSION INHIBITORS

When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.06 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient ground bus.

3.07 LIGHTNING PROTECTION SYSTEM

Bond the lightning protection system to the electrical grounding electrode system.

3.08 TELECOMMUNICATIONS SYSTEM

A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.

B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.

C. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.

D. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milli ohms or less.

E. Below-Grade Grounding Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly cleaned the joint area. Notify the Resident Engineer prior to backfilling any ground connections.

F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.

G. Bonding Jumpers:

1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm^2 (6 AWG) insulated copper wire.
2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
3. Use compression connectors of proper size for conductors specified. Use connector

manufacturer's compression tool.

H. Bonding Jumper Fasteners:

1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
4. Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.09 ELECTRICAL ROOM GROUNDING

Building Earth Ground Busbars: Provide ground busbar hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

3.10 COMMUNICATION ROOM GROUNDING

A. Telecommunications Ground Busbars:

1. Provide communications room telecommunications ground busbar hardware at 950 mm (18 inches) at locations indicated.
2. Connect the telecommunications room ground busbars to other room grounding busbars as indicated on the Grounding Riser diagram.

B. Telephone-Type Cable Rack Systems: aluminum pan installed on telephone-type cable rack serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:

1. Install a 16 mm² (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
2. Use 16 mm² (6 AWG) bonding jumpers across aluminum pan junctions.

C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:

1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
2. Bond together nonadjacent ground bars on equipment racks and cabinets with 16 mm² (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.

3. Provide a 16 mm² (6 AWG) bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable tray or the raised floor stringer as appropriate.

D. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using an insulated 16 mm² (16 AWG) bonding jumper.

E. Other Communication Room Ground Systems: Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the telecommunications ground busbar, whichever is closer, using insulated 16 mm² (6 AWG) ground wire bonding jumpers.

3.11 COMMUNICATIONS CABLE GROUNDING

A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.

1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

3.12 COMMUNICATIONS CABLE TRAY SYSTEMS

A. Bond the metallic structures of one cable tray in each tray run following the same path to provide 100 percent electrical continuity throughout this cable tray systems as follows:

1. Splice plates provided by the cable tray manufacturer can be used for providing a ground bonding connection between cable tray sections when the resistance across a bolted connection is 10 milliohms or less. The Subcontractor shall verify this loss by testing across one slice plate connection in the presence of the Contractor.
2. Install a 16 mm² (6 AWG) bonding jumper across each cable tray splice or junction where splice plates cannot be used.
3. When cable tray terminations to cable rack, install 16 mm² (6 AWG) bonding jumper between cable tray and cable rank pan.

3.13 COMPUTER ROOM GROUNDING

A. Conduit: ground and bond metallic conduit systems as follows:

1. Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 16 mm (6AWG)bonding jumpers.
2. Bond at all intermediate metallic enclosures and across all joints using 16 mm² (6 AWG) bonding jumpers.

3. Bond every metallic conduit that penetrates the plan of the raised floor to the raised floor stringer system as follows:

   a. Unpainted Supports Attached to Raised Floor System: When conduit/strut clamps are used to attach conduit to Unistrut, no additional bonding is required.
   b. Unpainted Supports Not Attached to Raised Floor System: When conduit/strut clamps are used to attach conduit to Unistrut, use 16 mm² (6 AWG) bonding jumpers to connect Unistrut to the raised floor system.
   c. Painted Supports: Use 16 mm² (6 AWG) bonding jumpers to connect conduit to the stringer system. Mount a push-type conduit fastener onto every metallic conduit. Place fasteners no higher or lower than 75 mm (3 inches) from the raised floor stringer.

B. Equipotential Grounding Grid:

1. Install a bolted stringer system to serve as the computer room equipotential grounding grid.
2. If a bolted stringer system is not provided, install equipotential grounding grid in a 600 mm square grid consisting of 50 mm² (1/0 AWG) bare copper conductor welded at the intersection of each grid.
3. Attach the equipotential ground grid to the room signal ground bus using a 50 mm² (1/0 AWG) bare copper grounding conductor.

3.14 WIREWAY GROUNDING

A. Ground and Bond Metallic Wireway Systems as follows:

1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
2. Install insulated 16 mm² (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
3. Use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
4. Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

3.15 COMMUNICATIONS RACEWAY GROUNDING

A. Conduit: Use insulated 16 mm² (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
B. Wireway: use insulated 16 mm² (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.
C. Cable Tray Systems: Use insulated 16 mm² (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 meters (50 feet).

3.16 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or

additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Services at power company interface points shall comply with the power company ground resistance requirements.

D. Below-grade connections shall be visually inspected by the Resident Engineer prior to backfilling. The Contractor shall notify the Resident Engineer 24 hours before the connections are ready for inspection.

3.17 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.18 GROUNDING FOR RF/EMI CONTROL

A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 100 mm (4 inches) wide copper strip or two 6 mm² (10 AWG) copper conductors spaced minimum 100 mm (4 inches) apart. Use 16 mm² (6 AWG) copper where exposed and subject to damage.

B. Comply with the following when shielded cable is used for data circuits.

1. Shields shall be continuous throughout each circuit.
2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
3. Do not connect shields from different circuits together.
4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.

END OF SECTION VI

ATTACHMENT A: INDEMNICIATION AGREEMENT

_____***{Contractor/Vendor/Lessee}*** agrees to protect, defend, indemnify, save and hold harmless the State of Louisiana, all State departments, Agencies, Boards and Commissions, its officers, agents, servants, employees, and volunteers, from and against any and all claims, demands, expense and liability arising out of injury or death to any person or the damage, loss or destruction of any property which may occur or in any way grow out of any act or omission of _____***{Contractor/Vendor/Lessee}*** its agents, servants, and employees, or any and all costs, expense and/or attorney fees incurred by _____***{Contractor/Vendor/Lessee}*** as a result of any claims, demands, suits and/or causes of action except those claims, demands, suits and/or causes of action arising out of the negligence of the State of Louisiana, all State Departments, Agencies, Boards, Commissions, its officers, agents, servants, employees and volunteers.

_____***{Contractors/Vendor/Lessee}*** agrees to investigate, handle, respond to, provide defense for and defend any such claims, demands, suits, or causes of action at its sole expense and agrees to bear all other costs and expenses related thereto, even if the claims, demands, suites, or causes of action are groundless, false or fraudulent.

Accepted By: _____

Company Name

_____

Signature

_____

Title

_____

Date Accepted

Is certificate of insurance attached?_____YES_____NO

*****This form must be completed and submitted with your bid***

ATTACHMENT B: REFERENCE FORM

(Company Name)	(Facility Type)
(Address)	(Phone Number)
(Contract Administrator)	

(Company Name)	(Facility Type)
(Address)	(Phone Number)
(Contract Administrator)	

(Company Name)	(Facility Type)
(Address)	(Phone Number)
(Contract Administrator)	

Form must be completed and submitted with the bid

END OF BID DOCUMENTS