DELAWARE STATE UNIVERSITY
CONTRACT # FD-15-027

SPECIFICATIONS
FOR

Science Center North Electrical Service Upgrade

IN

East Dover Hundred - Kent County
Dover, Delaware

PREPARED
BY

Gipe Associates Inc.

ISSUED FOR BID
June 26, 2015

TABLE OF CONTENTS

A. Specifications for this project are arranged in accordance with the Construction Specification Institute numbering system and format. Section numbering is discontinuous and all numbers not appearing in the Table of Contents are not used for this Project.

B. DOCUMENTS BOUND HEREWITH

END OF SECTION 00 01 10

LIST OF DRAWING SHEETS

COVER SHEET

Sheet # CS.1	Cover Sheet
Sheet # M1.1	Partial First Floor Plan HVAC New Work
Sheet # M2.1	Part Plans, Details, Schedules, Specifications HVAC New Work
Sheet # ET1.1	Partial First Floor Plan Electrical Temporary Power
Sheet # ET2.1	Part Plan Electrical Temporary Power
Sheet # ET5.1	Partial Single Line Diagram Electrical Temporary Power
Sheet # ED1.1	Partial First Floor Plan Electrical Demolition
Sheet # ED2.2	Part Plans Electrical Demolition
Sheet # ED4.1	Schedules Electrical Demolition
Sheet # ED5.1	Partial Single Line Diagram Electrical Demolition
Sheet # E1.1	Partial First Floor Plan Electrical New Work
Sheet # E2.1	Part Plan Electrical New Work
Sheet # E3.1	Details Electrical
Sheet # E3.2	Details Electrical
Sheet # E3.3	Details Electrical
Sheet # E4.1	Schedules Electrical New Work
Sheet # E5.1	Partial Single Line Diagram Electrical New Work

END OF SECTION 00 01 15

INVITATION TO BID

Sealed bids for Delaware State University Contract No. **FD-15–027 – Science Center North Electrical Service Upgrade** will be received by the Delaware State University, in the reception area of the Purchasing Office in the Administration Building, 1200 N. DuPont Highway, Dover, DE 19901-2277 (Third Floor), until **3:00 PM EST** local time on **September 18, 2015,** at which time they will be publicly opened and read aloud in the Conference Room. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

Project involves: Electrical service upgrade that serve the Science Center North building and as per bid documents and in accordance with all national, state, and local building and electrical codes.

A **MANDATORY** Pre-Bid Meeting will be held on **August 17, 2015, at 1:30 PM EST** at the **Science Center North Lobby** for the purpose of establishing the listing of subcontractors and to answer questions. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to the Delaware State University c/o the Purchasing Department, Administration Building, Room 321 (Third Floor), Dover, DE 19901-2277, Attn: Jessica Wilson, Director of Purchasing. The outer envelope should clearly indicate: **"DSU CONTRACT NO. FD-15-027 – Science Center Electrical Service Upgrade** - **SEALED BID - DO NOT OPEN."**

Contract documents may be obtained or reviewed at the office of Gipe Associates Inc. 8719 Brooks Drive, Easton Maryland 21601 upon receipt of $150.00 per set/non-refundable, starting on the day of the mandatory pre-bid. Checks are to be made payable to: Gipe associates Inc. Alternatively, in consideration of our environment, and in alignment with the University's sustainability initiatives, bidders may request an electronic copy of the bidding documents by submitting a written request to constructionbid@desu.edu. Delaware State University will track all bidders and ensure plan holder receive all addenda.

Summary of Events and Dates:

August 17, 2015	**Mandatory Site Visit at Science Center North Lobby (1:30PM EST)**
September 15, 2015	**Deadline for Questions (4:00PM EST)**
September 16, 2015	**Posting of Answers to Contractor Questions (4:00PM EST)**
September 16, 2015	**Final Date for Addendums**
September 18, 2015	**Proposals Due (3:00 PM EST)**
September 25, 2015	**Contractor Selection Date**
October 05, 2015	**Anticipated Start of Construction Date (subject to change)**
October 18, 2015	**Latest Date for Contract Award**
December 31, 2015	**Substantial Completion**

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates.

The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. Delaware State University reserves the right to reject any or all bids and to waive any informalities therein. Delaware State University may extend the time and place for the opening of the bids from that described in the advertisement, with not less than two calendar days' notice by certified delivery, facsimile machine or other electronic means to those bidders receiving plans.

END OF ADVERTISEMENT FOR BIDS

INSTRUCTIONS TO BIDDERS

TABLE OF ARTICLES

ARTICLE 1: GENERAL

1.1 DEFINITIONS

1.1.1 Whenever the following terms are used, their intent and meaning shall be interpreted as follows:

1.2 STATE: The State of Delaware.

1.3 BOARD: The Delaware State University Board of Trustees

1.4 UNIVERSITY: The Delaware State University

1.5 AGENCY: The Delaware State University

1.6 DESIGNATED OFFICIAL: The agent authorized to act for the Agency.

1.7 BIDDING DOCUMENTS: Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement for Bid, Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the Bid Form (including the Non-collusion Statement), and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, as well as the Drawings, Specifications (Project Manual) and all Addenda issued prior to execution of the Contract.

1.8 CONTRACT DOCUMENTS: The Contract Documents consist of the, Instructions to Bidders, Supplementary Instructions to Bidders (if any), General Conditions, Supplementary General Conditions, General Requirements, Special Provisions (if any), the form of agreement between the Owner and the Contractor, Drawings (if any), Specifications (Project Manual), and all addenda.

1.9 AGREEMENT: The form of the Agreement shall be AIA Document A101, Standard Form of Agreement between Owner and Contractor where the basis of payment is a STIPULATED SUM. In the case of conflict between the instructions contained therein and the General Requirements herein, these General Requirements shall prevail.

1.10 GENERAL REQUIREMENTS (or CONDITIONS): General Requirements (or conditions) are instructions pertaining to the Bidding Documents and to contracts in general. They contain, in summary, requirements of laws of the State; policies of the Agency and instructions to bidders.

1.11 SPECIAL PROVISIONS: Special Provisions are specific conditions or requirements peculiar to the bidding documents and to the contract under consideration and are supplemental to the General Requirements. Should the Special Provisions conflict with the General Requirements, the Special Provisions shall prevail.

1.12 ADDENDA: Written or graphic instruments issued by the Owner/Architect prior to the execution of the contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

1.13 BIDDER OR VENDOR: A person or entity who formally submits a Bid for the material or Work contemplated, acting directly or through a duly authorized representative who meets the requirements set forth in the Bidding Documents.

1.14 SUB-BIDDER: A person or entity who submits a Bid to a Bidder for materials or labor, or both for a portion of the Work.

1.15 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.16 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).

1.17 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted.

1.18 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

1.19 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.

1.20 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.

1.21 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.

1.22 CONTRACTOR: Any individual, firm or corporation with whom a contract is made by the Agency.

1.23 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.

1.24 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.

1.25 LIQUIDATED DAMAGES: An amount due and payable to the University by the Contractor for additional costs incurred by the University resulting from the Contractor's failure to complete within the Contract time.

ARTICLE 2: BIDDER'S REPRESENTATIONS

2.1 PRE-BID MEETING

2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid, unless this requirement is specifically waived elsewhere in the Bid Documents.

2.2 By submitting a Bid, the Bidder represents that:

2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.

2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder's his personal observations with the requirements of the proposed Contract Documents.

2.2.3 The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

2.3 JOINT VENTURE REQUIREMENTS

2.3.1 For Public Works Contracts, each Joint Venturer shall be qualified and capable to complete the Work with their own forces.

2.3.2 Included with the Bid submission, and as a requirement to bid, a copy of the executed Joint Venture Agreement shall be submitted and signed by all Joint Venturers involved.

2.3.3 All required Bid Bonds, Performance Bonds, Material and Labor Payment Bonds must be executed by both Joint Venturers and be placed in both of their names.

2.3.4 All required insurance certificates shall name both Joint Venturers.

2.3.5 Both Joint Venturers shall sign the Bid Form and shall submit a copy of a valid Delaware Business License with their Bid.

2.3.6 Both Joint Venturers shall include their Federal E.I. Number with the Bid.

2.3.7 In the event of a mandatory Pre-bid Meeting, each Joint Venturer shall have a representative in attendance.

2.3.8 Due to exceptional circumstances and for good cause shown, one or more of these provisions may be waived at the discretion of the State.

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

2.4.1 As consideration for the award and execution by the Owner of this contract, the Contractor hereby grants, conveys, sells, assigns and transfers to the State of Delaware all of its right, title and interests in and to all known or unknown causes of action it presently has or may now or hereafter acquire under the antitrust laws of the United States and the State of Delaware, relating to the particular goods or services purchased or acquired by the Owner pursuant to this contract.

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

3.1.1 Bidders may obtain complete sets of the Bidding Documents from the Architectural/Engineering firm designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein.

3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. The issuing Agency nor the Architect assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

3.1.3 Any errors, inconsistencies or omissions discovered shall be reported to the Architect immediately.

3.1.4 The Agency and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall report any errors, inconsistencies, or ambiguities discovered to the Architect.

3.2.2 Bidders or Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request to the Architect at least seven days prior to the date for receipt of Bids. Interpretations,

corrections and changes to the Bidding Documents will be made by written Addendum. Interpretations, corrections, or changes to the Bidding Documents made in any other manner shall not be binding.

3.2.3 The apparent silence of the specifications as to any detail, or the apparent omission from it of detailed description concerning any point, shall be regarded as meaning that only the best commercial practice is to prevail and only material and workmanship of the first quality are to be used. Proof of specification compliance will be the responsibility of the Bidder.

3.2.4 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all permits, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

3.2.5 The Owner will bear the costs for all impact and user fees associated with the project.

3.3 SUBSTITUTIONS

3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of quality, required function, dimension, and appearance to be met by any proposed substitution. The specification of a particular manufacturer or model number is not intended to be proprietary in any way. Substitutions of products for those named will be considered, providing that the Vendor certifies that the function, quality, and performance characteristics of the material offered is equal or superior to that specified. It shall be the Bidder's responsibility to assure that the proposed substitution will not affect the intent of the design, and to make any installation modifications required to accommodate the substitution.

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

3.3.3 If the Architect approves a substitution prior to the receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding.

3.3.4 The Architect shall have no obligation to consider any substitutions after the Contract award.

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 No Addenda will be issued later than 4 days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of bids.

3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.

4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.

4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).

4.1.4 Where so indicated by the makeup on the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.

4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.

4.1.6 BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY. If there is no change in the Base Bid for an Alternate, enter “No Change”. The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.

4.1.7 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.

4.1.8 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached, certifying agent's authority to bind the Bidder.

4.1.9 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.

4.1.10 In the construction of all Public Works projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.

4.1.11 Each bidder shall include in their bid a copy of a valid Delaware Business License.’

4.2 BID SECURITY

4.2.1 All bids shall be accompanied by a deposit of either a good and sufficient bond to the agency for the benefit of the agency, with corporate surety authorized to do business in this State, the form of the bond and the surety to be approved by the agency, or a security of the bidder assigned to the agency, for a sum equal to at least 10% of the bid plus all add alternates, or in lieu of the bid bond a security deposit in the form of a certified check, bank treasurer’s check, cashier’s check, money order, or other prior approved secured deposit assigned to the State. The bid bond need not be for a specific sum, but may be stated to be for a sum equal to 10% of the bid plus all add alternates to which it relates and not to exceed a certain stated sum, if said sum is equal to at least 10% of the bid. The Bid Bond form used shall be the standard OMB form (attached).

4.2.2 The Agency has the right to retain the bid security of Bidders to whom an award is being considered until either a formal contract has been executed and bonds have been furnished or the specified time has elapsed so the Bids may be withdrawn or all Bids have been rejected.

4.2.3 In the event of any successful Bidder refusing or neglecting to execute a formal contract and bond within 20 days of the awarding of the contract, the bid bond or security deposited by the successful bidder shall be forfeited.

4.3 SUBCONTRACTOR LIST

4.3.1 As required by Delaware Code, Title 29, section 6962(d)(10)b, each Bidder shall submit with their Bid a completed List of Sub-Contractors included with the Bid Form. NAME ONLY ONE SUBCONTRACTOR FOR EACH TRADE. A Bid will be considered non-responsive unless the completed list is included.

4.3.2 Provide the Name and Address for each listed subcontractor. Addresses by City, Town or Locality, plus State, will be acceptable.

4.3.3 It is the responsibility of the Contractor to ensure that their Subcontractors are in compliance with the provisions of this law. Also, if a Contractor elects to list themselves as a Subcontractor for any category, they must specifically name themselves on the Bid Form and be able to document their capability to act as Subcontractor in that category in accordance with this law.

4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

4.4.1 During the performance of this contract, the contractor agrees as follows:

A. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

B. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin."

4.5 PREVAILING WAGE REQUIREMENT

4.5.1 Wage Provisions: In accordance with Delaware Code, Title 29, Section 6960, renovation projects whose total cost shall exceed $15,000, and $100,000 for new construction, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

4.5.2 The prevailing wage shall be the wage paid to a majority of employees performing similar work as reported in the Department's annual prevailing wage survey or in the absence of a majority, the average paid to all employees reported.

4.5.3 The employer shall pay all mechanics and labors employed directly upon the site of work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics.

4.5.4 The scale of the wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work.

4.5.5 Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

4.6 SUBMISSION OF BIDS

4.6.1 Enclose the Bid, the Bid Security, and any other documents required to be submitted with the Bid in a sealed opaque envelope. Address the envelope to the party receiving the Bids. Identify with the project name, project number, and the Bidder's name and address. If the Bid is sent by mail, enclose the sealed envelope in a separate mailing envelope with the notation "BID ENCLOSED" on the face thereof. The State is not responsible for the opening of bids prior to bid opening date and time that are not properly marked.

4.6.2 Deposit Bids at the designated location prior to the time and date for receipt of bids indicated in the Advertisement for Bids. Bids received after the time and date for receipt of bids will be marked “LATE BID” and returned.

4.6.3 Bidder assumes full responsibility for timely delivery at location designated for receipt of bids.

4.6.4 Oral, telephonic or telegraphic bids are invalid and will not receive consideration.

4.6.5 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in compliance with these Instructions to Bidders.

4.7 MODIFICATION OR WITHDRAW OF BIDS

4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.

4.7.2 Bidders submitting Bids that are late shall be notified as soon as practicable and the bid shall be returned.

4.7.3 A Bid may not be modified, withdrawn or canceled by the Bidder during a thirty (30) day period following the time and date designated for the receipt and opening of Bids, and Bidder so agrees in submitting their Bid. Bids shall be binding for 30 days after the date of the Bid opening.

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

5.1.1 Unless otherwise stated, Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids will be made available to Bidders.

5.1.2 The Agency shall have the right to reject any and all Bids. A Bid not accompanied by a required Bid Security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

5.1.3 If the Bids are rejected, it will be done within thirty (30) calendar day of the Bid opening.

5.2 COMPARISON OF BIDS

5.2.1 After the Bids have been opened and read, the bid prices will be compared and the result of such comparisons will be made available to the public. Comparisons of the Bids may be based on the Base Bid plus desired Alternates. The Agency shall have the right to accept Alternates in any order or combination.

5.2.2 The Agency reserves the right to waive technicalities, to reject any or all Bids, or any portion thereof, to advertise for new Bids, to proceed to do the Work otherwise, or to abandon the Work, if in the judgment of the Agency or its agent(s), it is in the best interest of the State.

5.2.3 An increase or decrease in the quantity for any item is not sufficient grounds for an increase or decrease in the Unit Price.

5.2.4 The prices quoted are to be those for which the material will be furnished F.O.B. Job Site and include all charges that may be imposed during the period of the Contract.

5.2.5 No qualifying letter or statements in or attached to the Bid, or separate discounts will be considered in determining the low Bid except as may be otherwise herein noted. Cash or separate discounts should be computed and incorporated into Unit Bid Price(s).

5.3 DISQUALIFICATION OF BIDDERS

5.3.1 An agency shall determine that each Bidder on any Public Works Contract is responsible before awarding the Contract. Factors to be considered in determining the responsibility of a Bidder include:

A. The Bidder's financial, physical, personnel or other resources including Subcontracts;

B. The Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state;

C. The Bidder's written safety plan;

D. Whether the Bidder is qualified legally to contract with the State;

E. Whether the Bidder supplied all necessary information concerning its responsibility; and,

F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.

5.3.2 If an agency determines that a Bidder is nonresponsive and/or nonresponsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within five (5) working days of said determination.

5.3.3 In addition, any one or more of the following causes may be considered as sufficient for the disqualification of a Bidder and the rejection of their Bid or Bids.

5.3.3.1 More than one Bid for the same Contract from an individual, firm or corporation under the same or different names.

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

5.3.3.4 If the Unit Prices are obviously unbalanced either in excess or below reasonable cost analysis values.

5.3.3.5 If there are any unauthorized additions, interlineation, conditional or alternate bids or irregularities of any kind which may tend to make the Bid incomplete, indefinite or ambiguous as to its meaning.

5.3.3.6 If the Bid is not accompanied by the required Bid Security and other data required by the Bidding Documents.

5.3.3.7 If any exceptions or qualifications of the Bid are noted on the Bid Form.

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

5.4.1 A formal Contract shall be executed with the successful Bidder within twenty (20) calendar days after the award of the Contract.

5.4.2 Per Section 6962(d)(13) a., Title 29, Delaware Code, "The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid."

5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.

5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.

5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in affect for period of one year after the date of substantial completion.

5.4.6 If the successful Bidder fails to execute the required Contract and Bond, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.

5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and a copy of its Delaware business license, and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

6.1.1 Bidders to whom award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.

6.2 BUSINESS DESIGNATION FORM

6.2.1 Successful bidder shall be required to accurately complete an Office of Management and Budget Business Designation Form for Subcontractors.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.

7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder's usual sources, changes in cost will be adjusted as provide in the Contract Documents.

7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).

7.2 TIME OF DELIVERY AND FORM OF BONDS

7.2.1 The bonds shall be dated on or after the date of the Contract.

7.2.2 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix a certified and current copy of the power of attorney.

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

8.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum.

ARTICLE 9: LIQUIDATED DAMAGES

9.1 Schedule of Liquidated Damages:

Schedule of Liquidated Damages		
Awarded Contract Value		Daily Charge
For Greater Than	Up to and Including	Calendar Day
$0.00	$25,000.00	$290.00
$25,000.00	$50,000.00	$300.00
$50,000.00	$100,000.00	$400.00
$100,000.00	$500,000.00	$630.00
$500,000.00	$1,000,000.00	$820.00
$1,000,000.00	$2,000,000.00	$1,000.00
$2,000,000.00	$5,000,000.00	$1,060.00
$5,000,000.00	$10,000,000.00	$1,180.00
$10,000,000.00	$15,000,000.00	$1,870.00
$15,000,000.00	$20,000,000.00	$3,130.00
$20,000,000.00	Over	$4,360.00

9.2 For each calendar day or work day that work remains uncompleted after the Contract time has expired or beyond the completion date established by the Contract, the sum specified in paragraph 9.1 of this document, will be deducted from any money due the Contractor. This sum shall not be considered and treated as a penalty but as liquidated damages due the University by reason of inconvenience to the public, added cost of engineering and supervision, and other extra expenditures of public funds due to the Contractor's failure to complete the work on time. Any adjustment of the Contract time for completion of the work granted by the University will be considered in the assessment of liquidated damages.

END OF SECTION 00 21 13

BID FORM

Project: FD-15-027 – Science Center North Electrical Service Upgrade

Location: Delaware State University
Science center North Building
Main Campus
1200 N. DuPont Hwy.
Dover, DE.

For Bids Due: September 18, 2015 @ 3:00 PM EST

To: Delaware State University
Administration Bldg,
Purchasing, Room 321
1200 N. DuPont Highway
Dover, DE 19901-2277
Attn: Jessica Wilson
Director of Purchasing

Name of Bidder: _____

Delaware Business License No.:_____ **Taxpayer ID No.:** _____
(A copy of Bidder's Delaware Business License must be attached to this form.)

(Other License Nos.): _____

Phone No.: ( ) _____ - _____ Fax No.: ( ) _____ - _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

$_____(Written Out).
($) (Figures).

A. ALTERNATES (Note: *project is subject to prevailing wages*)

1. Alternates: Alternate prices conform to applicable project specification section. Refer to the drawing specifications for a complete description of the following Alternates. An "ADD" or "DEDUCT" amount is indicated by the crossing out the part that does not apply.
   a. **Alternate #1:** Net - ADD / DEDUCT

- _____ (Figures).
- _____ (Written Out).

b. **Alternate #2:** Net - ADD / DEDUCT

- _____ (Figures).
- _____ (Written Out).

c. **Alternate #3:** Net - ADD / DEDUCT

- _____ (Figures).
- _____ (Written Out).

B. UNIT PRICES

1. Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

		ADD	**DEDUCT**
UNIT PRICE No. 1:	(BRIEF DESCRIPTION)	$ _____	$ _____
UNIT PRICE No. 2:	(BRIEF DESCRIPTION)	$ _____	$ _____
UNIT PRICE No. 3:	(BRIEF DESCRIPTION)	$ _____	$ _____

C. WORK SCHEDULE

1. We understand that this contract is governed by liquidated damages and that submission of this bid is acceptance of the proposed contract completion date. Our proposed detailed project schedule shows more fully the sequence of activities necessary to meet the specified schedule. The project schedule is a required attachment of a complete bid and failure to submit a viable schedule will be a justifiable reason to deem the bid as incomplete.

2. I/We can begin work _____ calendar days after notification of award and will require _____ calendar days thereafter to complete the work. Work on the project will begin _____ calendar days after Letter of Intent.

3. Alternative Work Hours

   Work during “regular hours” at this site is being performed on a single shift, eight hours per day, 7:30 AM to 4:30 PM, and five days per week, Monday through Friday. To meet the schedule established on the basis of Item 1 above, our proposed work hours will be ____ hours per day, _____ AM to _____ PM, and _____ days per week, _____ through _____ the cost of which is reflected in our lump sum price. Our lump sum price also includes any mandatory off-hours work required per special conditions.

D. SITE SUPERINTENDANT

We propose to use _____ as our site superintendent. A resume of his/her qualifications is attached.

We understand that DSU reserves the right to interview him/her prior to contract award/prior to start of work and to reject him/her if not considered acceptable. If rejected, we will propose alternate personnel for the position who will be subject to the same review and acceptance procedure, at no increase in our lump sum proposal.

We also understand DSU reserves the right to reject our bid if we are unable to provide a site supervisor acceptable to DSU within thirty (30) calendar days after submission of this bid.

E. REMARKS

1. I/We acknowledge Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

2. This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

3. The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

4. This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

5. Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____calendar days of the Notice to Proceed.

6. Our Bid Price(s) are firm based on contract award within thirty (30) calendar days of the date of submittal of this bid.

7. I/We understand that we will not be compensated at a later date for claimed additional costs based on any information received during the bid period, but which is not identified in our proposal and subsequently accepted in writing by DSU.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
(Individual's / General Partner's / Corporate Name)

_____
(State of Corporation)

Business Address:_____
_____
_____
_____

Witness: _____ **By:** _____
(Authorized Signature)

(SEAL)

_____
(Title)

Date: _____

ATTACHMENTS

Sub-Contractor List
Non-Collusion Statement
Bid Security
Construction Schedule
Resume of Site Superintendent
(Others as Required by Project Manuals)

END OF SECTION 00 41 13

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____ _____ of _____ in the County of _____ and State of _____ as **Principal**, and _____ _____ of _____ in the County of _____ and State of _____ as **Surety**, legally authorized to do business in the State of Delaware ("**State**"), are held and firmly unto the **State** in the sum of _____ Dollars ($_____), or _____ percent not to exceed _____ _____ Dollars ($_____) of amount of bid on Contract No. _____, to be paid to the **State** for the use and benefit of _____ (***insert State agency name***) for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bonded **Principal** who has submitted to the _____ (***insert State agency name***) a certain proposal to enter into this contract for the furnishing of certain material and/or services within the **State**, shall be awarded this Contract, and if said **Principal** shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the _____ (***insert State agency name***) this Contract to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with _____ seal and dated this _____day of _____ in the year of our Lord two thousand and _____ (20___).

SEALED, AND DELIVERED IN THE
Presence of

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness:_____ By: _____

_____
Title

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor **must be listed for each category** where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the *Owner*, **it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.**

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax payer ID # or Delaware Business license #
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date *(to the Office of Management and Budget, Division of Facilities Management)*.

All the terms and conditions of *(Project or Contract Number)* have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

_____

_____

E-MAIL: _____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2007

The contract to be utilized on this project shall be the “Standard Form of Agreement Between Owner and Contractor” AIA Document A101-2007.

END OF SECTION 00 52 13

SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2007

The following supplements modify the "Standard Form of Agreement Between Owner and Contractor," AIA Document A101-2007. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.3 Delete paragraph 5.1.3 in its entirety and replace with the following:

"Provided that a valid Application for Payment is received by the Architect that meets all requirements of the Contract, payment shall be made by the Owner not later than 30 days after the Owner receives the valid Application for Payment."

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.2 Insert the following:

"Payments are due 30 days after receipt of a valid Application for Payment. After that 30 day period, interest may be charged at the rate of 1% per month not to exceed 12% per annum."

8.5 Delete paragraph 8.5 in its entirety and replace with the following:

"The Contractor's representative shall not be changed without ten days written notice to the Owner."

END OF SECTION 00 54 13

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("**Principal**"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("**Surety**"), are held and firmly bound unto the _____ ("**Owner**") (***insert State agency name***), in the amount of _____ ($_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____ dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by **Owner**, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause **Principal** fails or neglects to so fully perform and complete such work.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

_____ By: _____ (SEAL)
Name: Name:
Title:

(Corporate Seal)

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PAYMENT BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("**Principal**"), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("**Surety**"), are held and firmly bound unto the _____ ("**Owner**") (***insert State agency name***), in the amount of _____ ($_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____ day of_____, 20__.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

APPLICATION AND CERTIFICATION FOR PAYMENT

AIA DOCUMENT G702 PAGE ONE OF PAGES

TO OWNER:
Owner
0000 4th Street
Las Vegas, Nv. 00000

PROJECT: New Office & Warehouse

APPLICATION NO: 4

PERIOD TO: 12/31/99

Distribution to:
- [ ] OWNER
- [ ] ARCHITECT
- [ ] CONTRACTOR
- [ ] GENERAL CONTRACTOR
- [ ]

FROM CONTRACTOR:
XYZ ELECTRIC
000 Las Vegas BLVD.
Las Vegas, Nv. 00000

VIA ARCHITECT:
Arhitects
000 Tropicana Blvd.
Las Vegas, Nv. 00000

PROJECT NOS: NV000

CONTRACT FOR: Elect. Systems

VIA GENERAL CONTRACTOR: Burke And Associates

CONTRACT DATE: 08/13/99

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM		$ 120,693.00
2. Net change by Change Orders		$ 832.16
3. CONTRACT SUM TO DATE (Line 1 ± 2)		$ 121,525.16
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703)		$ 53,064.30
5. RETAINAGE:		
a. % of Completed Work (Column D + E on G703)	$ 5,069.73	
b. % of Stored Material (Column F on G703)	$ 236.70	
Total Retainage (Lines 5a + 5b or Total in Column I of G703)		$ 5,306.43
6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total)		$ 47,757.87
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate)		$ 21,970.80
8. CURRENT PAYMENT DUE		$ 25,787.07
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6)	$	73,767.29

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$0.00	
Total approved this Month	$832.16	
TOTALS	$832.16	$0.00
NET CHANGES by Change Order	$832.16	

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR: XYZ ELECTRIC

By: _____ Date: 12/31/99
President

State of:
Subscribed and sworn to before me this
Notary Public:
My Commission expires:

County of:
day of

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED ..... $ _____

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and onthe Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

CONTINUATION SHEET

AIA DOCUMENT G703

PAGE OF PAGES

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing Contractor's signed certification is attached.

In tabulations below, amounts are stated to the nearest dollar.

Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: 4
APPLICATION DATE: 12/31/99
PERIOD TO: 12/31/99
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
1	Bid Depository Fee	$1,500.00	$1,500.00			$1,500.00	100.00%		$150.00
2	Equipment/Switch Gear (Materials Only)	$14,471.00	$9,607.00			$9,607.00	66.39%	$4,864.00	$960.70
3	Light Fixtures (Materials Only)	$22,087.00			$2,367.00	$2,367.00	10.72%	$19,720.00	$236.70
4	Fire Alarm - Rough	$7,748.00	$2,750.00	$312.00		$3,062.00	39.52%	$4,686.00	$306.20
5	Fire Alarm - Trim	$2,082.00						$2,082.00	$0.00
6	Office - Under Slab	$21,110.00	$10,555.00	$10,555.00		$21,110.00	100.00%		$2,111.00
7	Office - Rough	$15,395.00		$5,850.10		$5,850.10	38.00%	$9,544.90	$585.01
8	Office - Trim	$12,169.00						$12,169.00	$0.00
9	Warehouse - Under Slab	$7,634.00		$7,634.00		$7,634.00	100.00%		$763.40
10	Warehouse - Rough	$5,090.00		$1,934.20		$1,934.20	38.00%	$3,155.80	$193.42
11	Warehouse - Trim	$2,667.00						$2,667.00	$0.00
12	Site Underground	$8,740.00						$8,740.00	$0.00
13	Subcontract Change Order # 1 - Add Lighting	$832.16						$832.16	$0.00
									$0.00
									$0.00
									$0.00
									$0.00
									$0.00
									$0.00
									$0.00
									$0.00
									$0.00
									$0.00
									$0.00
	GRAND TOTALS	$121,525.16	$24,412.00	$26,285.30	$2,367.00	$53,064.30	43.67%	$68,460.86	$5,306.43

Users may obtain validation of this document by requesting of the license a completed AIA Document D401 - Certification of Document's Authenticity

GENERAL CONDITIONS

TO THE

CONTRACT

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2007 Edition) entitled General Conditions of the Contract for Construction and is part of this project manual as if herein written in full.

END OF SECTION 00 72 13

SUPPLEMENTARY GENERAL CONDITIONS A201-2007

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2007. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Delete the last sentence in its entirety and replace with the following:

"The Contract Documents also include Advertisement for Bid, Instructions to Bidder, sample forms, the Bid Form, the Contractor's completed Bid and the Award Letter."

Add the following Paragraph:

1.1.1.1 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Division of Facilities Management shall take precedence over all other documents.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Paragraphs:

1.2.4 In the case of an inconsistency between the Drawings and the Specifications, or within either document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect's interpretation.

1.2.5 The word "PROVIDE" as used in the Contract Documents shall mean "FURNISH AND INSTALL" and shall include, without limitation, all labor, materials, equipment, transportation, services and other items required to complete the Work.

1.2.6 The word "PRODUCT" as used in the Contract Documents means all materials, systems and equipment.

1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

Delete Paragraph 1.5.1 in its entirety and replace with the following:

"All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-subcontractors and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect's consultants.

The Architect shall not be liable for injury or damage resulting from the re-use of drawings and specifications if the Architect is not involved in the re-use Project. Prior to re-use of construction documents for a Project in which the Architect is not also involved, the Owner will remove from such documents all identification of the original Architect, including name, address and professional seal or stamp."

Delete Paragraph 1.5.2 in its entirety.

ARTICLE 2: OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

To Subparagraph 2.2.3 – Add the following sentence:

"The Contractor, at their expense shall bear the costs to accurately identify the location of all underground utilities in the area of their excavation and shall bear all cost for any repairs required, out of failure to accurately identify said utilities."

Delete Subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor shall be furnished free of charge up to five (5) sets of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Amend Paragraph 3.2.2 to state that any errors, inconsistencies or omissions discovered shall be reported to the Architect and Owner immediately.

Delete the third sentence in Paragraph 3.2.3.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Paragraphs:

3.3.2.1 The Contractor shall immediately remove from the Work, whenever requested to do so by the Owner, any person who is considered by the Owner or Architect to be incompetent or disposed to be so disorderly, or who for any reason is not satisfactory to the Owner, and that person shall not again be employed on the Work without the consent of the Owner or the Architect.

3.3.4 The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials. Consult the Owner and the Architect before storing any materials.

3.3.5 When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.

3.4 LABOR AND MATERIALS

Add the Following Paragraphs:

3.4.4 Before starting the Work, each Contractor shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to insure that its Work and adjacent, related Work, will finish to proper contours, planes and levels. Promptly notify the General Contractor/Construction Manager of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized.

3.4.5 Under no circumstances shall the Contractor's Work proceed prior to preparatory Work proceed prior to preparatory Work having been completely cured, dried and/or otherwise made satisfactory to receive this Work. Responsibility for timely installation of all materials rests solely with the Contractor responsible for that Work, who shall maintain coordination at all times.

3.5 WARRANTY

Add the following Paragraphs:

3.5.1 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for two years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of guarantee.

3.5.2 Defects appearing during the period of guarantee will be made good by the Contractor at his expense upon demand of the Owner, it being required that all work will be in perfect condition when the period of guarantee will have elapsed.

3.5.3 In addition to the General Guarantee there are other guarantees required for certain items for different periods of time than the two years as above, and are particularly so stated in that part of the specifications referring to same. The said guarantees will commence at the same time as the General Guarantee.

3.5.4 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair, or otherwise remedy the failure, defect or damage at the Contractor's expense.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Paragraphs:

3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.

3.11.2 At the completion of the project, the Contractor shall obtain a set of reproducible drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions.

3.11.3 The Contractor shall provide two (2) prints of the as-built conditions, along with the reproducible drawings themselves, to the Owner and one (1) set to the Architect. In addition, attach one complete set to each of the Operating and Maintenance Instructions/Manuals.

3.17 In the second sentence of the paragraph, insert "indemnify" between "shall" and "hold".

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

Delete the first sentence of Paragraph 4.2.7 and replace with the following:

The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples for the purpose of checking for conformance with the Contract Documents.

Delete the second sentence of Paragraph 4.2.7 and replace with the following:

The Architect's action will be taken with such reasonable promptness as to cause no delay in the Work in the activities of the Owner, Contractor or separate Contractors, while allowing sufficient time in the Owner's professional judgment to permit adequate review.

Add the following Paragraph:

4.2.10.1 There will be no full-time project representative provided by the Owner or Architect on this project.

Add to Paragraph 4.2.13 "and in compliance with all local requirements." to the end of the sentence

ARTICLE 5: SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

Delete Paragraph 5.2.3 in its entirety and replace with the following:

5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection, subject to the statutory requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4.

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

Delete Paragraph 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

6.2.3 In the second sentence, strike the word "shall" and insert the word "may".

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE GENERAL REQUIREMENTS)

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

Add the following Paragraphs:

8.2.1.1 Refer to Specification Section SUMMARY OF WORK for Contract time requirements.

8.2.4 If the Work falls behind the Progress Schedule as submitted by the Contractor, the Contractor shall employ additional labor and/or equipment necessary to bring the Work into compliance with the Progress Schedule at no additional cost to the Owner.

8.3 DELAYS AND EXTENSION OF TIME

8.3.1 Strike “arbitration” and insert “remedies at law or in equity”.

Add the following Paragraph:

8.3.2.1 The Contractor shall update the status of the suspension, delay, or interruption of the Work with each Application for Payment. (The Contractor shall report the termination of such cause immediately upon the termination thereof.) Failure to comply with this procedure shall constitute a waiver for any claim for adjustment of time or price based upon said cause.

Delete Paragraph 8.3.3 in its entirety and replace with the following:

8.3.3 Except in the case of a suspension of the Work directed by the Owner, an extension of time under the provisions of Paragraph 8.3.1 shall be the Contractor’s sole remedy in the progress of the Work and there shall be no payment or compensation to the Contractor for any expense or damage resulting from the delay.

Add the following Paragraph:

8.3.4 By permitting the Contractor to work after the expired time for completion of the project, the Owner does not waive their rights under the Contract.

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Paragraphs:

9.2.1 The Schedule of Values shall be submitted using AIA Document G702, Continuation Sheet to G703.

9.2.2 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 1% of the initial contract amount.

9.3 APPLICATIONS FOR PAYMENT

Add the following Paragraph:

9.3.1.3 Application for Payment shall be submitted on AIA Document G702 “Application and Certificate for Payment”, supported by AIA Document G703 “Continuation Sheet”. Said Applications shall be fully executed and notarized.

Add the following Paragraphs:

9.3.4 Until Closeout Documents have been received and outstanding items completed the Owner will pay 95% (ninety-five percent) of the amount due the Contractor on account of progress payments.

9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following to 9.5.1:

.8 failure to provide a current Progress Schedule;
.9 a lien or attachment is filed;
.10 failure to comply with mandatory requirements for maintaining Record Documents.

9.6 PROGRESS PAYMENTS

Delete Paragraph 9.6.1 in its entirety and replace with the following:

9.6.1 After the Architect has approved and issued a Certificate for Payment, payment shall be made by the Owner within 30 days after Owner's receipt of the Certificate for Payment.

9.7 FAILURE OF PAYMENT

In first sentence, strike "seven" and insert "thirty (30)". Also strike "binding dispute resolution" and insert "remedies at law or in equity".

9.8 SUBSTANTIAL COMPLETION

To Subparagraph 9.8.3 - Add the following sentence:

"If the Architect is required to make more than 2 inspections of the same portion of work, the Contractor shall be responsible for all costs associated with subsequent inspections including but not limited to any Architect's fees."

9.8.5 In the second sentence, strike "shall" and insert "may".

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Paragraphs:

10.1.1.1.1 Each Contractor shall develop a safety program in accordance with the Occupational Safety and Health Act of 1970. A copy of said plan shall be furnished to the Owner and Architect prior to the commencement of that Contractor's Work.

10.1.2 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time basis. If deemed necessary by the Owner or Architect, Contractor Safety meetings will be scheduled. The attendance of all Safety Representatives will be required. Minutes will be recorded of said meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Paragraph:

10.2.4.1 As required in the Hazardous Chemical Act of June 1984, all vendors supplying any material that may be defined as hazardous must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a caution warning on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in foreseeable emergency situations. Material Safety Data Sheets shall be provided directly to the Owner, along with the shipping slips that include those products.

10.3 HAZARDOUS MATERIALS

Delete Paragraph 10.3.3 in its entirety.

Delete Paragraph 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.4 Strike "the Owner" immediately following "(1)" and strike "and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations."

11.2 OWNER'S LIABILITY INSURANCE

Delete Paragraph 11.2 in its entirety.

11.3 PROPERTY INSURANCE

Delete Paragraph 11.3 in its entirety and replace with the following:

11.3 The State will not provide Builder's All Risk Insurance for the Project. The Contractor and all Subcontractors shall provide property coverage for their tools and equipment, as necessary. Any mandatory deductible required by the Contractor's Insurance shall be the responsibility of the Contractor.

11.4 PERFORMANCE BOND AND PAYMENT BOND

11.4.1 Add the following sentence: "The bonds will conform to those forms approved by the Office of Management and Budget."

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Paragraph:

12.2.2.1.1 At any time during the progress of the Work, or in any case where the nature of the defects will be such that it is not expedient to have corrected, the Owner, at its option, will have the right to deduct such sum, or sums, of money from the amount of the Contract as it considers justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

12.2.2.1 Strike "one" and insert "two".

12.2.2.2 Strike "one" and insert "two".

12.2.2.3 Strike "one" and insert "two".

12.2.5 In second sentence, strike "one" and insert "two".

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike “except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.”

13.6 INTEREST

Strike “the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.” Insert “30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month.

13.7 TIME LIMITS ON CLAIMS

Strike the last sentence.

Add the following Paragraph:

13.8 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

13.8.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United State of America, the Contractor shall notify the Architect and Owner immediately upon discovery.

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete Paragraph 14.4.3 in its entirety and replace with the following:

14.4.3 In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, and cost incurred by reason of such termination along with reasonable overhead.

ARTICLE 15: CLAIMS AND DISPUTES

15.1.2 Throughout the Paragraph strike “21” and insert “45”.

15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

Delete Paragraph 15.1.6 in its entirety.

15.2 INITIAL DECISION

Delete Paragraph 15.2.5 in its entirety and replace with the following:

15.2.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be subject to mediation and other remedies at law or in equity.

Delete Paragraph 15.2.6 and its subparagraphs in their entirety.

15.3 MEDIATION

15.3.1 Strike “binding dispute resolution” and insert “any or all remedies at law or in equity”.

15.3.2 In the first sentence, delete “administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedure in effect on the date of the Agreement,” Strike “binding dispute resolution” and insert “remedies at law and in equity”.

15.4 ARBITRATION

Delete Paragraph 15.4 and its sub-sections in its entirety.

END OF SECTION 00 73 13

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 451-3423

Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

Located at:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 13, 2015

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	21.87	26.94	39.20
BOILERMAKERS	39.67	33.22	48.83
BRICKLAYERS	49.39	49.39	49.39
CARPENTERS	51.86	51.86	41.22
CEMENT FINISHERS	69.27	29.11	21.20
ELECTRICAL LINE WORKERS	43.49	37.29	28.44
ELECTRICIANS	63.60	63.60	37.29
ELEVATOR CONSTRUCTORS	80.31	40.93	30.55
GLAZIERS	67.35	67.35	20.15
INSULATORS	53.38	53.38	53.38
IRON WORKERS	60.12	60.12	60.12
LABORERS	40.95	40.95	40.95
MILLWRIGHTS	47.47	65.23	51.80
PAINTERS	43.04	44.94	44.94
PILEDRIVERS	71.17	37.64	30.45
PLASTERERS	21.60	28.55	17.50
PLUMBERS/PIPEFITTERS/STEAMFITTERS	62.20	36.66	54.49
POWER EQUIPMENT OPERATORS	43.88	58.31	24.13
ROOFERS-COMPOSITION	21.82	20.45	17.63
ROOFERS-SHINGLE/SLATE/TILE	17.59	13.72	14.10
SHEET METAL WORKERS	47.05	64.16	64.16
SOFT FLOOR LAYERS	48.57	48.57	48.57
SPRINKLER FITTERS	53.52	53.52	53.52
TERRAZZO/MARBLE/TILE FNRS	54.11	52.50	45.45
TERRAZZO/MARBLE/TILE STRS	62.13	50.28	52.63
TRUCK DRIVERS	24.03	26.64	20.03

CERTIFIED: 7/6/15 BY: _____ for
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: FD-15-027 Science Center North Electrical Service Upgrade, Kent County

GENERAL REQUIREMENTS

TABLE OF ARTICLES

ARTICLE 1: GENERAL

1.1 CONTRACT DOCUMENTS

1.1.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to an extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.1.2 Work including material purchases shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order. Any work performed or material purchases prior to the issuance of the Purchase Order is done at the Contractor's own risk and cost.

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

1.2.1 For Public Works Projects financed in whole or in part by state appropriation the Contractor agrees that during the performance of this contract:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, sex, color, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, sex, color, sexual orientation, gender identity or national origin."

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

3.1 Schedule of Values: The successful Bidder shall within twenty (20) days after receiving notice to proceed with the work, furnish to the Owner a complete schedule of values on the various items comprising the work.

3.2 Subcontracts: Upon approval of Subcontractors, the Contractor shall award their Subcontracts as soon as possible after the signing of their own contract and see that all material, their own and those of their Subcontractors, are promptly ordered so that the work will not be delayed by failure of materials to arrive on time.

3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.

3.4 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions.

3.5 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.

3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.

3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.

3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.

3.10 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.

3.11 STATE LICENSE AND TAX REQUIREMENTS

3.11.1 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the Delaware Department of Finance within ten (10) days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties."

3.12. The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

4.1.2 All bonds will be required as follows unless specifically waived elsewhere in the Bidding Documents.

4.1.3 Contents of Performance Bonds – The bond shall be in the form approved by the Office of Management and Budget. The bond shall be conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the

proposal, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing materiel or performing labor in the performance of the Contract, of all sums of money due the person for such labor and materiel. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)

4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so require, cause judgement to be confessed upon the bond.

4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.

4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of two (2) years after the date of the Certificate for Final Payment. The Performance Bond shall guarantee the satisfactory completion of the Project and that the Contractor will make good any faults or defects in his work which may develop during the period of said guarantees as a result of improper or defective workmanship, material or apparatus, whether furnished by themselves or their Sub-Contractors. The Payment Bond shall guarantee that the Contractor shall pay in full all persons, firms or corporations who furnish labor or material or both labor and material for, or on account of, the work included herein. The bonds shall be paid for by this Contractor. The Owner shall have the right to demand that the proof parties signing the bonds are duly authorized to do so.

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from pursing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

4.3.2 The purchase or nonpurchase of such insurance or the involvement of the successful Bidder in any legal or equitable defense of any action brought against the successful Bidder based upon work performed pursuant to the Contract will not waive any defense which the State, its agencies and their respective officers, employees and agents might otherwise have against such claims, specifically including the defense of sovereign immunity, where applicable, and by the terms of this section, the State and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

4.4.1 The Owner shall have the right to audit the books and records of a Contractor or any Subcontractor under any Contract or Subcontract to the extent that the books and records relate to the performance of the Contract or Subcontract.

4.4.2 Said books and records shall be maintained by the Contractor for a period of seven (7) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of seven (7) years from the date of final payment under the Subcontract.

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

5.1.1 All contracts for the construction, reconstruction, alteration or repair of any public building (not a road, street or highway) shall be subject to the following provisions:

1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.

2. A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:

   A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;

   B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and

   C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.

5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders, and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.

5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.

5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:

A. Is unqualified to perform the work required;

B. Has failed to execute a timely reasonable Subcontract;

C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or

D. Is no longer engaged in such business.

5.1.5 Should a Bidder be awarded a contract, such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

5.2.1 Should the Contractor fail to utilize any or all of the Subcontractors in the Contractor's Bid statement in the performance of the Work on the public bidding, the Contractor shall be penalized in the amount of (project specific amount*). The Agency may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Agency. Any penalty amount assessed against the Contractor may be remitted or refunded, in whole or in part, by the Agency awarding the Contract, only if it is established to the satisfaction of the Agency that the Subcontractor in question has defaulted or is no longer engaged in such business. No claim for the remission or refund of any penalty shall be granted unless an application is filed within one year after the liability of the successful Bidder accrues. All penalty amounts assessed and not refunded or remitted to the contractor shall be reverted to the State.

*one (1) percent of contract amount not to exceed $10,000

5.3 ASBESTOS ABATEMENT

5.3.1 The selection of any Contractor to perform asbestos abatement for State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

5.4.1 All Contracts shall conform with the standard established by the Delaware Architectural Accessibility Board unless otherwise exempted by the Board.

5.5 CONTRACT PERFORMANCE

5.5.1 Any firm entering into a Public Works Contract that neglects or refuses to perform or fails to comply with its terms, the Agency may terminate the Contract and proceed to award a new Contract or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond.

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.1 The Owner reserves the right to simultaneously perform other construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other Projects at the same site.

6.2 The Contractor shall afford the Owner and other Contractors reasonable opportunity for access and storage of materials and equipment, and for the performance of their activities, and shall connect and coordinate their activities with other forces as required by the Contract Documents.

ARTICLE 7: CHANGES IN THE WORK

7.1 The Owner, without invalidating the Contract, may order changes in the Work consisting of Additions, Deletions, Modifications or Substitutions, with the Contract Sum and Contract completion date being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Professional, as the duly authorized agent, the Contractor and the Owner.

7.2 The Contract Sum and Contract Completion Date shall be adjusted only by a fully executed Change Order.

7.3 The additional cost, or credit to the Owner resulting from a change in the Work shall be by mutual agreement of the Owner, Contractor and the Architect. In all cases, this cost or credit shall be based on the 'DPE' wages required and the "invoice price" of the materials/equipment needed.

7.3.1 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes direct salary plus customary fringe benefits (prevailing wage rates) and documented statutory costs such as workman's compensation insurance, Social Security/Medicare, and unemployment insurance (a maximum multiplier of 1.35 times DPE).

7.3.2 "Invoice price" of materials/equipment shall be defined to mean the actual cost of materials and/or equipment that is paid by the Contractor, (or subcontractor), to a material distributor, direct factory vendor, store, material provider, or equipment leasing entity. Rates for equipment that is leased and/or owned by the Contractor or subcontractor(s) shall not exceed those listed in the latest version of the "Means Building Construction Cost Data" publication.

7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work. These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractors subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.

8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.

8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility.

8.4 SUSPENSION AND DEBARMENT

8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the

Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project."

8.4.2 "Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record."

8.5 RETAINAGE

8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor's failure to meet their responsibilities, the Agency may forfeit, at its discretion, all or part of the Contractor's retainage.

8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor's failure to meet their responsibilities, the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

9.1.1 Applications for payment shall be made upon AIA Document G702. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage may become payable upon receipt of all required closeout documentation, provided all other requirements of the Contract Documents have been met.

9.1.2 A date will be fixed for the taking of the monthly account of work done. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified, if found necessary, and approved for the amount. Statement shall be submitted to the Owner.

9.1.3 Section 6516, Title 29 of the Delaware Code annualized interest is not to exceed 12% per annum beginning thirty (30) days after the "presentment" (as opposed to the date) of the invoice.

9.2 PARTIAL PAYMENTS

9.2.1 Any public works Contract executed by any Agency may provide for partial payments at the option of the Owner with respect to materials placed along or upon the sites or stored at secured locations, which are suitable for use in the performance of the contract.

9.2.2 When approved by the agency, partial payment may include the values of tested and acceptable materials of a nonperishable or noncontaminative nature which have been produced or furnished for incorporation as a permanent part of the work yet to be completed, provided acceptable provisions have been made for storage.

9.2.2.1 Any allowance made for materials on hand will not exceed the delivered cost of the materials as verified by invoices furnished by the Contractor, nor will it exceed the contract bid price for the material complete in place.

9.2.3 If requested by the Agency, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment. Following such a request, no payment will be made until these receipted bills have been received by the Owner.

9.3 SUBSTANTIAL COMPLETION

9.3.1 When the building has been made suitable for occupancy, but still requires small items of miscellaneous work, the Owner will determine the date when the project has been substantially completed.

9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.

9.3.3 On projects where commissioning is included, the commissioning work as defined in the specifications must be complete prior to the issuance of substantial completion.

9.4 FINAL PAYMENT

9.4.1 Final payment, including the five percent (5%) retainage if determined appropriate, shall be made within thirty (30) days after the Work is fully completed and the Contract fully performed and provided that the Contractor has submitted the following closeout documentation (in addition to any other documentation required elsewhere in the Contract Documents):

9.4.1.1 Evidence satisfactory to the Owner that all payrolls, material bills, and other indebtedness connected with the work have been paid,

9.4.1.2 An acceptable RELEASE OF LIENS,

9.4.1.3 Copies of all applicable warranties,

9.4.1.4 As-built drawings,

9.4.1.5 Operations and Maintenance Manuals,

9.4.1.6 Instruction Manuals,

9.4.1.7 Consent of Surety to final payment.

9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.

10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.

10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.

10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.

11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.

11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.

11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.

11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, shall not be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this

contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.

11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury	$500,000	for each person
	$1,000,000	for each occurrence
	$1,000,000	aggregate
Property Damage	$500,000	for each occurrence
	$1,000,000	aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	$500,000	for each person
	$1,000,000	for each occurrence
	$1,000,000	aggregate
Property Damage	$500,000	for each occurrence
	$500,000	aggregate

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

Bodily Injury	$1,000,000	for each person
	$1,000,000	for each occurrence
Property Damage	$500,000	per accident

11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.

11.7.5 Workmen's Compensation (including Employer's Liability):

11.7.5.1 Minimum Limit on employer's liability to be as required by law.

11.7.5.2 Minimum Limit for all employees working at one site.

11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.

11.7.7 Social Security Liability

11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.

12.2 At any time during the progress of the work, or in any case where the nature of the defects shall be such that it is not expedient to have them corrected, the Owner, at their option, shall have the right to deduct such sum, or sums, of money from the amount of the contract as they consider justified to adjust the difference in value between the defective work and that required under contract including any damage to the structure.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 CUTTING AND PATCHING

13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

13.3 LABORATORY TESTS

13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.

13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

13.4 ARCHAEOLOGICAL EVIDENCE

13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the Delaware Archaeological Board and suspend work in the immediate area for a reasonable time to permit those

authorities, or persons designated by them, to examine the area and ensure the proper removal of the archaeological evidence for suitable preservation in the State Museum.

13.5 GLASS REPLACEMENT AND CLEANING

13.5.1 The General Contractor shall replace without expense to the Owner all glass broken during the construction of the project. If job conditions warrant, at completion of the job the General Contractor shall have all glass cleaned and polished.

13.6 WARRANTY

13.6.1 For a period of two (2) years from the date of substantial completion, as evidenced by the date of final acceptance of the work, the contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect of equipment, material or workmanship performed by the contractor or any of his subcontractors or suppliers. However, manufacturer's warranties and guarantees, if for a period longer than two (2) years, shall take precedence over the above warranties. The contractor shall remedy, at his own expense, any such failure to conform or any such defect. The protection of this warranty shall be included in the Contractor's Performance Bond.

ARTICLE 14: TERMINATION OF CONTRACT

14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

14.2 “If the continuation of this Agreement is contingent upon the appropriation of adequate state, or federal funds, this Agreement may be terminated on the date beginning on the first fiscal year for which funds are not appropriated or at the exhaustion of the appropriation. The Owner may terminate this Agreement by providing written notice to the parties of such non-appropriation. All payment obligations of the Owner will cease upon the date of termination. Notwithstanding the foregoing, the Owner agrees that it will use its best efforts to obtain approval of necessary funds to continue the Agreement by taking appropriate action to request adequate funds to continue the Agreement.”

END OF SECTION 00 81 13

Gipe Associates, Inc.
CONSULTING ENGINEERS

RELEASE OF ELECTRONIC MEDIA (DRAWINGS, SPECIFICATIONS, ETC.)

PROJECT:_____ DATE:_____

PROJECT NO:_____ RECORD DOCUMENT DATE _____

In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by Gipe Associates, Inc., the Owner, its agents, other design professionals, or contractors covenants and agrees that all such drawings and data are instruments of service of Gipe Associates, Inc., and its Consultants (hereinafter referred to as the Engineer), who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

For documentation purposes, the original electronic media (disks) will be retained by the Engineer, and both parties acknowledge that the referenced, dated Record Document is the actual contract deliverable. The Owner shall be permitted to retain copies of Drawings and Specifications prepared in electronic form for the Owner's convenience in connection with the specific project for which this information was prepared. Due to the potential that the information set forth on the electronic media can be modified, unintentionally or otherwise, the Engineer reserves the right to remove all indicia of its ownership and/or involvement from each document on the electronic media.

No warranty is made or implied as to the suitability of these files or the information they contain for such purpose. In all cases, the Contract Drawings and Specifications shall define all requirements. The Contractor is responsible for verification of Drawings and field conditions and/recognizing the impermanence and changeability of electronic files, assumes all responsibility for their use and alteration.

The Owner, its Agents or other design professionals further agree not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Owner, its Agents, other design professionals, or contractors agree to waive all claims against the Engineer, and to the fullest extent permitted by law, to indemnify and hold the Engineer harmless from any damage, liability or cost, including reasonable attorneys' fees and cost of defense, arising from any changes or use of the Drawings and data made by anyone other than the Engineer without the prior written consent of the Engineer. Any such unauthorized use or reuse will be at the Owner's sole risk and without liability or legal exposure to the Engineer.

Under no circumstances shall transfer of the Drawings and other instruments of service on electronic media for use by the Owner, its Agents or other design professionals be deemed a sale by the Engineer, and the Engineer makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.

_____
Accepted - Owner or Owner's Representative

_____
Printed Name and Title

_____
Date

DIVISION 26
SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL
TABLE OF CONTENTS

3.20 DEMOLITION
3.21 EXCAVATION AND BACKFILLING

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.

2. Sleeves for raceways and cables.

3. Grout.

4. Common electrical installation requirements.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all electrical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered.

E. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with Article “Submittals” specified below. The right is reserved to make reasonable changes in location of equipment, boxes, conduit/wiring, and devices, up to the time of rough-in or fabrication.

F. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

G. Coordinate the work under Division 26 with the work of all other construction trades.

H. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the Contract Documents.

1.3 PERMITS, FEES, AND INSPECTIONS

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with Division 01 Section, *General Requirements*.

C. Notify Inspection Authorities to schedule inspections of work.

D. Notify Engineer in advance of scheduled inspections.

E. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections.

F. An electrical certificate from an independent (non-governmental) electrical inspection agency approved by the State of Delaware Fire Marshal must be submitted prior to or with the final payment invoice. The electrical sub-contractor shall file with the independent inspection agency, and pay all fees associated with such filing, at the start of construction so that adequate rough-in inspection can be made during the course of work.

1.4 EXAMINATION OF SITE

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.

B. Examine and verify specific conditions described in individual Specifications sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.5 INTERPRETATION OF DOCUMENTS

A. Any discrepancies between Drawings, Specifications, Drawings and Specifications, or within Drawings and Specifications shall be promptly brought to the attention of the Owner during the bidding period. No allowance shall subsequently be made by reason of failure to have brought said discrepancies to the attention of the Owner during the bidding period or of any error on the Bidder's part.

B. The locations of products shown on Drawings are approximate. Place the devices to eliminate all interference with overhead ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the Owner.

C. No electrical equipment, e.g. switchboards, transformers, panelboards, disconnect switches, motor controllers, etc. shall be installed beneath ductwork, piping, etc.

D. All general trades and existing conditions shall be checked before installing any outlets, power wiring, etc.

E. Equipment sizes shown on the Drawings are estimated. Before installing any wire or conduit, obtain the exact equipment requirements and install wire, conduit, or other item of the correct size for the equipment actually installed. However, wire and conduit sizes shown on the

Drawings shall be taken as a minimum and shall not be reduced without written approval from the Owner.

F. Where variances occur between the Drawings and Specifications or within either document itself, the item or arrangement of better quality, greater quality, or higher cost shall be included in the Contract Price. The Engineer will decide on the item and manner in which the work shall be installed.

G. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions, and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed Shop Drawings for approval in accordance with Article "Submittals" as herein after specified. The right is reserved to make reasonable changes in location of equipment, conduit/wiring, and devices, up to the time of rough-in or fabrication.

H. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Engineer and Owner.

I. Perform the work in a first-class, substantial and workmanlike manner. Any materials installed which do not present an orderly and neat workmanlike appearance shall be removed and replaced when so directed by the Engineer, at the Contractor's expense.

J. The complete set of Mechanical and Electrical Drawings and Specifications apply to this work. The successful Bidder shall familiarize himself with all other related documents.

1.6 MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. Existing items of equipment are being reconnected under another Division of these Specifications. The Contractor shall be responsible for connecting all utilities as shown on the Drawings, to equipment identified as existing.

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.

D. Substitution will not be permitted for specified items of material or equipment where noted.

E. All items of equipment furnished shall have a service record of at least five (5) years.

1.7 ELECTRICAL WORK UNDER OTHER DIVISIONS

A. HVAC Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under HVAC divisions shall be supplied with control wiring, transformers, contacts, etc.

2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related thereto.

3. Certain mechanical units are furnished from the factory with motor starters, contactors, transformers, fuses, wiring, etc., required for fans, pumps, etc. When this equipment is supplied from the factory, Division 26 shall coordinate with Division 23 such that only one set of starters, fuses, switches, etc. is provided.

4. In general, control and interlock equipment (including, but not limited to wiring, conduit, transformers, relays, contacts, etc.) for HVAC equipment and systems is furnished under Division 23. Division 26 shall install and connect all equipment as necessary.

5. HVAC equipment refers to, but is not limited to the following:

a. Radiant Heat Panels
b. Ventilation Fans

1.8 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA and ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.9 REFERENCED STANDARDS, CODES AND SPECIFICATIONS

A. Specifications, Codes and Standards listed below are included as part of this Specification, latest edition:

1. ADA - Americans with Disabilities Act

2. ANSI - American National Standards Institute

3. ASTM - American Society for Testing and Materials

4. CSA - Canadian Standards Association

5. DNREC - Delaware Department of Natural Resources and Environmental Control

6. EPA - Environmental Protection Agency

7. FM - Factory Mutual

8. IBC - International Building Code

9. IEEE - Institute of Electrical and Electronics Engineers

10. NEC - National Electrical Code

11. NECA - National Electrical Contractors Association

12. NEMA - National Electrical Manufacturers Association

13. NFPA - National Fire Protection Association

14. OSHA - Occupational Safety and Health Act

15. UL - Underwriters' Laboratories

B. Electrical construction materials shall, where a listing is normal for the particular class of material, be listed in *Electrical Construction Materials List* of the Underwriters' Laboratories, Inc. (U.L.) and shall bear the listing label. Electrical equipment shall, where a listing is normal for the particular class of equipment, be listed in the *Electrical Appliance and Utilization Equipment List* of the Underwriters' Laboratories, Inc. (U.L.) and shall bear the listing label. Materials and equipment listed and labeled as "approved for the purpose" by other nationally recognized testing laboratory, inspection agency or approved organization (such as E.T.L. or Factory Mutual) shall be acceptable.

1.10 SUBMITTALS

A. Product Data: Include complete descriptive product data for items specified in Part 2 of this Section.

1.11 SUBMITTAL PROCEDURES

A. Refer to Division 01, Section “Submittal Procedures” for requirements in addition to those indicated herein.

B. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer, to be in the best interest of the Owner.

C. Electronic submittals shall be prepared as a Portable Document Format (PDF) file and shall include as page 1 the Contractor’s stamp, followed by the submittal contents. Submittal form shall identify the Project, Contractor, Subcontractor or Supplier, and pertinent Contract Document references.

D. Submittals shall consist of specifications, product data sheets, manufacturer’s catalog cuts, dimensional shop drawings, wiring diagrams, installation instructions, samples, and any other information necessary to indicate complete compliance with Contract Documents.

E. Submittals shall include, but not be limited to, the following information: size, type, functional characteristics, compliance with standards in Division 26, required service access which shall be suitable for intended location and use, electrical service connections and requirements, and deviations from Contract Document requirements.

F. Identify submittals, indicating intended application, location and service of submitted items. Refer to Specification sections or paragraphs and Drawings where applicable.

G. Clearly indicate exact type, model number, style, size, operating characteristics, ratings, options and special features of proposed item specifically for application to this project. Submittals of a general nature will not be acceptable.

H. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

I. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and all electrical requirements for equipment submitted. The Contractor shall be responsible for correctness of all submittals.

J. Submittals will be reviewed for general compliance with design concept in accordance with Contract Documents, but dimensions, quantities, or other details will not be verified.

K. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold Contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

L. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action and maintaining the Specification requirements if differences have not been clearly indicated in the submittal.

M. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

N. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct submittal. Identify all submittals by the name of the item/system and the applicable Specification Section and/or Drawing number. Grouping of items/systems that are not related shall be unacceptable.

Items and Systems

1. Analysis & Coordination Study
2. Arc Flash Hazard Analysis
3. Arc Flash Hazard Labels
4. Ballasts for Lighting Fixtures
5. Circuit Breakers
6. Conductors and Cables - 600V or Less
7. Conduit and Raceway
8. Electricity Meters

9. Equipment Nameplates/Labels
10. Firestopping Materials
11. Foam Duct Sealant
12. Fuses, Medium Voltage
13. Ground Conductors
14. Ground Rods
15. Grout
16. Hangers and Supports
17. Identification Products
18. Installer Certificates
19. Junction and Pull Boxes, Standard Sizes
20. Lamps
21. Lighting Fixtures, Interior
22. Medium Voltage Cable Termination & Splice Kits
23. Medium Voltage Cables
24. Medium Voltage Grounding
25. Motor Controllers
26. Operation and Maintenance Manual
27. Outlet and Device Boxes
28. Panelboard Circuit Directories
29. Panelboards
30. Qualification Data
31. Receptacles
32. Record Drawings
33. Sleeves
34. Surge Protective Devices
35. Switchboards
36. Testing Agency Qualifications
37. Test Reports
38. Transformers, 600V and Less
39. Transformers, Medium Voltage
40. Underground Ductbank Products
41. Wiring Diagrams

O. Submit for approval any other submittals as required by the Engineer or Owner. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

P. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.12 SHOP DRAWINGS

A. Prepare and submit Shop Drawings for all electrical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the Contract Drawings, or where the proposed installation differs from that shown on Contract Drawings.

B. Shop drawings shall include identification of products being installed, compliance with specified standards, notation of coordination requirements, notation of dimensions verified by

field measurement, etc. Do not base shop drawings on reproductions of the Contract Documents or standard printed data.

C. Submit shop drawings concurrent with product data. Shop drawings received without associated product data will be returned without review.

D. Submit for approval schematic diagrams of each electrical system installed in the building, including but not limited to Riser Diagrams and Schematic Wiring Diagrams for the following systems:

1. Grounding and Bonding System

E. Shop Drawing diagrams shall indicate device location, service, type, make, model number and the identification number of each device in the particular system. Following approval by all authorities, the diagrams shall be inserted into the O&M Manual specified herein.

F. Submit for approval any other shop drawings as required by the Engineer or Owner. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

G. For any shop drawing requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold Contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return for any reason.

H. Refer to individual Specification Sections and Contract Drawings for additional shop drawing requirements.

I. For resubmissions, the Contractor must address in writing all of the Engineer’s comments on the original submission to verify compliance.

1.13 DEFINITIONS

A. *Approve*: To permit use of material, equipment or methods conditional upon compliance with contract documents requirements.

B. *Building Line*: Exterior wall of building.

C. *Concealed:* Hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction, in crawl space, or in attic.

D. *Conduits* include conduit, all fittings, identification, and other accessories relative to such conduit.

E. *Contractor:* The Electrical Contractor and any of his subcontractors, vendors, suppliers, or fabricators.

F. *EPDM*: Ethylene-propylene-diene terpolymer rubber

G. *Exposed:* Not installed underground or *concealed* as defined above.

H. *Finished Spaces*: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

I. *Furnish and install* or *provide*: To supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

J. *Location, Damp*: Locations protected from water and not subject to saturation with water or other liquids, but subject to moderate degrees of moisture. Examples of such locations include interior locations such as basements, crawlspaces, attics, cold-storage rooms, etc…

K. *Location, Dry*: A location not normally subject to dampness or wetness. A dry location may temporarily be subject to dampness or wetness during building construction.

L. *Location, Wet*: Locations subject to saturation with water or other liquids, locations exposed to weather, and installations underground or in concrete slabs or masonry in direct contact with the Earth. Examples of such locations include all exterior locations (including those under canopies, roofed open porches, etc…) commercial kitchens, and vehicle washing areas.

M. *NBR*: Acrylonitrile-butadiene rubber.

N. *Review*: Limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

1.14 RECORD DRAWINGS

A. Upon completion of the electrical installations, the Contractor shall deliver to the Engineer one complete set of prints of the electrical Contract Drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings.

B. Contractor shall incorporate all sketches, addendums, value engineering, change orders, etc., into record drawings prior to delivering the same to the Architect.

1.15 WARRANTY

A. Contractor's attention is directed to warranty obligations contained in the General Conditions.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of equipment manufacturer’s warranties shall be included in the operations and maintenance manuals.

C. The Contractor guarantees for a two (2) year period from the time of final acceptance by the Owner:

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.

2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.

3. That the Contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The Contractor shall also make good all damages caused to their work or materials in the process of complying with this section.

4. That the entire work shall be water-tight and leak-proof.

1.16 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall have prepared three (3) hardcopies and one (1) electronic copy of the Operation and Maintenance Manual and deliver these copies of the manual to the Owner. The manual shall be as specified herein. The manual must be approved and will not be accepted as final until so stamped.

B. The manual shall be bound in a three-ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: *Operation and Maintenance Manual – Delaware State University Lune I. Mishoe Science Center Electrical Upgrade - Electrical.* No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out. Provide divider tabs and table of contents for organizing and separating information.

C. Provide the following data in the manual:

1. As first entry, an approved letter indicating the starting/ending time of Contractor's warranty period.

2. Maintenance operation and lubrication instructions on each piece of equipment furnished.

3. Complete catalog data on each piece of electrical equipment furnished including approved Shop Drawing/Submittal with Engineer's Comments (if any).

4. Manufacturer's extended limited warranties on equipment.

5. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.

6. Provide supplier and subcontractor's names, address, and phone number.

7. Catalog data of all equipment, starters, etc. shall include wiring diagrams, parts list and assembly drawing.

8. Access panel charts with index illustrating the location and purpose of access panels.

9. Approved Electrical Certificates.

10. Start-up reports for equipment.

D. Submit Operation and Maintenance Manual prior to the anticipated date of Substantial Completion for Engineer review and approval. Substantial Completion requires that Operation and Maintenance Manuals be reviewed and approved.

E. Deliver all instruction materials to the Owner prior to the formal instruction period.

F. Upon completion of all work, thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electrical equipment and systems.

G. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance.

H. Instructions shall be given only by experts in the equipment or system and shall include descriptions and demonstrations of procedures of operation, data record keeping, etc.

I. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one (1) 8-hour day.

J. Where specified in technical sections, provide longer periods required for specialized equipment.

K. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

L. The Operation and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

M. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer.

PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.3 SPARE KEY CABINET

A. Description: Wall-mounted, locking utility cabinet(s) with key hooks for spare keys provided with electrical equipment.

B. Construction: 22 gauge steel, manufacturer standard color, polyester powder paint finish inside and out.

C. Features:
1. 30 key cabinet.
2. “Out Key” tags to identify who has keys.
3. Numbered tag key holders to easily identify keys

D. Dimensions: Cabinet(s) shall be of proper size for orderly storage of spare keys stored in the same, plus space for 15 percent spare capacity. Cabinet(s) shall be no smaller than 12”H x 8”W x 3”D.

E. Identification: Provide engraved nameplate to read “SPARE KEYS” in 1/2" high lettering on front door of cabinet(s). Refer to Division 26 Section, “Electrical Identification” for nameplate requirements.

F. Installation: Provide one (1) locking key cabinet in the main electrical room. Cabinet(s) shall be mounted 5’-6” to top unless otherwise noted on the Contract Drawings.

G. Basis of Design: Provide key hook style locking utility cabinet as manufactured by Uline (Model H-1447), or approved equal.

PART 3 EXECUTION

3.1 TEMPORARY FACILITIES:

A. General: Refer to the Division 01 Sections and the Drawings for the requirements of temporary facilities.

B. Description: Furnish and install the necessary distribution equipment for an adequate, 3-phase, 4-wire temporary electrical service and all temporary wiring, including step-down or step-up dry-type transformers as required.

C. Attention is directed to the Occupational Safety and Health Act (OSHA), Americans with Disabilities Act (ADA) and National Electrical Code (NEC) requirements for electrical work on construction sites.

D. Obtain and pay for temporary electrical service for the Science Center – North Building.

E. Provide all underground and/or overhead equipment, transformers, overcurrent devices, wires, connections, etc., for providing temporary power from PMS-2 to Main Distribution Panelboard.

F. Remove all temporary power installations and connections after permanent power is established and/or prior to completion of the project.

3.2 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Install equipment with working space and dedicated space in strict accordance with 2011 NEC Article 110.

E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

F. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

G. Verify exact electrical requirements for each piece of equipment receiving one or more electrical connections, including but not limited to voltage, phase, and maximum fuse/overcurrent protection device rating. Provide electrical circuit of proper characteristics to serve provided equipment.

H. Include any and all items required by the National Electrical Code and/or field conditions for the proper connection and installation of each piece of equipment.

I. Make all connections to equipment in accordance with manufacturer's instructions.

J. Right of Way: Give to piping systems installed at a required slope.

K. Coordinate electrical work under other Divisions in accordance with Part 1 of this Section, Article "Electrical Work Under Other Divisions".

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Sleeves installed in floors shall extend 2 inches (50 mm) above finished floor level unless otherwise indicated on the Contract Drawings.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements of Division 26 Section “Electrical Firestopping”.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and approved sealant. Select sleeve size to allow for 1/2-inch annular clear space between pipe and sleeve.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 26 Section, "Electrical Firestopping".

3.5 SUPPORTS, HANGERS AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. Installing Equipment Foundations (Housekeeping Pads):

1. Provide four (4) inch high concrete foundations (housekeeping pads) for all interior pad-mounted equipment, extending a minimum of 6 inches beyond equipment bases, unless otherwise noted.

2. Provide six (6) inch high concrete foundations (housekeeping pads) for all exterior pad-mounted equipment, extending a minimum of 12 inches beyond equipment bases, unless otherwise noted.

3. Furnish foundations, bolts, sleeves, and appurtenances and set under the section furnishing the equipment. Anchor the concrete foundations by dowels inserted into the floor slab. Provide welded wire fabric reinforcement, chamfer exposed edges and corners, and finish exposed surfaces smooth.

4. Unless otherwise specified, provide all concrete work required for housekeeping/equipment pads.

5. Equipment shall be properly aligned. Level and grout equipment where necessary. Support conduit independently of equipment and so as not to cause a strain or thrust.

6. Determine exact location of all equipment, foundations, and supports after Shop Drawings of equipment have been approved.

D. Where new concrete housekeeping pads are placed on existing concrete, saw cut the existing concrete to the perimeter dimension of the new pad to a depth of ½ inch. Break out the top ½ inch area of the existing concrete. Add stubs of #4 rebar angled into the existing concrete at a depth of approximately 50 percent of the existing slab thickness. The top portion of the rebar stub shall extend into the new pad by approximately 50 percent of its thickness. Furnish one rebar stub per every two square feet of new pad. Chemically bond the new concrete to the existing concrete.

E. Refer to Division 26 Section “Hangers and Supports” for additional requirements.

3.6 PROVISIONS FOR ACCESS

A. The Contractor shall provide access panels and doors for all concealed equipment, and other devices requiring maintenance, service, adjustment or manual operation.

B. Where access doors are necessary, furnish and install manufactured painted steel door assemblies consisting of hinged door, key locks, and frame designed for the particular wall or ceiling construction. Properly locate each door. Door sizes shall be a 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 24 inches x 24 inches for full body access where required. Review locations and sizes with Architect prior to fabrication. Provide U.L. approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, Mifab, or approved equal.

1. Acoustical or Cement Plaster: Style B

2. Hard Finish Plaster: Style K or L

3. Masonry or Dry Wall: Style M

C. Where access is by means of liftout ceiling tiles or panels, mark each ceiling grid using small color-coded and numbered tabs. Provide a chart or index for identification. Place markers within ceiling grid not on ceiling tiles.

D. Access panels, doors, etc. described herein shall be furnished under the section of Specifications providing the particular service and to be turned over to the pertinent trade for installation. Coordinate installation with installing Contractor. All access doors shall be painted in baked enamel finish to match ceiling or wall finish.

E. Submit shop drawings indicating the proposed location of all access panels/doors. Access doors in finished spaces shall be coordinated with air devices, lighting and sprinklers to provide a neat and symmetrical appearance.

F. Provide sufficient access and working space for repair and maintenance about all lighting and electrical equipment to permit ready and safe operation and maintenance of such equipment in accordance with OSHA 29 CFR 1910 Subpart D and 1910.303(g).

3.7 PAINTING AND FINISHES

A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.

B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 26 to their original condition.

E. The preceding requirements apply to all work, whether exposed or concealed, as defined herein.

F. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces. Do not paint manufacturer's labels or tags.

G. All exterior equipment and conduits shall be painted to match adjacent surface in color as selected by Owner, unless otherwise indicated by the Owner.

H. All exposed conduit, boxes, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Owner and conform to ANSI Standards.

3.8 COLOR SELECTION

A. Color of finishes shall be as selected by the Owner.

3.9 PROTECTION OF WORK

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in conduits and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver conduits with factory applied end caps.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

E. Protect stored conduits from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.10 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.

C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing.

D. Do not use electrical systems for temporary services or during construction, unless approved by Owner in writing. Refer to Division 01 Section "Temporary Facilities and Controls".

E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items.

3.11 TESTING AND ADJUSTMENT

A. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices and perform all necessary preliminary tests to assure that the work is complete and ready for final test.

B. Adjust all systems, equipment and controls to operate in a safe, efficient and stable manner.

C. On all circuits, 600 volts or less, provide circuits that are free from ground faults, short circuits and open circuits.

D. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

E. Submit all test results to the Engineer for approval.

3.12 WALL AND FLOOR PENETRATIONS

A. All penetrations of partitions, ceilings, roofs and floors under Division 26 shall be sleeved, sealed, and caulked as specified herein.

B. All penetrations of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 26 Section, "Electrical Firestopping".

C. Provide conduit escutcheons for all exposed conduit penetrations in finished interior spaces and all exposed exterior penetrations.

D. Conduit sleeves:

1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.

2. Twenty-two (22) gauge galvanized steel elsewhere.

3.13 EQUIPMENT BY OTHERS

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of the equipment to furnish complete instructions for connections. Failure to do so will not relieve the Contractor of any responsibility for improper equipment operation.

3.14 OUTAGES

A. Provide a minimum of fourteen (14) days' notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.

B. Submit *Outage Request Form*, attached at the end of this Section, to Owner for approval.

3.15 CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 26. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval from the Engineer.

3.16 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

3.17 CONCRETE AND MASONRY WORK

A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 26. Perform work in accordance with requirements of Division 03 and other applicable Divisions of these Specifications.

B. Concrete shall achieve compressive strength not less than 3,000 psi after 28 days.

C. Grout shall be non-shrink, high strength mortar, free of iron of chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in accordance with manufacturer's instructions and standard grouting practices.

D. Place reinforcement accurately in position shown, securely fasten and support to prevent displacement before or during pouring. Clean, bend, place, and splice reinforcement in accordance with approved shop drawings. Lap ends and sides of mesh reinforcement in slabs not less than one inch. Coverage of main reinforcing shall be as follows:

1. Slabs - 3/4 inch
2. Concrete poured against earth - 3 inches
3. Other locations - 2 inches

E. Properly align, level, and grout all equipment where necessary.

3.18 CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. Unless otherwise noted on the Drawings, where existing electrical work is removed, including hangers, to a point below finished floors or behind finished walls and capped, such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.

B. Where work specified in Division 26 connects to existing equipment, conduits, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and to leave completed work in a finished and workmanlike condition.

C. Where the work specified under Division 26, or under other Divisions, requires relocation of existing equipment, conduit etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition.

D. Where the relocation of existing equipment is required for access or the installation of new equipment, the Contractor shall temporarily remove and/or relocate and re-install as required to leave the existing and new work in a finished and workman like condition.

3.19 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

5. To provide working space and dedicated space clearances per NEC Article 110.26.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Part 2 of this Section.

3.20 DEMOLITION

A. Refer to Division 26 Section, "Electrical Demolition for Remodeling" for additional requirements.

B. Unless otherwise noted all existing equipment, conduit, wire, etc., shall remain.

C. Where existing equipment is indicated to be removed, all associated conduit, power, controls, insulation, hangers, supports and housekeeping pads, etc…, shall also be removed. Patch, paint and repair walls/roof/floor to match existing and/or new finishes.

D. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

E. Where any abandoned conduits in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned conduits as necessary to accommodate new work.

F. The location of all existing equipment, conduits etc., indicated is approximate only and shall be checked and verified. Provide all new electrical work required to connect to or clear existing work as applicable.

G. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the Authority(ies) Having Jurisdiction (AHJ).

H. Make provisions and include in bid all costs associated with confined entry/space requirements in crawl spaces and all other applicable OSHA regulations.

I. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing conduit systems to new conduit systems.

J. At completion of project all temporary conduit, wires, etc., shall be removed in their entirety.

K. Existing conduit, equipment, wiring, etc., not required for re-use or re-installation in this pro-

ject, shall be removed from the project site.

L. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.

M. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing PCB's.

N. Where conduit and wiring are removed, remove all conduit hangers which were supporting the removed conduit. Patch the remaining penetration voids with like materials and paint to match existing construction.

O. Where required, provide and coordinate removal and re-installation of existing equipment. Take care to protect materials and equipment indicated for reuse. Contractor shall repair or replace items which are damaged. Contractor shall have Owner's representative present to confirm condition of equipment prior to demolition.

P. Before demolition begins, and in the presence of the Owners representative, test and note all deficiencies in all existing systems affected by demolition but not completely removed by demolition. Provide a copy of the list of system deficiencies to the Owner and the Engineer.

Q. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.

R. All devices and equipment designated by the Owner to remain the property of the Owner shall be moved and stored by the Contractor at a location on site as designated by the Owner. It shall be the Contractor's responsibility to store all devices and equipment in a safe manner to prevent damage while stored.

S. All existing equipment refused by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor in a timely manner and disposed of in a legal manner.

T. Work Abandoned in Place: Cut and remove conduit a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

U. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

V. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

3.21 EXCAVATION AND BACKFILLING

A. General:

1. Perform all necessary excavation, or installation of work under Division 26, in whatever materials or conditions encountered, using suitable methods and equipment.

2. Accurately establish required lines and grades and properly locate the work.

3. Determine the locations of all existing utilities before commencing the work.

B. Excavation:

1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.

2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, OSHA, and other applicable Guidelines.

3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling:

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.

2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.

3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.

4. Do not backfill against frozen material. Do not use frozen material for backfill.

END OF SECTION

OUTAGE REQUEST FORM

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE:_____

END OUTAGE - TIME: _____ DATE:_____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____
(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ NO ___ BY: _____DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER : _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ NO: ___ NAME: _____

POINT OF CONTACT: _____ PHONE: _____

DIVISION 26
SECTION 260502
ELECTRICAL DEMOLITION FOR REMODELING
TABLE OF CONTENTS

SECTION 260502 - ELECTRICAL DEMOLITION FOR REMODELING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SCOPE

A. Provide all demolition of existing electrical equipment including all conduit and wiring as required by the Contract Documents. Electrical demolition shall be performed in accordance with the Contract Documents.

B. Provide all cutting and patching for electrical construction.

C. Provide temporary service and provisions to maintain existing systems.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements and circuiting arrangements are as shown on the Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation. Report discrepancies to the Owner, and Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect and make electrically safe electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages and removal with the Owner and Engineer and other trades.

3.3 CONNECTIONS AND ALTERATIONS TO EXISTING SYSTEMS

A. Keep all existing electrical systems in operation during the progress of the work. Provide temporary electrical connections to systems of equipment, etc., where necessary to maintain

continuous operation until the new systems and equipment are ready for operation.

B. When existing electrical work is removed, remove all conduit, ducts, supports, etc. to a point below the finished floors or behind finished walls and cap. Such points shall be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.

C. When the work specified hereunder connects to any existing equipment, conduit, wiring, etc., perform all necessary alterations, cuttings, fittings, etc., of the existing work as may be necessary or required to make satisfactory connections between the new and existing work and leave the complete work in a finished and workmanlike condition.

D. When the work specified under other divisions necessitates relocation of existing equipment, conduits, wiring, etc., perform all work and make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition.

E. Provide responsibility for removing and replacing existing floor tile within the raised floor areas as required. Provide all necessary cutting and fitting of bushed holes for cable passage through tiles. Any tiles damaged during the Contract shall be replaced with like kind at no cost to the Owner.

F. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. In particular, all security and safety systems must be maintained in operation at all times as required by the Owner. This includes security and safety lighting.

G. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner, Engineer, and other trades at the site at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

H. Trace all circuits and controls to be disconnected to ensure that vital services to other areas are not interrupted.

3.4 PROTECTION

A. Provide protection for all existing and new cabling. Provide innerduct, conduit or other suitable means of protection to prevent damage to cables located in renovated areas.

B. Damage to wiring, cabling or equipment shall be repaired by skilled mechanics for the trade involved at no additional contract amount.

C. Fixtures, materials and equipment shall be protected at all times. The Contractor shall make good any damage caused either directly or indirectly by his workmen. Conduit openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water and chemical or other injury. At the completion of all work, the fixtures, materials and equipment shall be thoroughly cleaned and turned over in a condition satisfactory to the Owner.

D. Damage: Where wiring, raceways, lighting fixtures, devices or equipment to remain is inadvertently damaged or disturbed, cut out and remove damaged section and provide new of equal or capacity or quality.

3.5 ELECTRICAL DEMOLITION

A. Remove from the premises and dispose of all existing wiring, conduit, material, fixtures, devices, equipment, etc., not required for re-use or re-installation.

B. Deliver on the premises where directed existing material and equipment which is removed and is desired by the Owner or is indicated to remain the property of the Owner.

C. All other equipment and materials which are removed shall become the property of the demolisher and shall be removed by him from the premises.

D. Where electrical equipment is removed, also remove all wiring back to source panelboard or switch or to last remaining device on the same circuit. All conduit, hangers, supports, etc., shall also be removed unless otherwise noted. Such conduit may remain to be reused for new work provided said conduit is of the proper size and type as that specified and in a condition acceptable to Engineer and Owner.

E. Any conduit abandoned in concrete slabs, walls, or other inaccessible locations shall be left empty except for a nylon pull wire. Ends shall be capped with push plugs for future use.

3.6 EXISTING CONDUIT WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Abandoned Work: Concealed electrical work abandoned in place, shall be cut out approximately 2 inches beyond the face of adjacent construction, capped and the adjacent surface patched to match the existing finish.

D. Disconnect abandoned outlet boxes and remove devices. Remove abandoned outlet boxes if raceway servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes which are not removed.

E. Ensure access to existing boxes and other installations which remain active and which require access. Modify installation or provide access panel as appropriate.

F. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

G. Clean and repair existing raceway and boxes which remain or are to be reinstalled.

H. Remove all abandoned wiring from existing conduits and ductbanks. Abandoned wiring that cannot be removed shall be tagged at each end as “Abandoned”.

I. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors and patch surfaces.

3.7 EXISTING WIRING AND CABLING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes if wire and cable servicing them is abandoned and removed. Provide blank cover for abandoned boxes which are not removed.

C. Ensure access to existing wiring connections which remain active and which require access. Modify installation or provide access panel as appropriate.

D. Extend existing circuits using materials and methods compatible with existing electrical installations or as specified.

E. Clean and repair existing wire and cable which remain or is to be reinstalled.

3.8 EXISTING WIRING DEVICES WORK

A. Disconnect abandoned wiring devices and remove them.

B. Ensure access to existing wiring devices which remain active. Modify installation as appropriate.

C. Clean and repair existing wiring devices which remain or are to be reinstalled.

D. Provide blank coverplates over existing device boxes which are to remain empty. Finish shall match existing finish of surrounding area.

E. Disconnect abandoned wiring devices and remove devices. Remove abandoned outlet boxes if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes which are not removed.

3.9 EXISTING FUSE WORK

A. Remove fuses from abandoned circuits.

B. Ensure access to existing fuses and other installations which remain active and which require access. Modify installation or provide access panel as appropriate.

3.10 EXISTING TRANSFORMER WORK

A. Disconnect and remove abandoned transformers.

B. Ensure access and adequate ventilation to existing transformers and other installations which remain active and which require access and ventilation. Modify installation or provide access panel or ventilation grilles as appropriate.

3.11 EXISTING DISTRIBUTION WORK

A. Disconnect and remove abandoned panelboards and distribution equipment.

B. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.12 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work to meet all requirements of these specifications.

B. If certain raceways and boxes are abandoned but not scheduled for removal, those items must be shown on the As-Built Drawings.

C. Remove, relocate, and extend existing installations to accommodate new construction.

D. Remove abandoned wiring to source of supply.

E. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

H. Extend existing installations using materials and methods (compatible with existing electrical installations, or) as specified. This includes the extension of the circuit from the last active device to the next device in the system to be activated.

3.13 CLEANING AND REPAIR

A. Clean and repair existing equipment and materials that remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.14 INSTALLATION

A. Install relocated materials and equipment under the provisions of other related Sections.

END OF SECTION

DIVISION 26
SECTION 260513
MEDIUM VOLTAGE CABLES
TABLE OF CONTENTS

SECTION 260513 - MEDIUM VOLTAGE CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.4 GENERAL:

A. Definition: Medium voltage power cables shall mean all cables rated 5 KV and above.

B. Provide all necessary cables as indicated on the drawings or as specified herein.

C. This specification covers medium voltage conductor concentric neutral power cable suitable for use in wet and dry locations in conduit, underground duct systems, direct-buried and aerial installations.

1.5 RATING

A. Fifteen (15) KV cable for use on 12.47 KV grounded system.

1.6 CODES AND STANDARDS:

A. All cables and accessories furnished under this Section shall be in accordance with the latest applicable standards of AEIC, ANSI, NEMA, IEEE, ICEA, OSHA, and the National Electrical Code. In addition, 33 KV cable and accessories shall be in accordance with the requirements of local utility company. The requirements of the local utility are in addition to, and in no way a waiver of, the applicable codes and standards.

B. Where any requirements specified herein or shown on the Contract Drawings exceed the listed standards, the Bidder shall adhere to the higher standard. In the case of conflict in requirements between two or more standards, the decision of the Engineer shall be final. Code compliance is mandatory. Nothing in the Drawings and Specifications implies acceptance of work that does not comply with Codes.

C. Where applicable, all equipment and materials shall be listed and labeled by a nationally recognized testing laboratory with equipment listing and follow-up services.

1. American National Standards Institute (ANSI)

ANSI C2 National Electrical Safety Code

2. National Electrical Manufacturers Association (NEMA)
   NEMA WC8 Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

3. National Fire Protection Association (NFPA)
   NFPA 70-1999 National Electrical Code

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

   a. ASTM B-8 Concentric-Lay-Stranded Copper Conductors; Hard, Medium, or Soft.

   b. ASTM B-231 Concentric-Lay-Stranded Aluminum Alloy 1350 Conductors.

D. Association of Edison Illuminating companies (AEIC): AEIC CS6 EP Rubber Insulated Wire Cable.

E. Insulated Cable Engineers Association (ICEA): ICEA S-68-516 Cables Rated 0-3500X Ozone Resistance.

F. Underwriters Laboratories (UL): UL-1072 List of Acceptable Sunlight Resistant PVC Compounds for use as insulating and/or jacketing material on listed outdoor flexible cords.

G. AEIC CS 6-1987: Specification for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 kV.

H. IEEE 48-1990: Standard Test Procedures and Requirements for High-Voltage Air-Conditioning Cable Terminations (ANSI).

I. IEEE 386-1995: Standard for Separable Insulated Connectors System for Power Distribution Systems above 600 V (ANSI).

J. IEEE 404-1993: Standard for Cable Joints for Use with Extruded Dielectric Cable Rated 5000-138,000 Volts and Cable Joints for Use with Laminated Dielectric Cable Rated 2500-500,000 Volts (ANSI).

K. IEEE 576-1989: Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in the Petroleum and Chemical Industry (ANSI).

L. IEEE C2-1996: National Electrical Safety Code (ANSI).

M. ICEA T-31-610-1994: Guide for Conducting a Longitudinal Water Penetration Test for Sealed Conductor.

N. NETA ATS-1995: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

O. NEMA WC 8-88 (ICEA S-68-516): Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

P. NEMA WC 26-90 (including Revision 1 - 1993): Wire and Cable Packaging.

Q. NFPA 70-96: National Electrical Code.

1.7 GENERAL REQUIREMENTS

A. All materials supplied by the Contractor shall be new, of recent manufacture, and of the highest commercial grade as specified. They shall be resistant to moisture and corrosion to withstand their environment and operational conditions with minimum maintenance and long life.

1.8 QUALIFICATIONS

A. The manufacturer of the materials specified herein shall have at least ten years of demonstrated experience in the manufacture of the specified product.

B. The manufacturer shall be a company specializing in the manufacture of medium voltage cable and/or accessories with minimum five years documented experience in producing cable and/or accessories similar to those specified below.

C. The cable materials and manufacturer shall meet or exceed all applicable requirements of the latest editions of ICEA Standard S-68-516, AEIC and NEMA Standards.

D. The cable shall be manufactured using the triple tandem extrusion process in which all layers, from the conductor to, and including, the insulation tape shield, are installed at essentially the same time without an intervening storage period on reels or other storage devices.

E. Factory Tests:

1. Cable shall be factory-tested at high voltage AC, high voltage DC, and for corona discharge in accordance with ICEA requirements.

2. Certification of satisfactory completion of factory tests for cables shall be submitted to the Engineer at the time of cable delivery.

1.9 SUBMITTALS

A. Submit product data indicating cable and accessory construction, materials and ratings.

B. Submit Manufacturer's certificate stating factory test voltage.

C. Submit Manufacturer's installation instructions.

D. Submit Manufacturer's Certificate stating that medium voltage cable meets or exceeds all requirements.

E. Manufacturer's instructions for storage, handling, protection, examination and field testing of cables and accessories before initial energization.

F. Samples: 32-inch (800-mm) lengths of each type of cable specified.

G. Product Certificates: Signed by manufacturers of cables and accessories certifying that the products furnished comply with requirements.

H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

I. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

J. Product Test Reports: Indicate compliance of cables and accessories with requirements based on comprehensive testing of current products.

K. Medium Voltage Cable Terminating and Splicing Workman's Competency: In order to establish workman's competency regarding medium voltage cable terminating and splicing, the Contractor shall be required to submit the following within 30 days prior to commencement of termination of work.

1. Documentation to verify that the individual has completed a termination and splice of the types to be installed, under the supervision of the cable accessory manufacturer, or his representative.

2. A statement of the number of years in which the individual has been splicing/terminating medium voltage cables.

3. A list of the last three jobs where specific splices/terminations were installed within the last 12 consecutive months. This list shall include splice/termination manufacturer, catalog number, cable type and the quantity installed.

L. Maintenance Data: For cables and accessories to include in the maintenance manuals specified in Division 01.

1. Include periodic tests of cables in service.

2. Include operation of separable insulated connectors, and accessories.

1.10 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C2 and NFPA 70.

1.11 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Division 01.

B. Accurately record exact sizes, lengths, types, quantities, and locations of cables. Indicate where all splices and terminations are located for each cable.

1.12 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Division 01 and comply with NEMA WC 26.

B. Store and protect products under provisions of Division 01. Store cables and reels on elevated platforms in a dry location.

C. Accept cable and accessories on site in manufacturer's packages and inspect for damages.

D. Protect cable and accessories from weather by covering with opaque plastic or canvas. Provide ventilation to prevent condensation.

E. Cable shall be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F, the cable shall be moved to a heated (50 degrees F minimum) location. If necessary, cable will be stored off site.

1.13 SITE REQUIREMENTS

A. Provide responsibility for all safety requirements on the work site.

B. Comply with OSHA Confined Space Regulations, 8CCR 5156-5158.

C. Barricade open utility holes and pullboxes at all times. Provide for safe flow of traffic and pedestrians.

D. Provide for continuous, mechanically supplied, fresh air to manholes and vaults where workers are inside.

E. All switching of existing circuits shall be performed. Verify that circuits are de-energized and locked out prior to starting work.

F. Scheduled outages that may be required to complete the work will be coordinated with the Owner.

G. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer at least two (2) days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer/Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer must be able to meet these Specifications as well as the latest edition of Association of Edison Illuminating Company (AEIC) Specification CS6 and other applicable industry standards and specifications.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cables:

a. Okonite Company (The). (Basis of Design)

b. Prysmian (formally Pirelli) Cable Corporation; Power Cable Division.

c. American Insulated Wire Corporation; Leviton Manufacturing Company.

d. Rome Cable Corporation.

e. Southwire Company.

2. Cable Splicing and Terminating Products and Accessories:

a. 3M Company; Electrical Products Division.

b. Elastimold.

c. Raychem Corporation; Energy Division.

d. RTE Components; Cooper Power Systems, Inc.

e. Thomas & Betts Corporation.

2.2 MEDIUM VOLTAGE CABLE – UNDERGROUND PRIMARY DISTRIBUTION CABLE - JACKETED

A. Usage: This cable shall be used for all above and underground applications and shall be contained in conduit or other raceways.

B. Cable: Single conductor, insulated cable rated 15 KV, 133% insulation level, ungrounded, NEC-UL Type MV-90. Sizes as indicated on the Drawings.

C. Conductor: Aluminum per ASTM B-609, Class B Stranded per B-231, having nominal direct-current resistance equal to or less than that required in Section 2.5.2 and Table 2-12 of ICEA S-68-516.

D. Conductor Screen: Extruded semiconducting ethylene-propylene rubber meets or exceeds the requirements of ICEA S-94-649 and AEIC CS8.

E. Insulation: Extruded EPR (ethylene propylene rubber), rated at 15 KV, 133 percent insulation level, minimum nominal thickness of .220 inches, minimum insulation K factor of 50,000 megohms per 1000 foot length. Manufacturer's Certification of this value shall be a part of submittal for cable approval.

F. Insulation Screen: Extruded semiconducting ethylene-propylene rubber meets or exceeds the requirements of ICEA S-94-649 and AEIC CS8.

G. Concentric Conductor: Bare copper wires. Full neutral.

H. Jacket: Black Okolene with red extruded stripes meets or exceeds the requirements of ICEA S-94-649 for polyethylene jackets.

I. Cable Rating: Continuous duty at 90 degrees C, wet or dry locations, suitable for underground duct installations, NEC-UL Type MV-90, Type USE.

J. Basis of Design: Okoguard URO-J 161-23-3060.

2.3 SEPARABLE INSULATED CONNECTORS

A. Separable Insulated Connectors: Modular System complying with IEEE 386. Disconnecting, single-pole, cable terminators and matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

C. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 and ICEA S-94-649 before shipping.

B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine raceways to receive medium-voltage cables for compliance with requirements for installation tolerances and other conditions affecting performance of cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 CABLE PULLING

A. Prior to pulling cable, a mandrel/swab 1/4 inch smaller than the duct diameter shall be pulled through duct run to insure adequate opening of duct run. Thoroughly swab conduits to remove foreign material before pulling cables.

B. Cables shall not be pulled into outside (exterior) or underground systems from an outside (exterior) or underground location when the outside (exterior) air temperature is below 40 degrees Fahrenheit.

C. Furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment is to include, but not be limited to, sheaves, winches, cable reels and/or cable reel jacks, duct entrance funnels, pulling tension gauge, and similar devices. All equipment shall be of substantial construction to allow steady progress cone pulling has begun. Makeshift devices which may move or wear in a manner to pose a hazard to the cable shall not be used.

D. Cable ends shall be sealed and firmly held in the pulling device during the pulling operation.

E. Cable pulling shall be done in accordance with cable manufacturer's recommendations, except as modified herein, and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions shall not be exceeded. Pulling bending radius shall not be less than that determined by the manufacturer of the NEC. Actual pulling tensions shall be continuously monitored and permanently recorded in a log and submitted to the Engineer at the end of the project. Restrictions of pulling bending radius dimensions shall be strictly observed. Training bending radius shall not be less than 12 times cable diameter. Any cable bent or kinked to radius less than recommended dimension shall not be installed.

F. During pulling operation, an adequate number of persons shall be present to allow cable observation at all points of duct entry and exit as well as to feed cable and operate pulling machinery.

G. Cable Pulling: Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before the pulling of cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through the manhole opening and into the duct runs. Cable slack shall be accumulated at

each manhole or junction box where space permits by training the cable around the interior to form one complete loop. Minimum allowable bending radii shall be maintained in forming such loops.

H. Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

I. Pulling lubricant shall be used to ease pulling tensions. Lubricant shall be of a type which is non-injurious to the cable material used. Lubricant shall not harden or become adhesive with age.

J. Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer. Cable lubricants shall be petroleum grease for lead-covered cables (soap-stone, graphite, or talc for rubber jacketed cables). The lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

K. Avoid abrasion and other damage to cables during installation.

L. Where cables are left in manhole or switchgear overnight or more than 8 hours prior to termination, the cable ends shall be sealed with paraffin or shrink wrap caps and supported in a manner which will prevent entrance of moisture into the cable. Cable shall be terminated and energized as soon as possible.

3.3 INSTALLATION

A. The firm shall be a company specializing in installation of medium voltage cable and accessories with a minimum of five years documented experience in installation of the type of cable and accessories described below.

B. The electricians employed for this work shall be experienced in medium voltage cable installation. Workmen involved in splicing and termination of cables shall have been specifically trained in the procedures required for the splices and terminations used in this project. At the discretion of the Engineer, documentation of experience and/or training in medium voltage cable splicing and termination shall be furnished. At the Engineer's discretion, the electricians making up terminations or splices shall make up a sample splice and/or termination to be used to determine the capability of the electrician(s) involved.

C. Install cables as indicated, according to manufacturer's written instructions and IEEE 576.

D. Install separable insulated-connector components where indicated according to manufacturer's written instructions. Provide the following quantities of components:

1. Protective Cap: Install at each Terminal Junction, one on each terminal to which no feeder is indicated to be connected.

3.4 CABLE ROUTING IN EQUIPMENT

A. Cables within switchgear shall be routed in a manner which will allow adequate room for bending and terminating cables. Cables must be secured in a manner which will not result in cable weight being placed on the termination electrical joint. Cable support shall be made in

a manner that does not force cable against grounded metal or which compresses cable diameter. Cable training bending radius shall be at least 12 times cable diameter.

B. Ground metallic non-current carrying components such as cable racks, switches, and transformers. Use a #6 solid copper conductor, minimum.

3.5 TERMINATING AND SPLICING

A. Cable Terminating: Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings and moisture by the use of termination devices and materials. Install all terminations of insulated power and lighting cables in accordance with the manufacturer's requirements. Make terminations using materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kit manufacturer. Keep cable ends sealed prior to splicing or termination to prevent the entrance of moisture.

B. Certification: High voltage cable splicer/terminator certification of competency and experience shall be submitted thirty (30) days before splices or terminations are made in high voltage cables. Splicer/termination experience during the immediate past three years shall include performance in splicing and terminating cables of the type and classification being provided under this contract.

C. Only experienced electricians shall be employed in this phase of the work. Refer to *Quality Assurance* above.

D. Follow cable manufacturer's and splice or termination manufacturer's installation instructions and ANSI/IEEE C2 standards.

E. Clean, white lint-free gloves shall be used to handle the end of the cable during tape wrapping procedures.

F. Termination or splicing of the conductors (both power and ground conductors) shall be made only with tool-applied compression (swaged) fittings.

G. Ground system connections:

1. Cable to Bus: Compression cable fitting bolted to bus with lock washers under nut.

2. Cable to Ground Rod: Approved bolted fitting with backing plate between cable and rod.

H. Ground shields of cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware according to manufacturer's written instructions.

I. Splice or termination failure upon high potential acceptance test will require complete reconstruction of the joint to Manufacturer's Specifications. Make sure that there is enough free cable at each termination or splice for two more terminations or splices to be performed.

J. Install Scotch #70 tape for anti-tracking on all exposed terminations.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

B. Testing: On installation of medium-voltage cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.2.

2. Certify compliance with test parameters.

C. Correct malfunctioning cables and accessories at project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

D. Test and inspect cables according to NEMA WC 7 (ICEA S-66-524) and NEMA WC8 (ICEA S-68-516) before shipping.

E. Tests shall be performed on completed cable in accordance with ICEA S-68-516 and AEIC CS6 (latest edition) as specified.

1.	Conductor Resistance	per AEIC Paragraph 1.2
2.	AC Withstand (5 minutes)	15 kV - 44 kV
3.	IR Constant (at 15.6 C), min.	50,000 megohms - 1000 feet
4.	DC Withstand (15 min.)	15 kV - 80 kV
5.	Partial Discharge	Per AEIC, 5 pc max. at 4 times rated voltage

F. Test Reports: Certified test reports shall be furnished for all cables.

G. Field inspection and testing will be performed under provisions of Division 1.

H. Inspect exposed cable sections for physical damage. Verify that cable is connected according to Drawings and that shield grounding, cable support, and terminations are properly installed.

I. Perform DC high potential test of each conductor, with other conductors grounded, in accordance with the manufacturer's recommendations and IEEE Standard 400, Article 5 – "Direct Voltage Testing". Apply test voltage to conductors in at least eight equal increments to maximum test voltage. Record leakage current at each increment, allowing for charging current decay. Hold maximum test voltage for ten minutes.

J. Record results of test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time (30 second intervals) at maximum voltage. Curves

shall be identified with the cable to which they apply and shall be certified. Time of day, outside temperature and humidity at time of each test shall appear on each curve sheet.

K. Perform shield continuity tests.

L. Perform phasing checks.

M. If any primary cable fails the entire three cable assembly shall be removed, replaced, terminated, and tested without additional charge.

3.7 CABLE IDENTIFICATION AND LABELING

A. Provide the following information on cable identification label:

1. Phase.

2. To and From Data.

B. Install cable labels on each conductor at each cable termination. Additionally, at these locations, provide on inch (1") colored vinyl plastic electrical tape wrap identification, (Scotch 35 or approved equal) around each conductor and cable as follows:

1. 15 kV individual conductor system:

a. A - Phase - one (1) red wrap.

b. B - Phase - two (2) red wraps with ½-inch space between wraps.

c. C - Phase - three (3) red wraps with ½-inch space between wraps.

C. During entire cable installation, phasing of conductors shall be maintained and identified. Where final connections to equipment are made, phasing shall be verified and proper phase rotation determined prior to connection.

D. Identify cables as to manufacturer, year, voltage, size, temperature, rating and ampere capacity. If such identification is not visible on the surface, the information shall be supplied on an engraved lamicoid tag permanently secured to the cable in each accessible location.

3.8 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer, to prevent entrance of moisture into the cables and to ensure medium-voltage cables are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

DIVISION 26
SECTION 260519
CONDUCTORS AND CABLES
TABLE OF CONTENTS

SECTION 260519 - CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: Provide for each cable assembly type, wire, cables, conductors, and connectors.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Indicate procedures and values obtained.

C. Project Record Documents: Record actual locations of components and circuits.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.

1. The Terms *Listed and Labeled*: As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* as defined in OSHA Regulation 1910.7.

B. Comply with NEMA/Insulated Cable Engineers Association (ICEA) Standards.

C. Comply with NECA Standard of Installation.

D. Comply with NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

E. American Society for Testing and Materials (ASTM): Comply with requirements of the following:

1. B3: Standard Specification for Soft or Annealed Copper Wire

2. B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

3. D753: Standard Specification for General Purpose Polychloroprene Jacket for Wire and Cable

F. Electrical Testing Laboratories (ETL): Provide wiring, cabling and connector products which are ETL listed and labeled.

G. Institute of Electrical and Electronics Engineers (IEEE): Comply with the following standards which apply to wiring systems:

1. 82: Test procedure for Impulse Voltage Tests on Insulated Conductors

2. 241: Recommended Practice for Electric Power Systems in Commercial Buildings

H. NFPA: Comply with NFPA 70 requirements for construction, installation and color coding of electrical wire, cable and connections.

I. National Electrical Manufacturer's Association (NEMA): Comply with requirements of the following:

1. WC70: Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

J. UL: Provide material conforming to the following standards:

1. UL 83 - Thermoplastic-Insulated Wires and Cables.

2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors

K. UL Labels: Provide wiring, cabling and connector products which are UL listed and labeled.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver wires and cables according to NEMA WC 26, *Binational Wire and Cable Packaging Standard*.

B. Storage: Store wire and cable in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handling: Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

1.6 COORDINATION

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Engineer.

C. Determine required separation between cables and other work.

D. Determine cable routing to avoid interference with other work.

1.7 PROJECT CONDITIONS

A. Verify that field measurements are as shown on the Drawings.

B. Feeder conductor sizes are based on copper as indicated on the "Feeder Schedule" on the Contract Drawings.

C. Branch circuit conductor sizes are based on copper.

D. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

E. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Wires and Cables:

a. American Insulated Wire Corp.
b. BICC Brand-Rex Company.
c. General Cable.
d. Senator Wire & Cable Company.
e. Southwire Company.
f. Colonial Wire Company.

2. Connectors and Accessories for Wires and Cables:

a. AMP Incorporated.
b. Buchanan.
c. General Signal; O-Z/Gedney Unit.
d. Monogram Company; AFC.
e. NSI Industries, Inc.
f. Square D Company; Anderson.
g. 3M Company; Electrical Products Division.

2.2 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction and rating as specified herein.

B. Building wires and cables shall be annealed (soft) copper, 600 volt, Type THHN/THWN (dual-rated) single conductors rated 90°C dry / 75°C wet, with a minimum conductivity of 98 percent at 20°C (68°F), or a maximum resistivity of 1.7 micro-ohms per centimeter.

C. Conductors shall meet or exceed requirements of all applicable ASTM specifications, UL Standard 83, UL Standard 1581, NEMA WC 70, Federal Specification A-A-59544 and shall be RoHS/REACH Compliant.

D. Conductors shall be solid for 10 AWG and smaller, and stranded for 8 AWG and larger.

E. Building wire and cables shall be color-coded using colors factory impregnated throughout the insulation and jacket. The following color code convention(s) shall be used except where existing systems have established another color code convention:

1. 120/208-Volt, 3-Phase, 4-Wire System:

a.	Phase A:	Black
b.	Phase B:	Red
c.	Phase C:	Blue
d.	Neutral:	White
e.	Ground:	Green

2. 277/480-Volt, 3-Phase, 4-Wire System:

a.	Phase A:	Brown
b.	Phase B:	Orange
c.	Phase C:	Yellow
d.	Neutral:	Gray
e.	Ground:	Green

2.3 CONNECTORS AND SPLICES

A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 Article, "*Wire and Insulation Applications*".

B. Split Bolt Connectors: Not acceptable.

C. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.

D. Spring Wire Connectors: Not acceptable.

E. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic high conductivity copper tubing, internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

G. Heat shrinkable tubing shall meet the requirements of ANSI C119.1-1986 for buried connections to 90 degrees C and shall be material flame-retarded per IEEE 383 *Vertical Tray Flame Test*.

H. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer's tolerances.

I. Wire Nut Connectors:

1. Description: Twist-on wire connectors for branch circuit conductors 8 AWG and smaller with a color-coded housing.

2. Construction: Flame-retardant polypropylene housing, rated for 105 degrees Celsius. Zinc-plated steel insert. Square-wire spring to maintain secure positive grip that will not relax over time, no pre-twisting required.

3. Dimensions: Connectors shall be appropriately sized according to manufacturer's recommendation for the suitable wire sizes and voltage rating (600 volts minimum).

4. Quality Assurance:

   a. UL Listed to 486C and 94V-2 Flame Rating.
   b. CSA Certified to C22.2 No. 188
   c. RoHS Compliant

5. Special Features:

   a. Wire connectors for making grounding connections shall have green-colored housing and shall have opening at end of connector for grounding conductor to pass through for connection to metallic outlet boxes.
   b. Wire connectors for all exterior and underground work and work in damp/wet interior locations shall be pre-filled with silicone-based sealant to protect against moisture and corrosion, and shall be UL Listed to 486D for use in damp/wet locations, including direct burial applications.

6. Basis of Design: Provide products by Ideal Industries, Inc. or approved equal.

J. Insulated Connectors:

1. Connectors insulated with high-dielectric strength plastisol, molded for precise fit and supplied with removable access plugs over the hex screws.

2. Wire entry ports on one or both sides of the connector as required.

3. Mounting holes at each end of the connector for direct isolated mounting to wiring trough, panel or wireway.

4. UV and cold temperature rated.

5. Dual rated for use with copper and/or aluminum cables.

6. Rated 600V, 90°C.

7. Insulated connectors shall be IPLM or IPLMD Series as manufactured by Polaris, or approved equal by ILSCO, Burndy, T&B or other listed acceptable manufacturer.

2.4 INSULATING TAPE, PUTTY, RESIN AND SUPPORTS

A. Tape: Provide plastic electrical insulating tape which is flame-retardant, cold and weather-resistant. Tape for use in areas subject to temperatures 30 degrees C to 105 degrees C, or where the tape will be subjected to an oil splash, tape shall have a minimum thickness of 8.5 mils, and shall consist of an oil-resistant acrylic adhesive.

B. Materials: Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases, or compositions of the type approved for the particular use, location, voltage and temperature and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

C. Supports: Provide cable supports of the wedge type which firmly clamp each individual cable and tighten due to the cable weight.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. By beginning work, the Contractor has accepted conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRE AND INSULATION APPLICATIONS

A. No branch circuit wires smaller than 12 AWG shall be used unless otherwise indicated. Conductors shall be continuous from outlet to outlet and from terminal board to point of final connection, and no splice shall be made except within outlet or junction boxes. All conductors shall be of the size indicated. All wires 8 AWG and larger shall be stranded.

B. Control wiring shall not be less than 14 AWG and shall be color coded using colors impregnated into the insulation. All control wiring shall be color coded with wires of colors different from those used to designate phase wires.

C. All wiring, contacts, and terminal blocks shall be suitably tagged for ease in identification and tracing of circuits. Identification tags shall be engraved fiber or plastic type, subject to acceptance. Wires shall be numbered and coded, using Brady *Quicklabels*, or equal.

D. Wiring shall be tagged at terminations, in pull boxes, junction boxes, outlet boxes, panelboards, etc…

E. Switch leg wire shall be labeled with "*S"* tag.

F. Wiring for general 15 and 20 amp branch circuit work shall be as follows unless otherwise indicated:

HOME RUN LENGTH AND WIRE SIZE				CIRCUIT LENGTH AND WIRE SIZE			
120 Volt		277 Volt		120 Volt		277 Volt	
0 – 60 '	12AWG	0 – 175 '	12AWG	0-100 '	12AWG	0 – 200 '	12AWG
60 – 100 '	10AWG	175 - 350'	10AWG	100' & Up	10AWG	200 ' & Up	10AWG
100' & Up	8AWG	350> & Up	8AWG				

G. Circuit length as given above shall be the wire length between the first and last outlet on the circuit. Home run length as given above shall be the wire length between the first outlet and the panelboard. In accordance with the above, where the size of branch circuit conductors is increased by the minimum required by the NEC for the branch circuit rating, ensure that the termination provisions of all equipment connected to such circuits are listed as suitable for the conductor sizes involved.

H. Joints of 10 AWG and smaller shall be made with properly insulated solderless type pressure connectors. Where stranded conductors or multiple solid conductors are connected to terminals, solderless lugs manufactured by Thomas and Betts Company or equivalent shall be used.

I. Joints of 8 AWG and larger in power and lighting circuits shall be of the type indented into the conductor by means of a hand or hydraulic pressure tool. Connectors shall be Burndy *Hy-dent*, T&B *Sta-Kon*, or equivalent. Connectors for control wiring shall be Burndy *Hy-Lug*, or equivalent.

3.4 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's *Standard of Installation*.

B. Remove existing wires from raceway before pulling in new wires and cables.

C. Pull Conductors: Use a UL-listed and manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway. Completely and thoroughly swab conduit system before installing conductors.

E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 26 Section, “Common Work Results for Electrical” and Division 26 Section, “Hangers and Supports”.

G. Identify wires and cables according to Division 26 Section, “Electrical Identification”.

H. Conductors installed in parallel shall be of equal lengths.

I. Wiring at Outlets: Install with at least 6 inches (150 mm) of slack conductor at each outlet in accordance with Article 300.14 of the National Electrical Code.

J. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

K. The Contractor shall provide suitable installation equipment to prevent cutting and abrasion of conductor insulation. The Contractor shall use suitable cable guides, pulleys, and protective sleeving to prevent damage to cable during installation. Ropes used for pulling of wire and cable shall be made of polyethylene or other suitable non-metallic material. Pulling lines shall be attached to cable by means of either woven basket grips or pulling types attached directly to the conductors. Wire pulling lubricants, if used, shall conform to UL requirements applicable to the various insulations and raceway materials. The lubricants shall be certified by the manufacturer to be non-injurious to such insulation and materials.

L. Each cable shall be labeled at terminals and at all accessible points in equipment and in pull boxes. Each wire shall be labeled at both ends. Labels shall be self-sticking wire markers.

M. For rubber and plastic-covered wire and cable, pulling compound Ideal Yellow 77 may be used.

N. Terminal lugs for wires 8 AWG and larger shall be T&B 54,000 Series or Burndy *HY-Dent*, compression type, unless noted otherwise. One-hole lugs for wires 4/0 AWG and smaller. Two-hole lugs for all wires 250 kcmil AWG and larger.

O. Install wires and cables using braided rope larger than the cable being pulled to keep twists to a minimum.

P. Provide an insulated green equipment grounding conductor (EGC), sized per NEC, for all feeder and branch circuits, shown or not shown.

Q. Multi-wire branch circuits shall not be permitted. Provide a separate insulated neutral (grounded) conductor for all feeder and branch circuits requiring a neutral connection.

R. Install electrical cables, wires, and connectors as indicated in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.

S. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.

T. Conductors installed in runs within 6 inches of heating pipes or equipment shall be of types required by the NEC and shall be listed for the application.

U. No conductors shall be drawn into conduit until all work, which may cause cable damage, is completed.

V. All wiring in fluorescent fixture channels, and in other high ambient temperature areas, shall be of types required by NEC and shall be listed for the application.

W. During installation, do not deform cable by improper bending, stretching, twisting, kinking, or pinching, nor do any other abusive handling. Any failure to observe these instructions will be detected and corrected during the demonstrations following completion of the installation.

X. Cable bends shall have a radius not less than the value recommended by the cable manufacturer.

Y. All labels shall be of durable material and securely fastened to the cable.

Z. Wiring of different system voltages shall not be mixed at pull boxes enclosures, surface metal raceway, wiretrough, etc., unless a barrier (separator) is provided between the differing systems.

3.5 CONNECTIONS

A. Conductor Splices: Keep to minimum.

B. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

C. Use splice and tap connectors compatible with conductor material.

D. Apply oxide inhibitor in each termination for aluminum conductors per manufacturer’s instructions.

E. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

G. Wire splices and taps shall be adequate to carry full current rating of wire.

H. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes may be utilized where required. Wire connectors of insulating material or solderless pressure connections, properly taped, shall be utilized for all splices in wiring.

I. Splices in branch circuits and feeders shall be made where indicated or as required for the installation. All splices shall be accessible and made in enclosure approved for that purpose.

J. For splices in branch circuits provide connectors as follows;

1. Wire Sizes 10 AWG and smaller: Provide wire nut connectors as specified in Part 2 of this Section.

2. Wire Sizes 8 AWG and Larger: Provide insulated connectors securely fastened to enclosure as specified in Part 2 of this Section.

K. Thoroughly clean wiring prior to installing lugs or connectors.

3.6 IDENTIFICATION

A. Interface with Other Work:

1. Identify wire and cable using Thomas and Betts Type WM vinyl markers.

2. Identify each phase and neutral conductor with its circuit number or other designation indicated on the Drawings in all junction, pull, terminal boxes, and cabinets.

B. Provide identification tags on each conductor entering each panelboard, switch, junction box, and pull box to identify conductor.

C. Comply with the requirements of Division 26 Section, *Electrical Identification.*

D. Feeder Identification: Securely fasten nonferrous identifying tags or pressure-sensitive labels to all cables, feeders, and power circuits in pull boxes, panelboards, and at termination of cables.

1. Tags or labels shall be stamped or printed to correspond with markings on Contract Drawings or marked so that feeder or cable may be readily identified.

3.7 FIELD QUALITY CONTROL

A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.2. Certify compliance with test parameters.

B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor.

E. Tests: Feeder and branch circuit insulation shall be tested after installation, and before connection to fixtures and appliance.

1. Tests shall be performed with a 1,000-volt megger, and conductors shall test free from short-circuits and grounds.

2. Conductors shall be tested phase-to-phase and phase-to-ground.

3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Owner's Representative.

4. Actual test readings shall be recorded.

5. Submit all test reports to the Engineer for approval.

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

END OF SECTION

DIVISION 26
SECTION 260526
GROUNDING AND BONDING
TABLE OF CONTENTS

SECTION 260526– GROUNDING AND BONDING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Refer to Division 26 Section “Conductors and Cables” for conductor and cable requirements.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.

B. Bond the electrical service system neutral at service entrance equipment to grounding electrodes and metallic water service as supplementary.

C. Bond each separately-derived system neutral to nearest grounding system.

D. Bond together system neutrals; service equipment enclosures; exposed non-current carrying metal parts of electrical equipment; metal raceway systems; grounding conductor in raceways; receptacle ground connectors; and plumbing systems.

1.3 DEFINITIONS

A. EGB: Electrical grounding busbar.

B. EGC: Equipment grounding conductor.

C. GEC: Grounding electrode conductor.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for grounding rods, conductors, connectors and connection materials, and grounding fittings. Submit ground system manufacturer's recommended installation procedure for review.

C. Qualification data for firms and persons specified in *Quality Assurance* Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Field tests and observation reports indicating and interpreting the test reports for compliance with performance requirements, certified by Testing Agency.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: A *Nationally Recognized Testing Laboratory* (NRTL) as defined in OSHA Regulation 1910.7, or a full member company of the International Electrical Testing Association (NETA).

1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3 of this Section.

B. Comply with NFPA 70 - National Electrical Code.

C. Comply with UL 467 - UL Standard for Safety Grounding and Bonding Equipment.

D. Comply with ANSI/IEEE C2 - National Electrical Safety Code.

E. Comply with ANSI/IEEE 32 - Requirements, terms and test procedures for neutral grounding devices.

F. Comply with IEEE Standard 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

G. Comply with ANSI C33.8.

H. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms *Listed* and *Labeled*: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* (NRTL) as defined in OSHA Regulation 1910.7.

1.6 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of grounding electrodes and all primary grounding locations (i.e., grounding busbar location(s), water service connection(s), building steel, etc.)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Erico Inc.; Electrical Products Group.

2. Heary Brothers Lightning Protection Co.

3. Ideal Industries, Inc.

4. ILSCO.

5. O-Z/Gedney Co.

6. Raco, Inc.

7. Thomas & Betts, Electrical.

2.2 GROUNDING AND BONDING PRODUCTS

A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

A. Comply with Division 26, Section "Conductors and Cables". Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

B. Equipment Grounding Conductors: Size as indicated on the Drawings, or as required by 2011 National Electrical Code (NEC) Table 250-122, whichever is larger. Insulated with green color insulation.

C. Grounding Electrode Conductors: Size as indicated on the Drawings, in the Specifications, or as required by 2011 National Electrical Code (NEC) Table 250-66, whichever is larger. Insulated with green color insulation, unless installed in direct contact with earth, in which case conductors shall be bare.

D. Underground Conductors: Bare, tinned, stranded, 4/0 AWG size minimum, except as otherwise indicated.

E. Bare Copper Conductors: Conform to the following:

1. Solid Conductors: ASTM B 3.

2. Assembly of Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

2.4 MISCELLANEOUS CONDUCTORS

A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section, minimum size ¼-inch thick x 4-inches, length as required.

B. Braided Bonding Jumpers: Copper tape, braided bare copper wire, terminated with copper ferrules.

C. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, unless otherwise indicated.

2.5 CONNECTOR PRODUCTS

A. Mechanical Connectors

1. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of silicon bronze and supplied as a part of the connector body and shall be of the two-bolt type.

2. Split bolt connector types are NOT allowed unless indicated on the Drawings.

3. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

B. Compression Connectors

1. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99 percent by IACS Standards.

2. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

3. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.

4. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.

5. Each connector shall be factory filled with an oxide-inhibiting compound.

C. Exothermic Connections: Provide exothermic-weld kit selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

2.6 GROUNDING ELECTRODES

A. Grounding Rods: Copper-clad rod with rigid steel core.

1. Size: 3/4 inch by 120 inches (19 by 3000 mm). Provide the number of rods required to obtain proper ground resistance.

2. Rods shall have a minimum of ten (10) mils of copper.

3. Ground rods shall be UL listed #467.

PART 3 EXECUTION

3.1 APPLICATION

A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.

1. Install Equipment Grounding Conductor (EGC) with circuit conductors for the items below in addition to those required by Code:

a. Feeder circuits.

b. Lighting branch circuits.

c. Receptacle branch circuits.

d. Single-phase motor or appliance branch circuits.

e. Three-phase motor or appliance branch circuits.

f. Flexible raceway runs.

2. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

B. Mechanical System Grounding:

1. The incoming domestic and fire protection water services shall be bonded to the electrical grounding system; provide equipment grounding conductor (EGC) sized per the National Electrical Code.

2. All mechanical equipment, including but not limited to pumps, motors, packaged equipment, fans, heaters, etc. and their enclosures shall be properly grounded in accordance with Article 250 of the National Electrical Code.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

C. Separately Derived Systems: Ground and bond all separately derived systems in accordance with Article 250.30 of the National Electrical Code, and as follows:

1. Transformers:

a. Provide a grounding electrode conductor from the transformer to the nearest grounding electrode, e.g. building steel. Where the grounding electrode conductor is installed within metallic raceway, both ends of the raceway shall be also be bonded.
b. Provide a system bonding jumper from the transformer neutral point to the transformer enclosure. The system bonding jumper must remain within the enclosure where it originates.
c. Provide a supply-side bonding jumper from the transformer neutral point to the ground bus bar in the first disconnecting means or overcurrent device, e.g. panelboard.

2. Metal Water Pipe:

   a. All metal water piping in the area served by the separately derived system shall be bonded to the neutral point of the separately derived system with a bonding jumper in accordance with Article 250.104 of the National Electrical Code.
   b. Metal water piping is permitted to be bonded to the structural metal building frame in lieu of the neutral point of the separately derived system, if the structural metal serves as the grounding electrode for the separately derived system.

3. Structural Metal:

   a. Exposed structural metal in the area served by the separately derived system shall be bonded to the neutral point of the separately derived system with a bonding jumper in accordance with Article 250.104 of the National Electrical Code.
   b. A separate bonding jumper to structural metal is not required where the structural metal serves as the grounding electrode for the separately derived system.

4. Grounding and bonding conductors and jumpers shall be sized in accordance with Table 250.66, Table 250.122 and Article 250.102 of the National Electrical Code.

3.2 INSTALLATION

A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

B. Grounding Bus Bars: Space 1 inch (25 mm) from wall and support from wall 18 inches (450 mm) above finished floor, except as otherwise indicated.

C. Grounding Electrodes: Provide a minimum of three (3) grounding electrodes, unless otherwise indicated on the Drawings, in accordance with the following:

1. Locate a minimum of twenty-feet from each other and at least the same distance from any other grounding electrode, unless otherwise indicated on the Drawings.

2. Drive until tops are 18 inches below finished floor or final grade, except as otherwise indicated.

3. Interconnect with grounding-electrode conductors using exothermic welds. Make these connections without damaging copper coating or exposing steel.

D. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

E. Underground Grounding Conductors: Use bare copper wire. Bury at least 18 inches (600 mm) below grade.

F. Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding-clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install a grounding jumper across dielectric fittings. Bond grounding-conductor conduit to conductor at each end.

G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.

H. Grounding shall satisfy requirements of the applicable publications. All exposed noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in nonmetallic raceways, and grounded conductors of the wiring system shall be grounded.

I. The grounded conductor (neutral) of the wiring system shall be connected to the system grounding conductor at a single place in the system by removable bonding jumpers, sized according to the applicable provisions of the National Electrical Code. The grounded conductor (neutral) connection to the grounding conductor (ground) shall be located in the enclosure for the system's overcurrent protection or where otherwise indicated on the Drawings or Specifications.

J. Ground buses and neutral buses in all switchboards, distribution panelboards, panelboards, and those provided in any equipment shall be isolated except where required to be connected as specified above for the service entrance and in transformer terminal compartments.

K. Equipment grounding conductors shall be extended from the ground bus in the distribution equipment to the receptacle, fixture or device lugs where they are provided. When not provided, they shall be connected to equipment enclosures. The connections shall be arranged such that removal of receptacle, the equipment grounding conductors, or ground jumpers from ground busing, shall not affect the system ground.

L. Ground bus shall be provided as indicated on the Drawings or as necessary to provide termination for equipment grounding conductor. Non-current carrying metal parts of electric equipment shall be effectively grounded by bonding to the bus. The ground bus shall be bonded to both the system neutral and the service ground.

M. Raceways shall not be considered as a grounding conductor. Each power, lighting, or control raceway shall have a separate equipment grounding conductor installed. Receptacles shall have a separate grounding pole.

N. All switchgear shall be equipped with a grounding bus separate from the neutral bus.

3.3 CONNECTIONS

A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor (EGC) Terminations: For 8 AWG and larger, use compression-type grounding lugs.

D. Non-Contact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Grounding System: Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes.

3.5 FIELD QUALITY CONTROL

A. Independent Testing Agency: Engage an independent electrical testing organization to perform tests described below.

B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method according to IEEE 81.

C. Maximum grounding to resistance values are as follows:

1. Equipment Rated 500 to 1000 kVA: 5 ohms.

D. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance and to accomplish recommended work.

E. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results. Submit all tests to the Engineer for approval.

3.6 ADJUSTING AND CLEANING

A. Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

DIVISION 26
SECTION 260528
ELECTRICAL FIRESTOPPING
TABLE OF CONTENTS

SECTION 260528 - ELECTRICAL FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Through-penetration firestopping in fire rated construction.

B. Related items: Raceway seals and manufactured electrical devices: Refer to Division 26 Section, “Raceways and Boxes”.

1.3 REFERENCES

A. Underwriters Laboratories

1. UL Fire Resistance Directory

a. Through-penetration firestop devices (XHCR)

b. Fire resistance rating (BXUV)

c. Through-penetration firestop systems (XHEZ)

d. Fill, void, or cavity material (XHHW)

B. American Society for Testing and Materials Standards: ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.4 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

B. Barriers: Time-rated fire walls, time rated ceiling/floor assemblies and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

E. System: Specific products and applications classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

F. Sleeve: Metal fabrication or pipe section extended through thickness of barrier and used to permanently guard penetration. Refer to Division 26 Section, “Common Work Results for Electrical” for sleeve requirements.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption.

1.6 SUBMITTALS

A. Submit in accordance with Division 01, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.

2. Manufacturer's installation instructions.

1.7 QUALITY ASSURANCE

A. Installer's qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, State or local authority where applicable.

2. At least 2 years experience with systems.

3. Successfully completed at least 5 comparable scale projects using this system.

B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.

C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

D. Manufacturer shall be a member of the International Firestop Council (IFC).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Deliver products in original unopened packaging with legible manufacturer's identification.

2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.9 PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.

2. Furnish forced air ventilation during installation if required by manufacturer.

3. Keep flammable materials away from sparks or flame.

4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

1.10 GUARANTEE

A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fall in joint adhesion, extrusion resistance, migration resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be two years from date of substantial completion unless otherwise noted.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Hilti

2. 3M

3. Nelson

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems of devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrate type,

annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.

1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

2. Acceptable manufacturers and products.

   a. Those listed in the UL Fire Resistance directory for the UL System involved and as further defined in the "System and Applications Schedule" in Part 3 of this Section.

   b. All firestopping products must be from a single manufacturer.

2.3 ACCESSORIES

A. Fill, void or cavity materials: As classified under category XHHW in the UL Fire Resistance Directory.

B. Forming materials: As classified under category XHKU in the UL Fire Resistance Directory.

C. Sleeves: Minimum 24 MSG galvanized steel, 12-inch diameter or smaller steel pipe. Sleeve shall project ½-inch from each surface of the floor/wall. Size as recommended by firestop manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

B. Seal holes or voids made by penetrations to ensure an effective barrier.

C. Protect materials from damage on surfaces subject to traffic.

D. When large openings are created in walls or floors to permit installation of conduits, cable tray, or other items, close unused portions of opening with firestopping materials tested for the application.

E. Provide sleeves the full thickness of the assembly being penetrated and cut sleeves to a length of 1-inch more than the overall thickness of the penetration, or as recommended by the firestop manufacturer.

3.4 FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

3.5 ADJUSTING AND CLEANING

A. Clean up spills of liquid components.

B. Neatly cut and trim materials as required.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.6 SYSTEMS AND APPLICATION SCHEDULES*

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
Metal Pipe	CAJ1001 CP25S/L, CP25N/S CAJ1006 CS-195+, FS-195+ CAJ1007 FS-195+, 1-inch& 2-inch Wide CAJ1009 2000, 2000+, 2003 CAJ1010 2000, 2000+, 2003 CAJ1012 2000, 2000+, 2003 CAJ1013 2000, 2000+, 2003 CAJ1014 2000, 2000+, 2003 CAJ1015 2000, 2000+, 2003 CAJ1017 FD 150 CAJ1021 FD 150 CAJ1027 MPS-2+ CAJ1044 CP 25WB+ CAJ1052 CP 25S/L, CP 25N/S CAJ1058 2000, 2000+, 2003 CAJ1060 2000, 2000+, 2003 CAJ1063 2000, 2000+, 2003 CAJ1066 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1091 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1092 CP 25WB+ CAJ1112 FS-195+ CAJ1160 CP 25S/L, CP 25N/S	WL1001 CP 25 WL1002 FS-195+ WL1003 CP 25WB+,CP 25N/S WL1008 2000+ WL1009 2000+ WL1010 2000+ WL1016 CP 25WB+ WL1017 CP 25WB+,CP 25N/S WL1032 CP 25WB+,CP 25N/S WL1036 FD 150 WL1037 CS-195+,FS-195+ WL1067 CP 25N/S WL1073 CP 25WB+ WL1080 MPS-2+ WL1082 2000+	FC1002 CP 25 FC1003 2000,2000+,20003 FC1006 CP 25WB+

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
	CAJ1175 CP 25WB+ CAJ1176 CP 25WB+ CAJ1188 2000+ CBJ1020 CS-195+, FS-195+ CBJ1021 CS-195+, MPS-2+ CBJ1031 2001 CBJ1032 2001 FA1002 CP 25WB+ WJ1010 CP 25WB+ WJ1023 2001		
Non-Metallic	CAJ2001 FS-195+, 1-inch& 2-inch WIDE, PPD'S CAJ2002 FS-195+ CAJ2003 CS-195+, FS-195+ CAJ2005 FS-195+ CAJ2006 FS-195+ CAJ2013 FS-195+ CAJ2019 2000, 2000+, 2003 CAJ2027 FS-195+, CP 25N/S, CP 25S/L, CP 25WB+ CAJ2028 FS-195, MPS-2+ CAJ2029 FS-195+, PPD'S CAJ2030 CS-195+, FS-195+ CAJ2040 FS-195+, CP 25WB+ CAJ2044 FS-195+, CP 25N/S, CP 25S/L CP 25 WB+ CAJ2090 FS-195+ CAJ2177 FS-195+, PPD'S FA2001 FS-195+, PPD'S FS2002 CS-195+, FS-195+, MPS-2+, PPD'S FA2011 FS-195+ WJ2012 FS-195+ 1-inch WIDE	WL2002 FS-195+, PPD'S WL2003 FS-195+ WL2004 FS-195+ WL2005 FS-195+ 4' WIDE WL2006 FS-195+ WL2013 FS-195+ WL2031 CS-195+, FS-195+ WL2032 CS-195+, FS-195+ WL2033 FS-195+ WL2073 FS-195+ 1-inch WIDE	FC2002 FS-195+, PPD'S FC2007 FS-195+, PPD'S FC2008 FS-195+ FC2009 FS-195+, PPD'S FC2024 FS-195+ FC2026 FS-195+ FC2028 FS-195+, 1' & 2-inch WIDE, PPD'S
Insulated Cable	CAJ3001 CP 25N/S, CP 25S/L CAJ3005 CS 195+, FS-195+ CAJ3007 2001 CAJ3009 2000, 2000+, 2003 CAJ3010 2000, 2000+, 2003 CAJ3011 2001 CAJ3014 FD 150 CAJ3015 FD 150 CAJ3021 MPS-2+ CAJ3029 2000, 2000+, 2003 CAJ3030 CP 25WB+ CAJ3031 CP 25N/S, CP 25S/L CAJ3041 2000, 2000+, 2003 CAJ3044 CS-195+, FS-195+ CAJ3058 FS-195+, MPS-2+ CAJ3071 CP 25N/S, CP 25S/L CAJ3074 CP 25N/S, CP 25S/L CAJ3075 2001 CAJ3080 CP 25WB+ CBJ3016 CS-195+, FS-195+	WL3001 CP 25, MPS-2+ WL3008 2000+ WL3009 2000+ WL3015 CP 25WB+, CP 25N/S WL3022 2000+ WL3030 FS-195+ WL3031 MPS-2+ WL3032 CP 25WB+ WL3041 2000+ WL3051 CP 25N/S WL3056 CP25N/S WL3062 CP 25WB+	FC3001 CP 25S/L, CP 25N/S FC3002 2000+ FC3003 2000, 2000+, 20003 FC3007 CP 25WB+, MPS-2+ FC3008 FS-195+

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
	CBJ3017 CS-195+, MPS-2+ FA3001 CP 25WB+ FB3004 CS-195+, MP WJ3015 2001 WJ3016 2001		
Mixed Penetrating Items Combos	CAJ8001 CS-195+ FS-195+ CAJ8003 2000, 2000+, 20003 CAJ8004 2000, 2000+, 20003 CAJ8006 2001 CAJ8013 FS-195+, CP 25 CBJ8004 CS-195, FS-195+ CBJ8005 CS-195+, MPS-2+ CBJ8008 2001 FA8001 FS-195+, CP 25WB+	WL8002 CS-195+, FS-195+	

* Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF SECTION

DIVISION 26
SECTION 260529
HANGERS AND SUPPORTS
TABLE OF CONTENTS

SECTION 260529 – HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Requirements of the following Sections apply to this Section:

1. Division 26 Section, "Common Work Results for Electrical" for general installation requirements.

1.2 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. Provide equipment supports consisting of concrete pads, structural members, hangers, rods, racks, and incidental materials.

C. Provide all labor, supervision, and fabrication. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to properly distribute the load and impact over building areas. Provide all engineering and fabrication as required for installation of support system.

D. Provide hangers, clamps, anchors, inserts, supports, supplementary steel framing, and hardware of the proper size and load capacity to support electrical equipment and raceways, whether indicated on the drawings or not.

1.3 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 01 Specification Sections.

B. Product data for each type of product specified.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 *National Electrical Code*.

B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party Certification follow-up services.

C. Installation Standard: Installation shall meet or exceed the National Electrical Contractors Association (NECA) Standard of Installation.

D. Manufacturer's Qualifications:

1. The Manufacturer shall not have had less than ten years' experience in manufacturing Strut Support Systems.

2. The Manufacturer must certify in writing all components supplied have been produced in accordance with an established quality assurance program.

E. All Strut Support System components must be supplied by a single manufacturer.

F. Standards:

1. Work shall meet the requirements of the following standards:

a. Federal, State and Local Codes.

b. American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members.

c. American Society for Testing and Materials (ASTM).

d. Underwriters Laboratories (UL).

e. National Electrical Code (NEC).

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All material is to be delivered to the work site in original factory packaging to avoid damage to the finish.

B. Upon delivery to the work site, all components shall be protected from the elements by a shelter or other covering.

1.6 GUARANTEE

A. Separate guarantees shall be issued from the erector and manufacturer, valid for a period of one year against any defects that may arise from the installation or manufacture of the Strut Support System components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Slotted Metal Angle and U-Channel Systems:

a. American Electric, Kindorf

b. Alstrut

c. Unistrut Diversified Products

d. Power-Strut

e. Thomas & Betts

2.2 COATINGS

A. Dry, Interior Locations: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion-resistance using approved alternative treatment, finish, or inherent material characteristic. All products installed in dry interior locations shall be hot-dip galvanized, unless otherwise noted.

B. Damp or Wet Locations: Supports, support hardware, and fasteners installed in damp or wet locations, including exterior locations, shall be stainless steel.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features, as follows:

1. Expansion Anchors - Carbon steel wedge or sleeve type.

2. Toggle Bolts - All steel springhead type.

3. Power-Driven Threaded Studs - Heat-treated steel, designed specifically for the intended application.

C. U-Channel Systems: Sixteen-gauge channels with 9/16-inch-diameter holes at a minimum of eight inches on center in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

D. Concrete Equipment Pads:

1. Refer to Division 26 Section “Common Work Results for Electrical” for installation requirements.

2.4 ANCHOR METHODS

A. Hollow Masonry: Toggle bolts or plastic conical type expansion anchors.

B. Solid Masonry: Lead expansion anchors or preset inserts.

C. Metal Surfaces: Machine screws, bolts, or welded studs.

D. Wood Surfaces: Wood screws.

E. Concrete Surfaces: Self-drilling anchors or power-driven studs.

PART 3 EXECUTION

3.1 EXAMINATION

A. The installer shall inspect the work area prior to installation. If work area conditions are unsatisfactory, installation shall not proceed until satisfactory corrections are completed.

3.2 INSTALLATION

A. Set Strut System components into final position true to line, level and plumb, in accordance with approved Shop Drawings.

B. Anchor material firmly in place. Tighten all connections to their recommended torques.

C. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

D. Coordinate with the building structural system and with other electrical installation.

E. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

6. Space supports for raceways in accordance with Table I of this Section. Space supports for raceway types not covered by the above in accordance with NEC.

7. Support exposed and concealed raceway within one foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be

omitted where box or access fittings are independently supported and raceway terminations are not made with chase nipples or threadless box connectors.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminations.

F. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting disconnects, light fixtures, and other devices.

G. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to the raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

H. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including, but not limited to conduits, raceways, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

4. Concrete (New): Iron or steel inserts. Expander type anchors, specified for existing may be used provided concrete is clear of conduit for drilled depth.

5. Concrete (Existing): Double-plated expander type anchors. Phillips, Hilti, or approved equivalent. Loads shall not exceed 1/4 of tested pullout (or shear) strength.

6. Precast Concrete Plank: Drill hole through plank; bolt hanger rod to 4” x 4” x 1/8” steel plate on top of plank.

I. General Supporting Installations:

1. Provide appropriate concrete anchors for hanger rods. Rods shall be screwed into or extended through frame construction (with washer and nut). Supports shall secure

conduit in place, and shall prevent vibration, provide for expansion and contraction and shall make neat appearance. Strap hangers or chains are not permitted.

2. Electrical raceways 1-1/2-inches and smaller shall be secured with 1-hole malleable iron straps or brackets to walls. Trapeze supports shall be used for groups or parallel raceways with raceways secured to trapeze with approved clamps. Individual runs of raceways 2-inches and larger shall be supported by Clevis type hangers.

3. Provide all steel supports including roof curbs for all equipment provided under this Section.

4. Electrical raceway supports to be spaced on the following maximum centers, unless otherwise required by the NEC:

   a. 3/4-inch to 1-inch conduit - 8 feet

   b. 1-1/4-inch and larger conduit - 10 feet

5. Provide additional hangers or steel members to distribute the load among two or more structural members when required or directed.

6. Drilling of new concrete slabs will not be permitted. Anchors and inserts shall be cast in the concrete slabs.

J. Locations:

1. Anchor bolts, sleeves, inserts, hangers, and supports required for the electrical work shall be furnished and installed under Division 26.

2. Coordinate with other trades the location of anchors, sleeves, inserts, and supports and insure that they are properly installed.

3. Openings and sleeves shall be set true to line, level, plumb, and position and shall be set true to line, level, plumb, and position and shall be so maintained during construction. Where sleeves and openings are provided in poured concrete, inspect same during and after concrete is poured to insure proper position and correct any deviation.

K. Hangers and Supports:

1. Provide hangers, angles, channels, and other supports required by field conditions to install items of electrical equipment. Design of supports and methods of fastening to building structure shall be acceptable to the Owner.

2. Use of power-actuated fasteners and devices is permitted in the vertical surfaces of the building only with the following requirements.

   a. For fastening conduits 1-1/2-inch and smaller and lighting fixtures 50 lbs or less.

b. Load capacity per manufacturers' recommendations.

c. Fasteners shall be located in the thickest part of the slab.

d. Devices shall comply with OSHA requirements.

3. Use of lead shield expansion anchors is not permitted.

4. No electrical items shall rest on, or depend for support on suspended ceiling media (tiles, lath, plaster, splines, etc.).

5. In spaces with suspended ceilings, support conduits directly from structural slabs, decks (or framing members). Do not support conduits on ceiling suspension members.

6. Provide weight-distribution facilities, where required so as not to exceed the load bearing capabilities of floor or walls that bear the weight of, or support, electrical items.

7. For point-of-attachment weight of 100 lbs. or less, fasten items as follows:

a. On wood, use wood screws.

b. On concrete and solid masonry that is already in place, use self-drilling concrete anchors or expansion bolt and couplings.

c. On hollow construction, use toggle bolts.

d. On structural steel, use beam clamps.

8. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.

9. Trapeze type hangers may be used where several conduits are to be installed at the same elevation. The spacing of such trapeze hangers shall be in accordance with the NEC for the smallest conduit in the run.

10. Vertical conduits shall be supported by heavy wrought iron clamps or collars anchored to construction at each floor.

L. Inserts:

1. Inserts for suspended items in poured concrete construction shall be malleable-iron concrete inserts, adjustable type with insert nut. Items manufactured by Barrett, Crawford, Elcen, or Grinnell shall be used where applicable.

2. Inserts for surface-mounted items shall be suitable for the composition of the slab, wall, or structure on which installation is to be made.

M. TABLE I: SPACING FOR RACEWAY SUPPORTS

TABLE I: SPACING FOR RACEWAY SUPPORTS			
Raceway Size (Inches)	No. of Conductors in Run	Location	EMT, PVC, & RGS (Ft.)
		HORIZONTAL RUNS	
1/2, 3/4	1 or 2	Flat ceiling or wall.	5
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7
1/2, 3/4	3 or more	Any location.	7
1/2 - 1	3 or more	Any location.	
1 & larger	1 or 2	Flat ceiling or wall.	6
1 & larger	1 or more	Where it is difficult to provide supports except at intervals fixed by the building construction.	10
1 & larger	3 or more	Any location.	10
Any	---	Concealed.	10
		VERTICAL RUNS	
1/2, 3/4	---	Exposed.	7
1, 1-1/4	---	Exposed.	8
1-1/2 & larger	---	Exposed.	10
Up to 2	---	Shaftway.	14
2-1/2	---	Shaftway.	16
3 & larger	---	Shaftway.	20
Any	---	Concealed.	10
Abbreviations:	EMT	Electrical Metallic Tubing	
	PVC	Rigid Polyvinyl Chloride Conduit	
	RGS	Rigid Galvanized Steel	

3.3 CLEANUP

A. Upon completion of this Section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

3.4 PROTECTION

A. During installation, protect this work from damage.

B. Upon completion of this scope of work, it shall become the responsibility of the General Contractor to protect this work from damage during the remainder of construction on the project and until substantial completion.

END OF SECTION

DIVISION 26
SECTION 260533
RACEWAYS AND BOXES
TABLE OF CONTENTS

SECTION 260533 - RACEWAYS AND BOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 26 Section “Conductors and Cables” for conductors installed in raceways and boxes and conductor terminations.

2. Division 26 Section “Electrical Firestopping” for requirements for firestopping at penetrations through walls and floors that are fire barriers.

3. Division 26 Section “Hangers and Supports” for raceways and box supports.

4. Division 26 Section “Underground Ductbanks” for raceways installed in ductbanks and for ductbanks accessories.

5. Division 26 Section “Wiring Devices” for devices installed in boxes.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1. Raceways include the following:

a. EMT
b. FMC
c. LFMC
d. PVC
e. RGS
f. Wireways

2. Boxes, enclosures, and cabinets include the following:

a. Device boxes
b. Outlet boxes
c. Pull and junction boxes

3. Miscellaneous Products include the following:

a. Expansion/Deflection fittings
b. Bushings

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FMC: Flexible Metal Conduit.

C. LFMC: Liquidtight Flexible Metal Conduit.

D. PVC: Rigid Polyvinyl Chloride Conduit.

E. RGS: Rigid Galvanized Steel Conduit.

1.4 SUBMITTALS

A. Product Data: For raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. Comply with NECA's "Standard of Installation" and NECA 101 “Recommended Practice for Installing Steel Conduits”.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

B. Verify routing and termination locations of conduits and boxes prior to rough-in.

C. Conduit routing shown on Drawings is only approximate and diagrammatic. Route conduits as required for a complete conduit and wiring system.

D. Coordinate final locations, mounting heights, and orientation of all outlet boxes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Metal Conduit and Tubing:

    a. Allied Tube & Conduit Corporation.
    b. Anamet, Inc.; Anaconda Metal Hose.
    c. AFC/Monogram Company.
    d. Carol Cable Co., Inc.
    e. Cole-Flex Corp.
    f. Electri-Flex Co.
    g. Flexcon, Inc.; Coleman Cable Systems, Inc.
    h. Grinnell Co.; Allied Tube and Conduit Div.
    i. Monogram Co.; AFC.
    j. Spiraduct, Inc.
    k. Triangle PWC, Inc.
    l. Wheatland Tube Corporation

2. Nonmetallic Conduit and Tubing:

    a. Anamet, Inc.; Anaconda Metal Hose.
    b. Arnco Corp.
    c. Breeze-Illinois, Inc.
    d. Cantex Industries; Harsco Corp.
    e. Certainteed Corp.; Pipe & Plastics Group.
    f. Cole-Flex Corp.
    g. Condux International; Electrical Products.
    h. Electri-Flex Co.
    i. George-Ingraham Corp.
    j. Hubbell, Inc.; Raco, Inc.
    k. Lamson & Sessions; Carlon Electrical Products.
    l. R&G Sloan Manufacturing Co., Inc.
    m. Spiraduct, Inc.
    n. Thomas & Betts Corporation

3. Conduit Bodies and Fittings:

    a. American Electric; Construction Materials Group.
    b. Crouse-Hinds; Div. of Cooper Industries.
    c. Emerson Electric Co.; Appleton Electric Co.
    d. Hubbell, Inc.; Killark Electric Manufacturing Co.
    e. Lamson & Sessions; Carlon Electrical Products.
    f. O-Z/Gedney; Unit of General Signal.
    g. Scott Fetzer Co.; Adalet-PLM.
    h. Spring City Electrical Manufacturing Co.
    i. Thomas & Betts Corporation.

4. Metal Wireways:

    a. Hoffman Engineering Co.
    b. Keystone/Rees, Inc.
    c. Square D Co.

5. Boxes, Enclosures, and Cabinets:

a. American Electric; FL Industries.
b. Butler Manufacturing Co.; Walker Division.
c. Crouse-Hinds; Div. of Cooper Industries.
d. Electric Panelboard Co., Inc.
e. Erickson Electrical Equipment Co.
f. Hoffman Engineering Co.; Federal-Hoffman, Inc.
g. Hubbell Inc.; Killark Electric Manufacturing Co.
h. Hubbell Inc.; Raco, Inc.
i. Lamson & Sessions; Carlon Electrical Products.
j. O-Z/Gedney; Unit of General Signal.
k. Parker Electrical Manufacturing Co.
l. Robroy Industries, Inc.; Electrical Division.
m. Scott Fetzer Co.; Adalet-PLM.
n. Spring City Electrical Manufacturing Co.
o. Thomas & Betts Corp.
p. Woodhead Industries, Inc.; Daniel Woodhead Co.

2.2 METAL CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit: ANSI C80.1 and UL 6.

B. EMT and Fittings: Hot galvanized steel O.D. with an organic corrosion-resistant I.D. coating. Listed to UL Safety Standard 797 and manufactured in accordance with ANSI C80.3.

1. Fittings: Compression type, NEMA FB1.

C. FMC: Zinc-coated steel.

D. LFMC: Flexible steel conduit with PVC jacket.

E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. PVC: NEMA TC 2, UL 651, Schedule 40 or 80.

2.4 METAL WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

D. Wireway Covers: Screw-cover type.

E. Finish: Manufacturer's standard enamel finish.

2.5 OUTLET AND DEVICE BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized flat-rolled sheet steel.

B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box, deep type, with gasketed cover, and threaded hubs.

C. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including corrosion-resistant screws, mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.

2.6 PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1, galvanized flat-rolled sheet steel.

B. Sheet metal boxes over 12" in any dimension shall comply with the requirements of Article "Enclosures and Cabinets" of this Section.

C. Boxes for Outdoor and Wet Locations: Flat flanged, surface-mounted, UL listed as raintight, galvanized cast iron box and cover with neoprene gasket and stainless steel cover screws.

2.7 BOX EXTENSIONS

A. Prohibited on new construction.

B. Where more than one box is needed to flush out installation, provide a large (i.e., 6" x 6") box to flush out the existing box and nipple over to a new box.

2.8 EXPANSION / DEFLECTION FITTINGS

A. Provide an expansion/deflection fitting in each concealed or exposed electrical run crossing a building expansion joint. Fittings shall be complete with bronze end couplings, neoprene sleeves, tinned copper braid integral bonding jumper and stainless steel bands. Expansion/deflection fittings shall be suitable for the size and type of conduit run they connect. Bonding jumper shall comply with NEC and UL requirements.

B. Expansion/deflection fitting shall accommodate the following movements without collapsing or fracturing the conduit and damaging the wires it contains:

1. Axial expansion or contraction up to 3/4-inch.

2. Angular misalignment of the axes of the conduits up to 30 degrees in all directions.

3. Parallel misalignment of the axes of the conduits up to 3/4-inch in all directions.

C. Expansion/Deflection fitting shall be OZ/Gedney Type "DX" or approved equal by Crouse Hinds (Type XD).

2.9 BUSHINGS

A. Bushings for 1-inch conduit and smaller shall be self-extinguishing thermoplastic type - 150°C temperature rating.

B. Bushings for 1-1/4" conduit and larger shall be malleable iron body with 150 degrees C insulating ring. Insulating material shall be locked in place and non-removable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 RACEWAY AND BOX REQUIREMENTS

A. Conduit Application Schedule:

APPLICATION	CONDUIT TYPE	REMARKS
In or under concrete slab	RGS (Schedule 40 PVC)	
Exposed exterior locations.	RGS	Use threaded or rain-tight fittings and stainless steel hardware.
Damp/Wet interior locations.	RGS	Use threaded or rain-tight fittings and stainless steel hardware.
Exposed dry interior locations	EMT, RGS	Schedule 40 PVC is acceptable for concealing grounding electrode conductors, except for plenum spaces..
Exterior underground.	Sched. 40 PVC, RGS	RGS Elbows/Sweeps unless otherwise noted on the Drawings.
Equipment connections in dry interior locations.	FMC (e.g. Greenfield)	Short lengths only (maximum 6 feet).
Equipment connections in wet interior locations.	LFMC (e.g. Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings and stainless steel hardware.
Equipment connections in exterior locations.	LFMC (e.g Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings and stainless steel hardware.
Concealed in dry wall construction.	EMT	
Concealed above suspended ceilings.	EMT	
Concealed in masonry walls.	EMT	

B. General Requirements

1. Provide hot-dip Rigid Galvanized Steel Conduit (RGS) for medium voltage applications.

2. Aluminum conduit is prohibited.

3. Where indicated on the drawings, Rigid Non-metallic Conduit may be used as permitted in Article 352 of the NEC, with or without concrete encasement.

4. Where rigid non-metallic conduit is exposed, it shall be Schedule 80 PVC, with all provisions for thermal expansion/contraction as recommended by the Manufacturer.

5. Conduits for exterior underground electric work shall be rigid steel, galvanized and sherardized, leaving the building and to points 5 feet beyond footings. Beyond 5 feet of building, underground conduits shall be non-metallic Schedule 40 PVC, Type II (except for medium voltage applications, which shall be continuous RGS from end to end).

6. Conduits shall slope from entrance equipment toward outside of building.

C. Fittings:

1. All fittings to match conduit material and to be suitable for the purpose intended. Join conduit with fittings designed and approved for the purpose and make joints tight.

2. Provide UL listed compound filled sealing fittings for NEC-required locations, for conduits passing from interior to exterior, and at the interface of widely different space temperatures such as refrigeration or cold storage rooms where conduits pass from warm locations to cool locations, such as the boundaries of air conditioned spaces and non-conditioned air spaces. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

3. Provide expansion fittings with bonding jumpers where conduits cross expansion joints or where otherwise required to compensate for thermal expansion and contraction. Provide expansion fittings in each straight uninterrupted run of surface-mounted conduit, both horizontal and vertical, in excess of 200 feet. Distance between fittings shall not exceed 200 linear feet. The Contractor shall refer to the Architectural Drawings for expansion joint locations.

4. Fasten rigid steel conduit with threaded galvanized steel fittings, double locknuts, and insulated bushings. Insulated bushings shall be OZ/Gedney type "B", or equal.

5. Fasten EMT conduit with concrete-tight or rain-tight compression fittings made from zinc-plated steel. Fittings using set screw or indentations as a means of attachment or made from cast "white metal" are prohibited. All connectors shall have insulated throats.

6. Fasten liquid-tight conduit with fittings incorporating a threaded ferrule, nylon sealing ring, and steel or malleable iron compression nut and body. Furnish Crouse Hinds metallic liquid-tight fittings, or equal.

7. Fasten Flexible Metallic Conduit (FMC) with Thomas & Betts (T&B) "Tite-Bite" insulated connectors, or equal.

8. Watertight fittings shall use a copper base anti-corrosive conductive compound. Provide watertight fittings for conduits in damp or wet locations, underground locations.

D. Box Locations:

1. Electrical boxes shall accommodate wire pulling, splices, taps, equipment connections and Code compliance.

2. Coordinate access doors as required to provide access to boxes in hard ceilings and similar inaccessible areas.

E. Outlet Boxes:

1. Outlet boxes for dry interior locations and for concealed work shall be zinc-coated or cadmium-plated sheet steel boxes suitable for the service and type outlet.

2. Boxes and conduit fittings for damp or wet locations and exposed locations subject to damage shall be NEMA 4 cast-aluminum, cast steel or cast iron type with gasketed cover plates and threaded hubs for conduit entrance.

3. Extra large boxes shall be provided in accordance with the National Electrical Code where necessary to prevent crowding of wire in the box.

4. Plastic boxes and cast "white metal" boxes classified as NEMA 4 will not be acceptable.

5. Outlet boxes in unplastered brick or block walls shall be provided with deep square-cut device covers. They shall be set so that the brick or block can be cut and fitted closely to the cover opening and so that the standard wall plate will cover the joint between the brick or block and the box.

6. All outlet boxes used for supporting fixtures shall be furnished with malleable iron fixture studs of "no-bolt" type secured by locknut.

7. Provide support for boxes occurring in suspended ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction.

8. All boxes, whether outlet, junction, pull, or equipment, shall be furnished with appropriate covers.

9. No sectionalized boxes shall be used.

10. Provide factory-made knockout closures for unused openings in outlet boxes.

11. Provide blank coverplates for all unused boxes.

12. For multiple device installations, provide multi-gang boxes. Sectional boxes are not permitted. Provide barrier separation of different voltage conductors in the same box.

13. Provide recessed outlet boxes in finished areas, supported from interior partition studs. Supports are to be stamped steel stud bridges for hollow stud walls and adjustable steel channel fasteners for flush ceiling outlet boxes.

14. Provide back supports for boxes in metal stud walls.

F. Junction and Pull Boxes:

1. Junction and pull boxes shall be furnished and installed as shown or where required to facilitate pulling of wires or cables. Such boxes shall be installed in accessible locations. All boxes for concealed work shall be constructed of 12 gauge USS galvanized sheet steel minimum, unless otherwise specified or indicated and provided with mounting brackets and flat screw covers secured in position by round head brass or stainless steel 300 grade machine screws. Boxes for exterior work shall be cast aluminum or galvanized cast iron type with threaded hubs unless otherwise directed. Gasketed cover plates shall be furnished for outdoor installation.

2. Provide barrier (separators) where different system voltage share the same box.

3. Wherever possible, locate pull and junction boxes above accessible ceilings in finished areas.

4. Pull or junction boxes shall be supported independently of conduit.

3.3 INSTALLATION OF RACEWAYS

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

B. Furnish and install a separate and independent raceway system as shown on the Drawings for each of the various wiring systems including, but not limited to, the following:

Incoming Electric Service
Lighting
Power 120/208 volt
Power 277/480 volt

C. All raceway systems shall be completely wired as specified herein, shown on drawings and/or required for satisfactory operation of the various systems.

D. Raceways, generally, shall be concealed conduit as specified herein. Where wiring troughs are required or used to facilitate the wiring installation, they shall be equal to Square D Company's Square-Duct and fittings, with hinged cover arranged for total removal, all finished in baked enamel and all components U/L listed. The gutters shall be of ample size to accommodate conductors therein and as required by the NEC.

E. Underground conduits for services outside of building and entrance into building shall be as specified herein.

F. Support all conduit not embedded in concrete or masonry such that strain is not transmitted to outlet boxes and pull/junction boxes, etc. Supports to be sufficiently rigid to prevent distortion of conduits during wire pulling.

G. Minimum Raceway Size:

1. 3/4-inch trade size (DN21) for interior work

2. 1-inch trade size for exterior underground work.

H. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.

I. Electrical Metallic Tubing (EMT) shall be used for the following unless otherwise indicated:

1. Branch circuits and feeders for lighting, receptacles, and power concealed in:

a. Dry wall construction.
b. Hard ceilings, e.g. gypsum, etc.
c. Masonry walls.

2. Exposed in equipment room areas as needed to serve fixed equipment.

3. Circuits for communication and signaling concealed in:

a. Dry wall construction.
b. Hard ceilings, e.g. gypsum, etc…

J. Rigid Galvanized Steel Conduit (RGS) shall be used for the following, unless otherwise indicated:

1. Branch circuits and feeders for lighting, receptacle and power, installed exposed in areas subject to physical damage.

2. Circuits for communication and signaling exposed in areas subject to physical damage.

K. Wiring installed concealed above hard ceilings and exposed in areas with no ceilings shall be installed in conduit.

L. Conduit shall be run concealed wherever possible, within walls, ceilings, or floors, unless otherwise indicated or specified. Where exposed conduits runs are shown or required, they shall be run parallel to building construction and shall be suitably supported at required intervals.

M. Conduit may be run exposed in Mechanical Equipment rooms, Electrical rooms, and where necessary in Storage rooms and unfinished areas. Where conduit is run exposed, it shall be run as close as possible to walls and ceilings and shall not interfere with equipment, ductwork and piping.

N. Keep raceways at least 12 inches (300 mm) away from parallel runs of flues, steam or hot-water pipes and other hot surfaces above 77 degrees F. Install horizontal raceway runs above water and steam piping.

O. Install raceways level and square and at proper elevations. Provide adequate headroom.

P. Complete raceway installation before starting conductor installation.

Q. Support raceways as specified in Division 26 Section "Hangers and Supports". Arrange supports to prevent misalignment during wiring installation.

R. Use capped bushings or "push-penny" plugs to prevent foreign matter from entering the conduit system during construction. Clean and plug or cap all conduits left empty for future use.

S. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab. Conduit stub-ups and stub-downs shall be arranged in a neat and orderly manner and shall emerge at right angles to floors or ceilings.

T. Make bends and offsets so the inside diameter is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

U. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.

V. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.

W. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

X. Run parallel or banked raceways together, on common supports where practical.

Y. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

Z. Join raceways with fittings designed and approved for the purpose and make joints tight.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

2. Use insulating bushings to protect conductors.

AA. Tighten set screws of threadless fittings with suitable tools.

BB. Install pull wires in empty raceways. Use 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

CC. Lubricants for pulling wires shall be approved for use with the types of wire and conduit installed.

DD. Use conduit hubs or sealing lock nuts to fasten conduit to boxes in damp and wet locations.

EE. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inches (50 mm) in size.

FF. Avoid moisture traps; provide junction box with drain fittings at low points in conduit system.

GG. Die-cast fittings of pot metal will not be accepted.

HH. Conduits shall be free of any burrs, foreign objects, and water prior to conduit installation.

II. Conduit placed against concrete or masonry above ground shall be fastened to the concrete or masonry with pipe straps or one screw clamp attached to the concrete by means of expansion screw anchors and screws. "Caddy Clip" type hangers or straps will be permitted only in non-exposed areas and restricted to 3/4" conduit.

JJ. Where conduits turn up out of concrete slabs and are not concealed by wall construction, bends shall be carefully made so that no portion of the radius is above the floor.

KK. Rigid conduit or Electrical Metallic Tubing (EMT) shall not be strapped or fastened to equipment subject to vibration or mounted on shock-absorbing bases.

LL. Conduit shall be installed in such manner as to insure against the collection of trapped condensation, and runs of conduit shall be without traps wherever possible. Drill 1/8" diameter weep holes where necessary.

MM. Conduits run to and from cabinets shall be run neatly, in accurate manner and shall emerge from the floors and ceilings at right angles thereto.

NN. Exposed conduit installed on or adjacent to ventilating ducts shall be installed after the ducts are in place, and shall be run from ceiling or wall junction boxes in such manner as to retain accessibility to junction box covers and to permit future removal or replacement of ducts.

OO. Conduits and other electrical items shall not be fastened to, or supported from ventilating ducts but shall be separately supported. The method of supporting and details of the

supporting members shall be reviewed by the Owner's Representative. In no case shall screws penetrate the sheet metal of the ducts.

PP. Exposed conduit run on surface shall be supported according to Code and within three feet of each outlet, junction box, or cabinet, by galvanized malleable conduit clamps and clamp backs. Suspended conduits shall be supported every five feet by conduit hangers and round rods, or where two or more conduits are run parallel, by trapeze hangers suitably braced to prevent swaying.

QQ. Screws for all exposed work shall be stainless steel, unless otherwise noted.

RR. Zinc coated galvanized steel screws may be used for interior dry locations only.

SS. No running threads shall be cut or used.

TT. Conduits which are installed at this time and left empty for future use and which are five feet or more in length, including all telephone and communication conduits shall have a non-ferrous, 600 lb. tensile strength drag line left in place for future use. All empty conduits including conduit stubs shall be tagged at all exposed ends with tags identifying the location of the end of the conduit.

3.4 INSTALLATION OF BOXES

A. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors.

B. Provide junction boxes, pull boxes, cable support boxes, and wireways as required for proper installation of the electrical work. Covers shall be accessible. Small junction boxes shall be similar to outlet boxes. Provide barriers (separators) where different system voltage wires share the same box.

C. Pull boxes, cable support boxes, and large junction boxes for indoor use shall be made of Code gauge steel or no less than 12 gauge. Covers shall be held in place with zinc-coated galvanized steel screws. Paint interior and exterior surfaces with rust-inhibitive paint. (Pull boxes and covers shall be hot-dipped galvanized.)

D. Boxes located outdoors and in damp or wet locations shall be cast metal or alloy, fitted with screw-fastened covers and gaskets, and with threaded conduit connections. Fasteners shall be stainless steel.

E. Pull boxes shall be installed at all necessary points to facilitate pulling of wires and to prevent injury to the insulation or other damage that might result from pulling resistance or for other reasons necessary for proper installation. Pull box locations shall be approved by the Owner's representative prior to installation.

F. Where boxes are used in connection with exposed conduit, plain covers attached to the box with a suitable number of countersunk flat head machine screws shall be used.

G. Pull boxes with barriers shall have a single cover plate and the barriers shall be of the same gauge as the pull box.

H. Exposed pull boxes will not be permitted in finished spaces.

I. Location of pull boxes shall be coordinated with piping, ductwork, and other equipment so as to permit sufficient clearance for maintenance and access.

J. Pull boxes recessed in walls or partitions shall be provided with flanged type covers.

K. Outlet boxes and covers shall be of proper Code size for the number of wires and/or conduits passing through or terminating therein, but in no case shall any box be less than 4" square.

L. Outlet boxes for lighting fixtures shall be equipped with fixture supporting devices.

M. Outlet boxes for switches shall be of the gang type.

N. Each circuit in each pullbox shall be marked with a tag guide denoting panels to which they connect.

O. Boxes shall be separated to prevent sound transmission. Back-to-back boxes shall not be used.

P. Outlet boxes shall be provided with suitable plaster rings and covers or plates.

Q. Unused knockout holes shall remain closed and those opened by error shall be closed with approved factory-made knock-out seals.

R. Outlet boxes installed in plenum ceilings shall be in accordance with applicable codes.

S. Outlet boxes shall be installed true and plumb so that the covers or plates will be level and at uniform elevations for the types of outlets contained.

T. Outlet box locations as indicated shall be considered to be approximate only. Determine exact locations from architectural details or from field instructions and coordinate outlet box locations with the work of other trades.

U. Install junction and pull boxes to be accessible.

V. Locations of junction and pull boxes requiring access panels shall be reviewed by the Owner's Representative.

W. Install hinged-cover enclosures and cabinets plumb. Support at each corner at minimum.

3.5 INSTALLATION OF TERMINATIONS

A. Where raceways are terminated with lock nuts and bushings, align the raceway to enter squarely, and install the lock nuts with dished part against the box. Where terminations cannot be made secure with one lock nut, use two lock nuts, one inside and one outside of the box.

B. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

C. Open ends shall be capped with approved manufactured conduit seals as soon as installed and kept capped until ready to pull in conductors.

D. Where conductors enter a raceway, cabinet, pull box, and junction box, the conductors shall be protected by an insulated bushing providing a smoothly rounded surface.

E. Double lock nuts shall be used at termination of rigid conduit in knock-out openings.

F. Ends of conduits shall be equipped with insulating bushings for 1" and smaller, and insulated metallic bushings for 1-1/4" and larger. Ends of conduit shall be temporarily capped prior to installation and during construction to exclude foreign material.

3.6 FLEXIBLE CONNECTIONS

A. Provide Flexible Metal Conduit (FMC), e.g. Greenfield, in short lengths (maximum 6 feet) for the connection of dry type transformers and any vibrating equipment in dry interior locations. The flexible connections to recessed fixtures and equipment shall be sufficient slack to permit removal of fixture.

B. Provide Liquidtight Flexible Metal Conduit (LFMC), e.g. Sealtite, in short lengths (maximum 6 feet) for the connection of exterior equipment, motors and equipment in damp or wet locations as defined in Division 26 Section “Common Work Results for Electrical”.

C. Grounding conductors with green colored insulation shall be extended through all flexible connections including fixture "whips", and fastened to terminals within the first junction boxes on either side of the flexible length.

D. Flexible connections shall be sized per the Contract Drawings, or as required in accordance with Code; the more stringent requirement shall apply.

3.7 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

C. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

D. Steel conduit: Conduit that shows corrosion within the guarantee period shall be replaced.

3.8 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

B. After conduits and accessories have been installed, and concreting operations completed, conduit runs shall be satisfactorily cleared of obstructions and foreign matter. Defects which might damage cable upon installation shall be corrected. Where new conduits installed are connected to existing conduits, the entire run to the nearest box or other termination point shall be cleaned.

END OF SECTION

DIVISION 26
SECTION 260543
UNDERGROUND DUCTBANKS
TABLE OF CONTENTS

SECTION 260543 - UNDERGROUND DUCTBANKS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications apply to this Section.

1.2 SUMMARY

A. This Section includes complete direct burial materials and methods for outside power distribution.

B. This Section specifies underground duct placement, materials, and installation procedures.

1.3 CONTRACTOR RESPONSIBILITIES

A. All work described in this Section shall be performed and paid for under Division 26.

B. Existing Subsurface Utilities: Existing subsurface facilities are not shown on the plans since no information was available. Every effort shall be made by the contractor to avoid damage to essential utilities which must remain in service. Take reasonable steps to ascertain the exact location of all underground facilities prior to doing work that may damage such facilities. If the discovery of underground facilities not indicated on the plans or in a location different from what is indicated on the plans, protect such facilities, notify the Owner's representative immediately, and record actual conditions found onto the record drawings.

C. Construction Staking:

1. Provide the stakes and reference marks necessary for the construction of the improvements covered by this Contract.

2. Control stakes which constitute reference points for all Construction work shall be conspicuously marked with red flagging tape. Provide responsibility to inform employees and Subcontractors of the stakes' importance, and the necessity for their preservation. The cost of replacing such controls, should it become necessary for any reason whatsoever, shall be furnished at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Materials: All materials shall be new and the best of their respective kinds, free from all defects and as specified on the plans and the specifications or as accepted by the Project Engineer. Furnish materials or manufactured articles of the best grade in quality and workmanship obtainable on the market from firms of established good reputation, or if not ordinarily carried in stock, shall conform to the usual standards of first-class materials or articles of the kind required, with due consideration of the use to which they are to be put. In general, the work performed shall be in conformity and harmony with the intent to secure the best standard of Construction and equipment of the work as a whole or in part.

B. Manufacturer's Recommendations: Whether specifically mentioned or not in these Specifications, all materials, equipment, devices, etc., shall be installed in a manner meeting the approval of the manufacturer of the particular item.

C. Codes and Standards: Provide underground ductbanks conforming to the following:

1. National Electrical Manufacturers Association (NEMA) - Conform to the manufacturing standards of the following:

a. TC 2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
b. TC 3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.
c. TC 6: PVC and BAS Plastic Utilities Duct for Underground Installation.
d. TC 8: Extra-Strength PVC Plastic Utilities duct for Underground Installation.
e. TC 9: Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

2. Underwriters Laboratories, Inc. (UL): Conform to the following:

a. 6: Rigid Metal Conduit.
b. 651: Schedule 40 and 80 Rigid PVC Conduit.
c. 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.

1.5 SUBMITTALS

A. Submit shop drawings and product data for all conduit, duct, ductbank materials, accessories, and miscellaneous components. Submit product data for each type of manufactured material and product indicated.

B. Indicate material specifications, dimensions, capacities, and reinforcing details.

C. Record Documents: Show dimensional locations of underground ducts.

1.6 SITE CONDITIONS

A. General: Clearing work shall not begin until temporary fences, barricades, warning signs and other pedestrian control devices are installed.

B. Traffic Access:

1. Conduct operations and schedule cleanup in a manner which causes the least possible obstruction and inconvenience to adjacent property owners, pedestrians and vehicular traffic. Furnish, erect, construct and maintain such temporary fences, barriers, lights, reflectors, cones, signs, ramps, etc., that may be necessary to adequately provide separation and warn the public of work in progress and of any existing dangerous conditions. This requirement shall apply continuously and shall not be limited to normal working hours.

2. Provide responsibility for coordinating and obtaining approvals of the location for temporary barricades and/or detours of traffic from the Police and Fire Departments.

3. If peripheral fencing is used, it shall be provided with reflectors, flashers, signs, dangles, or barricades as the fence is being built.

4. Maintain continued access to parking areas, roads, abutting properties, and other facilities which the construction will cross.

5. If traffic is reduced to one way, provide a flag person. A minimum of one lane shall be maintained open to traffic at all times.

6. When entering or leaving road ways carrying public traffic, the equipment whether empty or loaded, shall in all cases yield to public traffic.

7. Supply and maintain cone placements at his sole additional expense.

8. All traffic signs which fall within the line of Construction or are obstructed by the equipment or operations shall be temporarily relocated to an unobstructed area. Temporarily relocated traffic signs shall be returned to their original location at the end of construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering the specified products that may be incorporated in the work, include, but are not limited to, the following:

1. Conduit and Fittings:

   a. Carlon Electrical Products.
   b. George-Ingraham Corporation.
   c. Condux International.

2. Ductbank Accessories:

   a. Carlon.
   b. Osburn Associates.
   c. Underground Devices, Inc.
   d. OZ/Gedney

2.2 UNDERGROUND DUCTBANKS

A. General: Underground ductbanks to be arrangements of single bore, PVC plastic conduits. The number and size of conduits to be as indicated. Turn up connections through slabs or floors shall be rigid metal.

B. Material:

1. Conduit and Fittings:

a. Type II, heavy wall Schedule 40 PVC plastic, sunlight UV-resistant, in accordance with the requirements of NEMA publications TC-2 and TC-3 (fittings).
b. Rigid galvanized heavy wall steel conduit (UL 6) with threaded couplings.
c. Rigid Metal Conduit, PVC Coated, UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40.
d. Conduit and fittings shall have a temperature rating at least equal to the operating temperature of the cable which it contains, minimum 90 degrees C. Conduit and fittings shall be free from all substances that injuriously affect any wire or cable insulation.
e. The Manufacturer shall certify that the plastic is 100 percent virgin material and the finished product meets the specifications. All PVC conduit and fittings shall have solvent-weld connections and shall provide a water-tight joint.

C. Conduit:

1. Size as indicated on the Drawings.

D. Elbows: rigid heavy wall galvanized steel with a minimum bend radius of 36 inches (915 mm).

E. Conduit Termination in Buildings and Equipment

1. Bushings: Pre-manufactured groundable steel bushings of appropriate sizes where bell ends are not used. Steel bushings shall be used on all metal conduit. When entering a new building, or a new manhole, the bell ends for PVC shall be a pre-manufactured system (System as manufactured by Formex or equal) with conduit seals, provisions for roughing into the concrete pour and water stops.

F. Plugs: Closure plugs or caps of the same material as the conduit at the ends of the unused sections at manholes, and at building entrance openings.

G. Pull wire: Provide a polypropylene, twisted yellow, rot and mildew-resistant 3/8" minimum pull rope (2400 lbs. tensile strength) in each empty duct.

H. Grounding: Rigid steel conduit with end bells shall be provided with an Appleton Catalog No. XJB Series or equal ground bushing with bonding strap. Connect bonding strap to ground wire in electrical distribution equipment, e.g. transformer(s).

2.3 ACCESSORIES

A. Underground Line Warning Tapes:

1. Refer to Division 26 Section, “Electrical Identification” for product requirements.

2. Bury underground line warning tape 12-inches below grade above every ductbank and buried conduit.

2.4 TEST PITS

A. Provide test pits to locate all utilities and structures. Provide test pits as necessary to determine actual locations and profiles of obstructions to proposed new work.

B. Verify existing utilities, locations, and inverts and points of connection.

PART 3 EXECUTION

3.1 LOCATION AND LAYOUT

A. Indicated plans and profiles: Approximate, based on field information and available as-built plans.

B. Actual locations and profiles: Based on test pits to locate all shown utilities and structures. Test pits at beginning, center, end, and at all ductbank bends and utility crossings.

C. Plan and profile adjustments: All provided at no additional cost to Owner, subject to approval.

D. Examine site to receive underground ductbanks for compliance with installation tolerances and other conditions affecting performance of the underground ductbanks. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. In accordance with NEMA publication TC-2 and manufacturer's recommendations.

B. Top of envelope below grade: Minimum as indicated on the Drawings.

C. Sweeps and bends: Minimum 25 foot radius (except at conduit risers) unless otherwise approved to accomplish changes in direction of runs either horizontally or vertically. Double offsets: Minimum 100 foot radius. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 36 inches.

D. Mandrel conduits: Mandrel 12 inch long, 1/4 inch less than conduit I.D. Draw a testing mandrel through each duct.

E. Clean conduits: After mandrel, with stiff brush, leave no particles or debris. Immediately install end plugs after cleaning.

F. Pull Line: Provide 100-pound-tested nylon pull line in all conduits, including spares. Provide 3 feet of slack at each end of conduit and tag.

G. Stagger vertical conduit joints: Minimum 6 inches. All joints shall have couplings installed.

3.3 EXCAVATION, BACKFILLING, COMPACTING AND SITE PREPARATION

A. Provide all excavating and backfilling and site preparation necessary to install underground ductbanks, cables, etc., included in this section of the work. Excavation and backfill shall be performed in accordance with the requirements of Division 26 Section, "Common Work Results for Electrical".

B. Install forms on sides of the ductbank if the trench is not of the proper firmness to prevent cave-in. Provide all required excavating, shoring, sheeting, bracing, and backfilling.

C. The bottom of the trench shall be undisturbed earth. If the trench bottom is too low for proper grade, fill to the proper level with sand and mechanically compact it. Cut trenches neatly and uniformly.

D. Each excavated section shall be completely excavated and graded before any duct is laid in that section.

E. Provide underground line warning tape 12-inches below finished grade over all ductbanks. Refer to Division 26 Section "*Electrical Identification*" for product requirements.

F. Excavation and Backfill: Refer to Division 26 Section "*Common Work Results for Electrical*".

G. After excavation of the trench, stakes shall be driven in the bottom of the trench at four-foot intervals to establish the grade and route of the duct bank.

H. Pitch the trenches uniformly towards utility holes or both ways from high points between utility holes for the required duct line drainage. Avoid pitching ducts towards buildings wherever possible.

I. Restore surface features at areas disturbed by excavation, and reestablish original grades except as otherwise indicated. Replace removed sod as soon as possible after backfilling is completed. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

J. Restore disturbed paving.

K. Remove pavements, sidewalks, curbs, and gutters where necessitated by construction of ducts.

L. On completion of distribution systems construction, replace pavements, sidewalks, curbs and gutters.

M. Surplus earth from the trenches, after compacting, shall be removed and disposed of.

3.4 CUTTING AND PATCHING

A. Provide all cutting and patching necessary for the installation of the electrical work. Any damage done to the work already in place by reason of this work shall be repaired expense by

a qualified mechanic experienced in such work. Patching shall be uniform in appearance and shall match with the surrounding surface.

B. Existing Obstructions: Where drawings indicate that underground conduits are to cross under existing roadways, walks or other similar paved areas, steel conduits shall be driven under such areas in lieu of installing the conduits in trenches as specified above. After installation of conduit by either method, all existing paved or grass areas which have been disturbed in any way shall be restored to their original conditions.

C. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.

3.5 PLACEMENT OF CONDUIT

A. Within five (5) feet of each existing building wall or utility hole penetration, install heavy wall galvanized steel conduit within the concrete envelope to provide protection against vertical shearing.

B. Core drill all existing walls, and seal with approved sealant.

C. Make tight conduit joints by complying with recommendations of conduit manufacturer, using coupling jointing compound or PVC primer and solvent cement. All joints in conduits and fittings shall be made up tight and shall be watertight. All threaded portions of steel conduits that are not to be encased in concrete and adjoining ends of conduits, couplings and fittings, shall be heavily coated with asphaltum after installation. All connections between conduits of different types shall be made in an approved manner, using adapters of other materials and methods recommended for the purpose by the conduit manufacturers.

D. Provide insulated, grounding bushings on duct ends in equipment enclosure.

E. Plug or cap empty conduits. Provide standard manufactured plugs.

F. Clear conduit by rod and pull an approved test mandrel from structure to structure or from structure to the conduit termination.

G. Leave nylon or polyester pull line in each conduit, tagged to identify the conduit's point of origin, contents and final destination.

H. Bends: Conduit generally shall be straight between upturned elbows. Where bends are unavoidable in non-metallic conduits, they may be made by assembling couplings at a slight angle, provided the watertight seals are not broken and the resulting radius is not less than 100 feet. For radii less than 100 feet, 5-degree angle couplings or 5-degree factory-made bend sections shall be used.

I. Install top of duct bank minimum 30 inches below finished grade.

J. Multiple conduit: Install multiple conduit as follows:

1. Multiple conduit runs shall be arranged substantially as shown on the drawings, but minor changes in location or cross sectional arrangement shall be made as necessary

to avoid obstructions. Where conduit runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, the condition shall be referred for instructions before further work is done. All underground conduit work shall be coordinated with other outside service work. Existing outside services shall be maintained in operation unless directed otherwise.

3.6 CONDUIT AND DUCT INSTALLATION

A. Install nonmetallic conduit and duct as indicated according to Manufacturer's written instructions.

B. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 50 feet (15 m) both horizontally and vertically at other locations.

C. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Installation of warning tapes: After placing a minimum of 12 –inches or a maximum of 18 inches of backfill over the ducts, place the appropriate warning tapes above and parallel to the centerline of the duct for the entire length of the duct trench.

E. Provide pull rope and measuring tape at the time a mandrel is pulled through each conduit. Record the wall-to-wall measurements and the size of mandrel used at this time. Provide this documentation to the Project Engineer on the following working day. After acceptance of these documents, the Contractor shall remove the measuring tape, leaving only the pull rope in the conduits.

F. All work and materials covered by these Specifications shall be subject to inspection at times by the Owner's designated representative. Any work concealed before it has been inspected by the Owner's designated representative shall be re-opened or uncovered and any required modification made to that portion of the work. All trenches shall be opened from manhole to manhole or manhole to building prior to laying conduit in that trench. Exceptions (such as street crossings) will be approved prior to excavation on a case-by-case basis by the Owner at a regular project meeting. These sites shall be inspected by the Owner's representative during excavation, installation, backfill, restoration, and cleanup.

G. Separation distance from other buried utilities shall be 18 inches.

3.7 REUSE OF EXISTING DUCTBANKS

A. Where new cables are to be installed in existing ductbanks and conduit , mandrel and brush clean each duct prior to installation of new cable. Mandrel and brush procedures shall be as specified for new conduit and ductbanks. If any duct is found to be collapsed, or deformed, it shall be brought to the attention of the Engineer immediately.

3.8 DIRECT BURIED CONDUIT

A. Provide where indicated direct-buried electrical circuits utilizing PVC Schedule 40 conduit, as indicated. Conduit shall be as specified in Division 26 Section, "Raceways and Boxes". Burial depth shall be as follows:

1. Below paved roads (PVC and RGS): 30-inches below top of paving.

2. Under non-vehicle concrete (PVC and RGS): 30-inches below top of paving.

3. Other areas (PVC): 30-inches.

4. Other areas (RGS30-inches.

B. Minimum separation from other utilities shall be the same as for ductbanks, specified previously in this Section.

C. Where feasible, and where indicated, install direct-buried lines parallel, but separated from other utility lines. Group several direct-buried conduits in a common trench where running in the same direction, or to/from the same source. All direct-buried conduits shall have yellow plastic warning tape buried midway between the conduit and finished grade. Tape shall be the same as used for ductbanks.

D. Where direct-buried conduits penetrate walls or floor slabs, seal all spaces around conduit and fittings.

E. Where an underground conduit, without a concrete envelope, enters the building through a non-waterproofed wall or floor, provide a sleeve made of Schedule 40 galvanized pipe. The space between the conduit and the sleeve shall be filled with a suitable plastic expansible compound or an oakum and lead joint on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device hereinbefore specified will be acceptable in lieu of the sleeve.

3.9 RECORD DOCUMENTS

A. Provide record set data of the actual elevation of the top of each end of each raceway or ductbank at the midpoint, at no more than 100 foot intervals, where changes in elevation are less than 2 feet between data points, or 10 foot intervals when the elevation between intervals is different by 2 feet or more between data points.

B. Provide record drawings indicating actual locations of all installed ductbanks including elevations. The record drawing shall indicate location, elevation, and type of service for all utilities crossed by new ductbank.

C. Cable Records: The Contractor shall provide a complete listing of all cables installed in each conduit.

3.10 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Division 26 Section "Common Work Results for Electrical" in the presence of the Engineer.

B. Exposed surfaces of concrete shall be kept wet (damp) throughout the curing period.

C. Upon completion of the duct bank installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall be not less than 12 inches long, and shall have a diameter 1/4-inch less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.

D. Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.

END OF SECTION

DIVISION 26
SECTION 260553
ELECTRICAL IDENTIFICATION
TABLE OF CONTENTS

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

B. This section includes labeling of all terminations and related subsystems; including, but not limited to, nameplates, stenciling, wire and cable markers, labeling and identification of cables, equipment and other products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels. Provide a schedule of nameplates and stenciling.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

D. Comply with applicable EIA/TIA Standards.

E. Comply with OSHA Standards.

PART 2 PRODUCTS

2.1 CONDUCTOR LABELS

A. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend, overlaminated with a clear, weather- and chemical-resistant coating.

B. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 3/4 inch wide, in appropriate colors for system voltage and phase.

D. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.2 WIRING DEVICE FACEPLATE LABELS

A. Adhesive Labels:

1. Thermal transfer printable, clear polyester material with glossy finish, 1/2" high, width as required. Printed lettering shall be 1/4" high black text.

2. Labels shall be backed with permanent acrylic adhesive and shall exhibit good adhesion to many metal and other types of surfaces, including textured surfaces and low surface energy plastics.

3. Labels shall be resistant to humidity, temperature and UV light.

4. Labels shall meet requirements of UL 969 *Labeling and Marking Standard* and shall be RoHS compliant.

5. Provide Brady B-432 Series, or approved equal by acceptable manufacturer.

2.3 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.45.

B. General Nameplate Requirements:

1. Use colors prescribed by ANSI A13.1, NFPA 70 and as follows:

a. Normal Power System: White lettering on black background.

2. Backed with adhesive material formulated for the type of surface, intended use and installed location.

C. Nameplates for Dry, Interior Locations:

1. Engraving stock, melamine 3-layer plastic laminate.

2. Minimum 1/16-inch (1.6-mm) thick for signs up to 20 sq. inches (129 sq. cm)

3. Minimum 1/8-inch (3.2-mm) thick for signs larger than 20 sq. inches.

D. Nameplates for Damp/Wet Interior and Exterior Locations:

1. Weather-resistant, non-fading, pre-printed, cellulose-acetate butyrate.

2. Minimum 1/8-inch thick with 0.0396-inch (1-mm) galvanized steel backing.

E. Refer to Contract Drawings for typical nameplate details.

F. Refer to Paragraph "Equipment Identification Labels" under Part 3 of this Section for installation requirements.

2.4 UNDERGROUND LINE WARNING TAPE

A. Non-biodegradable, polyethylene tape, 5 mil minimum thickness and a minimum of 6 inches wide with detectable metallic foil. Provide warning labels on 3 foot centers, colored as follows:

1. Electrical ducts, piping or cable (600V and below) – Red tape with black printed labeling: CAUTION-BURIED ELECTRIC LINE BELOW.

2. Electrical ducts, piping or cable (above 600V) - Red tape with black printed labeling: CAUTION –BURIED HIGH VOLTAGE CABLE BELOW.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Where mixed voltages are used in one building (e.g., 480 volts, 208 volts), each piece of equipment, including but not limited to, switchboard(s), panelboard(s), transformer(s), safety switches, etc., on each system must be labeled for voltage in addition to other requirements listed herein.

2. All branch circuit panelboards must be identified with the same designation used in the circuit directory in the Main Distribution Panelboard, Main Switchboard, and in Distribution Panelboards.

3. Before attaching labels, clean all surfaces with the label manufacturer's recommended cleaning agent.

4. Install all labels firmly, as recommended by the label manufacturer.

5. Labels attached to wiring device faceplates and electrical equipment shall be installed plumb and neatly on all equipment.

6. Install nameplates parallel to equipment lines.

7. Secure nameplates to equipment fronts unless otherwise noted.

8. Secure nameplate to inside of recessed panelboards in finished locations.

9. Embossed tape will not be permitted for any application.

10. Stenciling is prohibited.

11. Labels: All labels shall be permanent and be machine-generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.

12. Label size shall be appropriate for the conductor size(s), and wiring device faceplate layout. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the cable. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminated over the full extent of the printed area of the label.

B. Panelboard Circuit Directories:

1. Panelboards shall be equipped with equipment nameplates as specified in paragraph "Equipment Identifications Labels" in this Section.

2. Panelboards shall have accurate typed circuit directories indicating exactly what each branch circuit serves.

3. The Contractor shall provide up to date circuit directories in new panelboards, indicating all deletions and additions, and to note the date of all changes on the directory.

4. The circuit directories shall reflect the exact circuit designations. Directories indicating the reference room numbers on the contract drawings or in the panelboard schedule shall not be acceptable.

5. If at anytime after occupancy the circuit directories are found to be incorrect due to negligence by the installer, then the Contractor shall trace out circuits, and correct the directories at no additional cost to the Owner.

C. Miscellaneous Identification:

1. Individual circuit breakers, in distribution panelboards and switchboards: 1/4-inch text (6 mm); identify circuit and load served, including location.

2. Individual circuit breakers, enclosed switches, and motor starters: 1/4-inch text (6 mm); identify load served, circuit and voltage.

3. Junction boxes: 1/4-inch text (13 mm); identify load served, circuit and voltage.

D. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

F. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

G. Self-Adhesive Identification Products: Clean surfaces before applying.

H. Caution Labels for Boxes and Enclosures: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover. Install label on inside face of door or cover in finished spaces.

I. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.

2. Concealed Boxes: Plasticized card-stock tags.

3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

J. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground line warning tape located directly above line at 12 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

K. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system. Refer to Division 26 Section “Conductors and Cables” for additional requirements.

L. Power-Circuit Identification: Colored tape, wraparound marker bands for each conductor, cables, feeders, and power circuits in panelboard gutters, outlet boxes, junction boxes, pullboxes, switchboards, and at load connections. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

M. Apply identification to conductors as follows:

1. Conductors to be Extended in the Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.

3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

N. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

O. Equipment Identification Labels: Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise noted, labels/nameplates shall identify equipment designation(s), voltage rating, and source (including source locations). Labels for disconnect switches, motor starters, etc…, shall indicate the designation of the load served as the "equipment designation". In general, labels requiring one or two lines of text shall be 1-1/2 inches high. Labels requiring three lines of text shall be 2 inches high. The first line of text, which shall indicate equipment designation/load served, shall utilize ½ inch high lettering. Remaining lines of text, which shall indicate voltage ratings and source information shall utilize ¼ inch high lettering. Refer to the Drawings for nameplate examples. Apply labels to each unit of the following categories of equipment:

1. Panelboards.

2. Switchboards.

3. Transformers.

4. Disconnect Switches.

5. Motor Controllers.

6. Electrical Cabinets and Enclosures.

P. Provide NEC, ANSI, and OSHA-approved *DANGER - HIGH VOLTAGE* warning signs on all doors of dedicated electrical rooms or closets. Where doors are located in finished areas, locate sign on the inside of the door. Coordinate mounting requirements with the Engineer. Minimum sign dimension shall be 15-inch x 11-inch.

Q. Surfaces shall be cleaned and painted, if specified, before applying markings.

R. Place markings so that they are visible from the floor.

S. Protect finished identification to ensure that markings are clear and legible when project is turned over to the Owner.

END OF SECTION

DIVISION 26
SECTION 260573
ELECTRICAL SYSTEMS ANALYSIS
TABLE OF CONTENTS

SECTION 260573 – ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. An Engineering Analysis and Coordination Study shall be performed on the portions of the electrical distribution system indicated below. The analysis shall include a short-circuit analysis with protective device evaluation, a protective device coordination study, time-current analysis of each protective device, and equipment evaluation study.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E – *Standard for Electrical Safety in the Workplace*. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584-2002, the IEEE *Guide for Performing Arc-Flash Calculations.*

C. The project/report shall begin at the new overcurrent protective device ahead of the new pad-mounted transformer, to the 480/277V main switchboard (MSB) and continue through the 480/277V and 208/120V distribution systems to the new branch panelboard, including the new dry-type transformer. The following new items and related feeders shall be included in the study: 15kV fuses in PMS2-EL, Transformer T3-EL, MSB, TDP1, DP1, P1. The following existing items shall be included in the study: MDP, PB1 and L1C. See drawing E5.1 for additional information.

1.3 REFERENCES

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

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.

4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.

5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.

3. ANSI C37.010 – Standard Application Guide for AC High Voltage Power Circuit Breakers Rated on a Symmetrical Current Basis.

4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 – National Electrical Code, latest edition.

2. NFPA 70E – Standard for Electrical Safety in the Workplace.

1.4 SUBMITTALS

A. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

B. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. Electronic PDF copies of the report shall be provided upon request.

C. The report shall include the following sections:

1. Executive Summary including Introduction, Scope of Work and Results/ Recommendations.

2. Short-Circuit Methodology Analysis Results and Recommendations.

3. Short-Circuit Device Evaluation Table

4. Protective Device Coordination Methodology Analysis Results and Recommendations.

5. Protective Device Settings Table

6. Time-Current Coordination Graphs and Recommendations

7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.

8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.

9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

D. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineer and Owner, and other information specified.

1.5 QUALITY ASSURANCE

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered State of Delaware Professional Electrical Engineer skilled in performing and interpreting the power system studies. Report shall be signed and sealed by the Engineer.

B. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

C. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.

D. Engineering Analysis and Coordination Study shall be performed by one of the following, or an approved and qualified equal.

1. Cable Testing Services, Inc.
   505 School House Road
   Kennett Square, PA 19348
   Telephone: 302-369-5420
   Toll-Free: 1-800-824-1600
   Fax: 302-369-5515
   Contact: Charles Emery, P.E.

2. AB Engineering LLC
   303 Dressage Court
   West Chester, PA 19382
   Telephone: 610-765-1290
   Contact: Alton Baum, P.E.

3. Potomac Testing, Inc.
   1610 Professional Blvd, Suite A

Crofton, MD 21114
Telephone: 301-352-1930
Toll-Free: 1-800-331-2022
Contact: Paul Gill, P.E.

4. Coordinated Power Engineering, Inc.
1340-G Charwood Road
Hanover, MD 21076
Telephone: 410-694-9494
Fax: 410-694-0085
Contact: Carl E. Rager, P.E.

5. Keystone Engineering Group, Inc.
590 East Lancaster Avenue, Suite 200
Frazer, PA 19355
Telephone: 610-407-4100
Fax: 610-407-4101
Contact: Philip M. Gonski, P.E.

6. IETC
5410 Mt. Pigsah Road
York, PA 17406
Telephone: 717-252-4730
Fax: 717-252-4793
Contact: William N. Luddy, P.E.

7. Reuter Hanney
11620 Crossroads Circle
Suite D-E
Middle River, MD 21220
Telephone: 410-344-0300
Fax: 410-335-4389

PART 2 PRODUCTS

2.1 STUDIES

A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies.

2.2 DATA

A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing or required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source contribution may include present and future motors.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.

D. If applicable, include fault contribution of existing motors in the study. The contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT ANALYSIS

A. Transformer design impedances shall be used when test impedances are not available.

B. Provide the following:

1. Calculation methods and assumptions

2. Selected base per unit quantities.

3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.

4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.

6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

D. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings.

2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.

3. Contractor shall notify Engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title with descriptive device names.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable.

1. Electric utility's overcurrent protective device

2. Medium voltage equipment overcurrent relays

3. Medium and low voltage fuses including manufacturer's minimum emtl, total clearing, tolerance, and damage bands.

4. Low-voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands

5. Transformer full load current, magnetizing inrush current, and ANSI through fault protection curves.

6. Medium voltage conductor damage curves.

7. Ground fault protective devices, as applicable.

8. Pertinent motor starting characteristics and motor damage points, where applicable.

9. The largest feeder circuit breaker in each applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

G. Provide the following:

1. A one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.

3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devicse, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the devices is located, and the device number corresponding to the device on the system one-line diagram

5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.

6. Contractor shall notify Engineer in writing of any significant deficiencies in protection and /or coordination. Provide recommendations for improvements.

2.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04).

B. The flash protection boundary and the incident energy shall be calculated at all locations in the electrical distribution system (distribution panelboard, branch panelboards) where work could be performed on energized parts.

C. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

F. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 5 cycles.

H. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be check amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

L. Provide the following:

1. Results of the Arc-Flash Hazard Analysis shall be submitted to tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal protective equipment classes and AFIE (Arc Flash Incident Energy) levels.

2. The Arc Flash Hazard Analysis shall report incident energy values based on recommended device setting for equipment within the scope of the study.

3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

4. The Arc-Flash Hazard Analysis shall also include copies of arc-flash hazard warning labels specified in Part 3 of this Section, for all pieces of equipment receiving a label, which shall also be included in the O & M Manual specified in Division 01.

PART 3 EXECUTION

3.1 FIELD ADJUSTMENT

A. Contractor shall adjust device settings according to the recommended setting table provided by the coordination study.

B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Contractor shall notify Engineer in writing of any required major equipment modifications.

3.2 ARC FLASH HAZARD LABELS

A. Contractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The labels shall be designed according to the following standards:

1. UL969 – Standard for Marking and Labeling Systems

2. ANSI Z535.4 – Product Safety Signs and Labels

3. NFPA 70 (National Electrical Code) – Article 110.16

C. The labels shall include the following information:

1. System Voltage

2. Flash Protection boundary

3. Personal Protective Equipment category

4. Arc Flash Incident energy value (cal/cm^2)

5. Limited, restricted, and prohibited Approach Boundaries

6. Study report number and issue date

D. Labels shall be printed by a thermal transfer type printer, with no field markings.

E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:

1. Floor Standing Equipment – Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.

2. Wall Mounted Equipment – Labels shall be provided on the front cover of a nearby adjacent surface, depending upon equipment configuration.

3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

F. Labels shall be field installed by Contractor.

3.3 ARC FLASH HAZARD TRAINING

A. The vendor supplying the Arc Flash Hazard Analysis shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 2 hours).

3.4 AVAILABLE FAULT CURRENT LABELS

A. Contractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each piece of service equipment as defined in the National Electrical Code.

B. The labels shall be designed according to the following standards:

1. UL969 – Standard for Marking and Labeling Systems

2. ANSI Z535.4 – Product Safety Signs and Labels

3. NFPA 70 (National Electrical Code) – Article 110.24.

C. The labels shall include the following information:

1. Line 1 – "Maximum Available Fault Current"

2. Line 2 – "_____ Amperes"; Contractor shall field mark maximum available fault current available at the line terminals of the equipment.

3. Line 3 – Date of Installation

D. Labels shall be printed by a thermal transfer type printer.

E. Labels shall be field-installed by the Contractor.

END OF SECTION

DIVISION 26
SECTION 261200
MEDIUM VOLTAGE TRANSFORMERS
TABLE OF CONTENTS

SECTION 261200 - MEDIUM VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, Specification Sections apply to this Section.

B. Related Sections:

1. Section 260500 “Common Work Results for Electrical”
2. Section 260524 “Medium Voltage Grounding”

1.2 SUMMARY

A. This Section includes the following:

1. Liquid-filled pad-mounted distribution transformers.

1.3 SUBMITTALS

A. Shop Drawings

1. Submit product data under provisions of General Conditions of the Contract and Section “Common Work Results for Electrical”.

2. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVa, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

3. Include detailed drawings of any changes to existing installations to suit proposed equipment to be furnished.

4. Include manufacturer's installation instructions.

5. Submit ¼-inch scaled shop drawings indicating transformer(s), equipment pads, clearances, dimensions, existing conditions, and other major components. Shop drawings shall be specific to location being installed.

B. Factory Certified Tests

1. Factory certified tests shall be performed on the transformer being supplied and the results presented to the Project Manager for approval before shipment. The following factory certified tests shall be performed:

a. Insulation resistance tests shall be performed winding-to-winding and winding-to ground.

b. A turns ratio test shall be performed between windings at all service tap settings.
c. Overpotential test shall be made on all high and low voltage windings to ground.
d. Winding resistance tests shall be made for each winding at the in-service tap.
e. Verify that the tap settings/changer is at the desired ratio.
f. Measure secondary voltage phase-to-phase and phase-to-ground after final energization and prior to loading.
g. Verify and/or connect transformer "XO" to ground, load side of "WYE" systems.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of General Conditions of the Contract and Division 01.

B. Include procedures for cleaning unit , maintaining fluid levels, and replacing components.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in distribution transformers with ten years experience.

B. Comply with the latest requirements of IEEE, ANSI, ASTM, NEMA, and ASA-NEMA Standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store and protect equipment in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.

B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers: No other manufacturers are acceptable.

1. Oil-Filled Transformers

a. Cooper Power (Basis of Design)
b. Square D Company
c. ABB, Inc.
d. General Electric

2.2 OIL-FILLED TRANSFORMERS

A. Furnish and install at the locations indicated on drawings completely metal enclosed, compartmented, oil-filled, pad-mounted distribution transformers.

B. Equipment shall have the following ratings:

1.	Capacity:	-	KVA rating as indicated on the Drawings @ 65 degrees C Rise.
2.	Primary Voltage:	-	As indicated on the Drawings.
3.	Secondary Voltage:	-	As indicated on the Drawings.
4.	Internally Bonded:	-	XO-HO Connection
5.	Taps:	-	Two (2) @ 2-1/2 percent Above and Below Nominal.
6.	Phase:	-	Three.
7.	Frequency:	-	60 Hertz.
8.	B.I.L.:	-	95 kV.
9.	Insulation:	-	O.I.S.C.
10.	Impedance:	-	5.75 percent Nominal (for 750-1000 kVA).

C. The unit shall be constructed for outdoor, fenceless, weatherproof service, and shall be suitable for mounting directly on the concrete foundation pad with high and low voltage cable entrance from below.

D. The front of the unit shall contain an air-filled termination chamber divided with a steel barrier into two sections.

1. The left section shall contain three 15 kV primary, 200 amp bushing wells with feed through inserts for dead front configuration situated to provide at least 30-inches of vertical space for cable training and termination. Include three 15 kV distribution class metal oxide surge arrestors mounted in this compartment connected to the above bushings.

2. The low voltage compartment shall contain four 8-hole NEMA drilled spade type side wall porcelain bushings.

E. Interrupting capacity shall be a minimum of 42,000 amperes symmetrical. Provide low voltage barrier.

F. The transformer shall be of sealed tank construction and furnished with the following:

1. Combination drain and sampler valve (minimum 1-inch).

2. Upper filter press connection.

3. Liquid level gauge.

4. Dial thermometer.

5. Manual tap changer handle.

6. Pressure relief valve.

7. Lifting lugs.

8. Grounding pads.

9. Jacking lugs.

10. Tamper-proof handhole on tank.

11. Diagrammatic nameplate.

12. Provisions for padlocking and recessed bolting the hinged doors of the air terminal chamber with access to the high voltage section only after opening the low voltage section door.

13. Non-PCB Certification label.

14. ANSI Tank Ground Pad.

15. Filling plug-mounted in the cover.

16. Tap changer handle.

17. Vacuum/Pressure Gauge.

18. Liquid Temperature Gauge.

19. Winding Temperature Gauge with alarm contacts and control relays.

20. *WARNING - HIGH VOLTAGE* Label.

G. The unit shall be constructed of welded steel plate with no exposed boltheads, protrusions, sharp edges, or openings which would permit entrance by other than authorized personnel. The entire assembly shall be cleaned of weld scale, primed, and given a finish coat of "Forest Green", oil-resistance outdoor enamel paint, or other color as selected by the Owner.

H. The transformer shall be manufactured and tested in accordance with the latest applicable requirements of IEEE, NEMA and ANSI.

I. Liquid: Mineral Oil. All oil shall be non-PCB. A permanent label shall be affixed to the tank indicating transformer dielectric fluids contained less than 50 PPM of PCB in accordance with EPA Requirements at the time of shipment.

J. Primary Terminations:

1. For radial feed transformers, provide three (3) ANSI/IEEE 386 bushing wells, three primary surge arrestors, insulated loadbreak connectors with parking stands, and one (1) internal oil-immersed, two-position load-break switch.

K. Primary Overcurrent Protection: Two fuse system consisting of Bayonet-type, oil-immersed expulsion fuse in series with current-limiting backup fuse mounted inside the transformer under oil. The current limiting fuse should be located as near as practical to the incoming primary bushing, on the source side of the expulsion fuse. The two fuses shall be coordinated so that the expulsion fuse clears low energy faults on the secondary system and the current limiting fuse clears only high energy, includes overload protection, can be provided as an alternate with approval from the Owner. All transformer fusing shall be coordinated with upstream phase overcurrent devices.

L. Copper windings.

M. Transformer Start-Up: The transformer will not be started until all tests are complete and turned over to the Owner and the Engineer (2 sets) for review and approval.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field measurements are as shown on Drawings.

B. Verify that required utilities are available, in proper location and ready for use.

C. Beginning of installation means installer accepts conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set transformer plumb and level.

C. Connect transformer to adjacent equipment using new cables or existing bus to match existing configuration.

D. Mount primary surge arresters inside of transformers.

E. Provide safety labels per NEMA 260.

3.3 EQUIPMENT MOUNTING PADS:

A. Provide concrete equipment mounting pads as required for setting medium voltage transformers. Concrete shall be 3000 psi, 28-day minimum. Refer to detail on electrical drawings for electrical equipment pads.

3.4 FIELD QUALITY CONTROL

A. Oil-Filled Transformers: Field testing will be performed by independent testing agency provided by the Contractor. Perform testing as required by NETA and as follows:

1. Sample insulating liquid in accordance with ASTM D3613 and perform dissolved gas analysis (DGA) in accordance with ANSI / IEEE and ASTM.

2. Turns ratio tests on the rated voltage connection and on all tap connections.

3. Polarity and phase-relation tests on the rated voltage connection.

4. Power factor tests in accordance with manufacturer's instructions.

5. Dielectric absorption test, winding-winding, and winding-ground.

6. Winding resistance for each winding at nominal tap position.

B. Any equipment which fails any of the required tests shall be replaced with new, or repaired at Owner's discretion. Equipment with marginal results, as interpreted by the Owner or Engineer, shall also be replaced or repaired at the Owner's discretion.

C. Check for damage and tight connections prior to energizing transformer.

3.5 ADJUSTING

A. Adjust transformer primary taps so that secondary voltage is within 1.5 percent of rated voltage.

END OF SECTION 261200

DIVISION 26
SECTION 262200
TRANSFORMERS
TABLE OF CONTENTS

SECTION 262200 - TRANSFORMERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes dry-type distribution transformers rated 1000 V, and less.

1.3 SUBMITTALS

A. Product Data: Include data on features, components, ratings, dimensions, weight, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.

B. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.

C. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.

D. Field Test Reports: Indicate and interpret test results for tests specified in Part 3 of this Section.

E. Maintenance Data: For transformers to be included in the Operation and Maintenance Manuals specified in Division 01 and Division 26 Section, “Common Work Results for Electrical”.

F. Project Record Documents: Record actual transformer locations.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.

1. The Terms *Listed* and *Labele*d: As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* as defined in OSHA Regulation 1910.7.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

B. Store and protect equipment in a dry location with uniform temperature. Cover ventilation openings to keep dust out.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers: No other manufacturers are acceptable.

1. Square D Company. (Basis of Design)

2. Eaton/Cutler-Hammer.

3. Acme Electric Corp.; Transformer Division.

4. General Electric

2.2 TRANSFORMERS, GENERAL REQUIREMENTS

A. Description: Factory-assembled and tested, air-cooled units of types specified, designed for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous aluminum windings without splices, except for taps.

D. Coil Conductors: Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies.

E. Internal Coil Connections: Brazed or pressure type.

F. Enclosure: Class complies with NEMA 250 for the environment in which installed. Comply with NEMA ST 20.

G. Nameplates: Include transformer connection data and overload capacity based on rated allowable temperature rise.

H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.

2.3 ENERGY EFFICIENT GENERAL PURPOSE TRANSFORMERS

A. Description

1. Dry-Type distribution transformers for general loads, single and/or three-phase, with primary and secondary voltages of 600 V and less and capacity ratings 15kVA through 750kVA.

B. Standards

1. Transformers 750kVA and smaller shall be listed by Underwriters Laboratories.

2. Conform to the requirements of ANSI/NFPA 70.

3. Transformers are to be manufactured and tested in accordance with NEMA ST20 and UL 1561.

4. Transformers shall be low loss type with minimum efficiencies per NEMA TP1 when operated at 35% of full load capacity. Efficiency shall be tested in accord with NEMA TP2.

C. Manufacturers

1. Approved manufacturers shall be registered firms in accordance with ISO 9001:1994 SIC3612 (US); which is the design and manufacture of low voltage dry type power, distribution and specialty transformers.

D. Ratings Information

1. All insulating materials are to exceed NEMA ST20 standards and be rated for 220 degrees C UL component recognized insulation system.

2. Transformers 15kVA and larger shall be 150 degrees C temperature rise above 40 degrees C ambient. Transformers 25kVA and larger shall have a minimum of 4 – 2.5% full capacity primary taps. Exact voltages and taps to be as designated on the plans or the transformer schedule.

3. The maximum temperature of the top of the enclosure shall not exceed 50 degrees C rise above a 40 degrees C ambient.

E. Construction

1. Transformer coils shall be of continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish.

2. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturated point to prevent core overheating. Cores for transformers greater than 500kVA shall be clamped utilizing insulated bolts through the core laminations to ensure proper pressure throughout the length of the core. The completed core and coil shall be bolted to the base of the enclosure, but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

3. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.

4. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be ANSI 49.

F. Sound Levels

1. Sound levels shall be warranted by the manufacturer not to exceed the following: 15 to 50 KVA - 45dB; 51 to 150kVA – 50dB; 151 to 300kVA – 55dB; 301 to 500kVA – 60dB; 501 to 700kVA – 62dB; 701 to 1000kVA – 64dB; 1001 to 1500kVA – 65dB; 1501 to 2000kVA – 66dB

2.4 FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with safety requirements of IEEE C2.

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

C. Identify transformers and install warning signs according to Division 26 Section “Electrical Identification”.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Install transformers in accordance with NECA SI, as indicated on the Drawings, and Manufacturer's published instructions, at locations as indicated on the Drawings.

1. Use Manufacturer-approved mounting brackets for transformers supported from building structure.

2. Securely anchor transformers to concrete pad for floor-mounted transformers.

3. Provide working clearances in conformance with NFPA 70.

4. Provide both, primary and secondary protection using fuses or circuit breakers as indicated on the Drawings.

F. Set transformers plumb and level.

G. Use minimum two (2) foot length flexible conduit for connections to transformer case. Make conduit connections to side panel of enclosure.

H. Mount transformers on vibration isolating pads suitable for isolating transformer noise from building structure.

I. Provide minimum 4-inch high concrete pad for floor-mounted transformers. Refer to Division 26 Section, "Common Work Results for Electrical" for installation requirements.

J. Verify mounting supports are properly sized and located, including concealed bracing in walls.

3.2 GROUNDING

A. Separately Derived Systems: Comply with requirements of 2011 National Electrical Code Article 250.30 – The grounding electrode conductor (GEC) connection shall be made at the source of the separately derived system (i.e. the transformer) in the transformer enclosure, where the system bonding jumper shall also be installed. Provide supply-side bonding jumper from transformer to first disconnecting means or overcurrent device after the transformer.

B. Comply with Division 26 Section "Grounding and Bonding" for materials and installation requirements.

C. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

3.3 FIELD QUALITY CONTROL

A. Report: Submit a written report of observations and tests. Report defective materials and installation.

B. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.

2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.
   a. Minimum Test Voltage: 1000 V, dc.
   b. Minimum Insulation Resistance: 500 megohms.
   c. Duration of Each Test: 10 minutes.
   d. Temperature Correction: Correct results for test temperature deviation from 20 degrees C standard.

C. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.4 CLEANING

A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 ADJUSTING

A. After installing and cleaning, touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

END OF SECTION

DIVISION 26
SECTION 262413
SWITCHBOARDS
TABLE OF CONTENTS

SECTION 262413 - SWITCHBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes service and distribution switchboards rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section “Common Work Results for Electrical” for general and installation materials and methods.

2. Division 26 Section “Electrical Identification” for identification materials.

1.3 SUBMITTALS

A. Product Data: For each product and component specified.

B. Shop Drawings: For each switchboard, show dimensioned plans and elevations, including required clearances and service space, component and device lists, and a single-line diagram showing main- and branch-bus current ratings and short-time and short-circuit ratings of switchboard. Include the following:

1. Wiring Diagrams: Details of wiring for power and control and differentiating between manufacturer-installed and field-installed wiring.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

D. Maintenance Data: For switchboards to include in the maintenance manuals specified in Division 01.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide switchboard assemblies specified in this Section that are listed and labeled.

1. The Terms *Listed* and *Labeled*: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* as defined in OSHA Regulation 1910.7.

B. Comply with NFPA 70.

C. Comply with NEMA PB 2/PB2.1/PB2.2.

D. Comply with UL 891. Equipment shall be UL labeled and service entrance labeled.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path.

B. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to avoid condensation.

C. Handle switchboards according to NEMA PB 2.1. Use only factory-installed lifting provisions.

1.6 PROJECT CONDITIONS

A. Verify dimensions by field measurements.

B. Determine suitable path for moving switchboard into place considering Project conditions.

C. Verify NEC and all Code clearance requirements. Locate switchboard to meet installation tolerances.

D. Revise locations and elevations from those indicated as required to suit Project conditions.

1.7 WARRANTY

A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for the lesser of two (2) years from date of installation or thirty (30) months from date of purchase.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers: No other manufacturers are acceptable.

1. Square D Company. (Basis of Design)

2. Eaton Corporation; & Cutler-Hammer Products.

3. Siemens Energy & Automation Inc.

4. General Electric

2.2 MANUFACTURED UNITS

A. Front-Accessible Switchboard: Front and rear aligned, with features as follows:

1. Main Device: Individually fixed mounted.

2. Branch Devices: Individually fixed and panel mounted.

B. Ratings: Provide nominal system voltage, continuous main-bus amperage, and short-circuit current ratings as indicated.

2.3 FABRICATION AND FEATURES

A. Enclosure Finish for Indoor Units: A minimum of one (1) coat of factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

B. Hinged Front Panels: Allow access to breaker, metering, accessory, and blank compartments.

C. Buses and Connections: 3 phase, 4 wire, except as otherwise indicated. Features as follows:

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.

2. Provide mechanical lugs to accommodate the conductors shown on the Contract Drawings.

3. Ground Bus: 1/4-by-2-inch minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder- and branch-circuit ground conductors. Provide ground lug and ground bus firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

4. Contact Surfaces of Buses: Silver plated.

5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity the entire length of the switchboard main and distribution sections. Provide for future extensions from both ends.

6. Neutral Buses: 100 percent of the ampacity of the phase buses, except as indicated, and equipped with approved pressure connectors for outgoing circuit neutral cables.

7. Service entrance rated.

D. Individual switchboard sections shall be isolated by means of physical barriers.

E. Expansion Provisions: The switchboard shall be designed for future expansion, with full size horizontal bussing throughout and extension stub-outs. Coordinate bus short circuit rating with available fault current. Size in accordance with NEMA PB.2.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.

2. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.

3. Lugs: Mechanical lugs for number, size, and material of conductors indicated.

2.5 MAIN DEVICE SECTION

A. Main Circuit Breaker(s).

1. Electronic trip, molded case, 80% rated circuit breaker with Micrologic® interchangeable ammeter trip unit with ground-fault protection.

2. All electronic circuit breakers shall have the following time/current response adjustments:

a. Long Time Pickup
b. Long Time Delay
c. Short Time Pickup
d. Short Time Delay

3. Circuit breaker trip system shall be microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic.

4. Sensor ampere ratings shall be as indicated herein or on the Drawings.

5. Long time pickup indication shall signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker.

6. Basis of Design: Square D Company, Micrologic® Model No. 6.0A.

2.6 DISTRIBUTION SECTION DEVICES

A. Group Mounted Thermal Magnetic Circuit Breakers through 1200A.

1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.

2. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulator laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

3. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.

4. Line side circuit breaker connections are to be jaw type.

5. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

6. Furnish electronic trip (LSI) molded case circuit breakers for 400A frame and above.

2.7 ELECTRONIC METER WITH DIGITAL DISPLAY

A. Three-phase electronic type suitable for connection to three (3) and four (4) wire circuits with the following features:

1. Meter shall be capable of measuring amperes (A), volts (V), power factor (PF), kilowatts (kW), kilowatt demand (kWd), kilovolt-amperes (KVA), kilovolt-amperes demand (kVAd), kilowatt-hours (kWh), kilovolt-ampere hours (kVAh), and Total Harmonic Distortion (THD).

2. Meter shall be equipped with a minimum of one (1) RS-485 Modbus communication port, one (1) digital input, one (1) KY-type digital output, and one (1) analog output.

3. Meter shall be equipped with high-visibility, anti-glare, backlit LCD display offering multi-phase measurements, summary services, bar charts, intuitive navigation and selectable languages.

4. Measurements shall meet the accuracy requirements of IEC 62053-22 Class 0.5S and ANSI C12.20 Class 0.5S.

5. Meter shall be equipped with non-volatile on-board memory for capable of extensive logging of min/max values, energy and demand, maintenance data, alarms and any measured parameters.

6. Meter shall provide custom alarming with time stamping.

7. Current transformers shall be Square D Type 100R or approved equal.

8. Potential transformers shall be provided where 277/480V metering is required, unless electronic meter is DIN rail compatible and is mounted directly to the switchboard bussing.

B. Electronic meter shall be Electro Industries/Gauge Tech, Shark 200. This product is a campus standard and no other manufacturers are acceptable.

2.8 METERING TRANSFORMERS

A. Manufacturer: Shall be Square D Company.

B. Current Transformers: ANSI C57.13;5 ampere secondary.

C. Voltage Transformers : ANSI C57.13 ;120 V single secondary, (Not required for type PM meters).

2.9 SURGE PROTECTIVE DEVICES

A. Description: Surge Protective Devices (SPD) installed in switchboard.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D Company - "IMA" Series (Basis of Design)
2. Eaton Corporation; Cutler-Hammer Products
3. Siemens Energy & Automation, Inc.

C. The manufacturer of the SPD shall be the same as the manufacturer of the electrical distribution equipment in which the SPDs are installed and shipped.

D. Standards - Most recent editions of:

1. Underwriters Laboratories:
   a. UL 1449 - "Surge Protective Devices"
   b. UL 1283 - "Electromagnetic Interference Filters"

2. ANSI/IEEE C62.41.1-2002, C62.41.2-2002, C62.45-2002

3. National Electrical Code: Article 285 - "Surge Protective Devices, 1 kV or Less"

E. Listing Requirements:

1. SPD shall bear the UL Mark and shall be Listed to most recent editions of UL 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL Listing and does not meet the intent of this Specification.

F. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per 2008 NEC Article 285.6

G. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including Neutral-Ground (N-G), shall be protected by internal overcurrent and thermal overtemperature controls.

H. SPD shall be UL labeled with 20kA I-nominal (I-n) for compliance to UL 96A - "Installation Requirements for Lightning Protection Systems" for Master Label Certificate, and NFPA 780 - "Standard for the Installation of Lightning Protection Systems."

I. Minimum surge current capability (single pulse rated) per phase shall be as follows:

1. Service-Entrance Equipment: 320kA

J. SPD shall provide surge current paths for all modes of protection: Line-Neutral (L-N), Line-Ground (L-G), and Neutral-Ground (N-G) for Wye systems; Line-Line (L-L), and Line-Ground (L-G) in Delta and impedance grounded Wye systems.

K. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
480Y/277V	1200V	1200V	1800V	1200V

L. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	MCOV	Allowable System Voltage Fluctuation (%)
480Y/277V	320V	15%

M. SPD shall be constructed of one self-contained suppression module per phase.

N. Visible indication of proper SPD connection and operation shall be provided. SPD shall include LED indicator lights which shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module.

O. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module.

P. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

Q. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.

R. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.

S. Terminals shall be provided for necessary power and ground connections.

T. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory loss upon loss of AC power.

U. SPD shall have a warranty period of ten (10) years from date of invoice and shall include unlimited replacement of suppression modules within the warranty period. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.10 IDENTIFICATION

A. Nameplates and label products are specified in Division 26 Section "Electrical Identification." Compartment Nameplates: Engraved laminated-plastic for each compartment, mounted with corrosion-resistant screws.

B. Nameplates: Engraved nameplates with 1/4" high white lettering shall be furnished for all mains and feeder circuits including control fuses and also for all indicating lights and instruments. Nameplates shall give item designation and circuit number as well as frame size and appropriate trip rating. Furnish Master Nameplate giving switchboard designation, voltage ampere rating, short circuit rating, manufacturer's name, general order number and item number.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive switchboard for compliance with installation tolerances and other conditions affecting performance of switchboards.
   1. Do not proceed with installation until unsatisfactory conditions have been corrected.

   2. Verify dimensions of switchboard and working space clearances.

B. Verify that all neutral conductors are bonded to the system ground at the service-entrance prior to installation of the surge protective device.

C. Verify that neutral-ground bonds do not exist at locations that are not service entrances or separately derived power sources.

3.2 INSTALLATION

A. Install switchboards level and plumb as indicated, according to manufacturer's written instructions and NEMA PB 2.1.

B. Support switchboards on concrete housekeeping pads. Refer to Division 26 Section, "Common Work Results for Electrical" for requirements for housekeeping pads.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount printed, basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on the front of switchboards.

E. Do not energize or connect service-entrance equipment and switchboards to their sources until surge protective devices are properly installed and connected.

3.3 CONNECTIONS

A. Connect switchboards and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten electrical connectors and terminals, including screws and bolts, according to manufacturer's published torque tightening values. Use a calibrated torque wrench. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Neutral and ground conductors shall be isolated and terminated only at their respective bus bars. There shall only be one neutral-ground connection in service-entrance equipment by means of a removable main bonding jumper. Neutral and ground terminations at one bus bar shall not be acceptable.

3.4 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section “Electrical Identification”.

B. Install compartment nameplates.

3.5 FIELD QUALITY CONTROL

A. Acceptance Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters and submit all test results for review and approval. Include test results in O&M Manual.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

3. Measure resistance of switchboard insulation.

4. Provide ground fault testing in accordance with NETA ATS.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated in system Coordination Study Report.

3.7 CLEANING

A. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION

DIVISION 26
SECTION 262416
PANELBOARDS
TABLE OF CONTENTS

SECTION 262416 - PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

B. Panelboards shall be series rated for the AIC identified. Documentation must be provided to support series ratings with submittal package.

C. Related Sections include the following:

1. Division 26 Section “Common Work Results for Electrical” for general materials and installation methods.

2. Division 26 Section “Electrical Identification” for labeling materials.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, accessory item, and component specified.

B. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA 250, Type 1.

2. Bus configuration and current ratings.

3. Short-circuit current rating of panelboard.

4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

5. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Maintenance Data: For panelboard components to include in the Operation and Maintenance Manuals specified in Division 01.

F. Project Record Data: Record actual locations of products, indicated actual branch circuit arrangement.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms *Listed* and Labeled: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* as defined in OSHA Regulation 1910.7.

B. Comply with NFPA 70, *National Electrical Code*.

C. Comply with NEMA AB1, *Molded Case Circuit Breakers*.

D. Comply with NEMA PB1, *Panelboards*.

E. Comply with NEMA PB1.1, *Instructions for Safe Installation, Operation & Maintenance of Panelboards Rated 600 Volts or Less.*

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path.

B. Store so condensation will not occur on or in panelboard. Provide temporary heaters as required to avoid condensation.

C. Handle panelboards according to NEMA PB 2.1. Use only factory-installed lifting provisions.

1.6 PROJECT CONDITIONS

A. Verify dimensions by field measurements.

B. Determine suitable path for moving panelboards into place considering Project conditions.

C. Verify NEC and all Code clearance requirements. Locate panelboard to meet installation tolerances.

D. Revise locations and elevations from those indicated as required to suit Project conditions.

1.7 WARRANTY

A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for the lesser of two (2) years from date of installation or thirty (30) months from date of purchase.

1.8 EXTRA MATERIALS

A. Keys: 2 spares of each type for panelboard cabinet lock.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers; no other manufacturers are acceptable:

1. Square D Company. (Basis of Design)

2. Eaton Corp.; Cutler-Hammer Products.

3. Siemens Energy & Automation Inc.

4. General Electric.

2.2 PANELBOARD FABRICATION

A. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

B. Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated.

C. Directory Frame: Clear plastic cardholder, mounted inside each panelboard door.

D. Phase and Neutral Bus: Hard drawn copper of 98 percent conductivity.

E. Phase and Neutral Lugs: Provide mechanical lugs to accommodate the conductors shown on the Contract Drawings.

F. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box. Hard drawn copper of 98 percent conductivity.

G. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the over-current protective device ampere ratings indicated for future installation of devices.

2.3 POWER DISTRIBUTION PANELBOARDS

A. Interior

1. Continuous main current ratings as indicated on Contract Drawings not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests in accordance with UL 67.

2. Provide UL listed short circuit current ratings (SCCR) as indicated on the contract drawings, not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes.

3. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

4. The bussing shall be fully rated with sequentially phased branch distribution. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel mounting pan by fasteners.

5. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.

6. A solidly bonded equipment ground bar shall be provided.

7. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter mounted neutral will not be acceptable.

B. Main Circuit Breakers – Electronic Type

1. Electronic trip, molded case, 80% rated circuit breaker with Micrologic® interchangeable ammeter trip unit.

2. All electronic circuit breakers shall have the following time/current response adjustments:

   a. Long Time Pickup
   b. Long Time Delay
   c. Short Time Pickup
   d. Short Time Delay

3. Circuit breaker trip system shall be microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic.

4. Sensor ampere ratings shall be as indicated herein or on the Drawings.

5. Long time pickup indication shall signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker.

6. Basis of Design: Square D Company, Micrologic® Model No. 5.0A.

C. Group Mounted Circuit Breakers Through 1200A

1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.

2. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

3. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

4. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

D. Thermal Magnetic Molded Case Circuit Breakers

1. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.

2. Circuit breakers shall have interrupting ratings as shown on the Contract Drawings, but not less than 18,000 AIC rms symmetrical amperes at rated voltage. Ampere ratings shall be as shown on the Drawings.

E. Padlock Attachment

1. Provide permanent padlock attachment so as to be able to lock the circuit breaker in the off position as indicated on the drawings.

F. Enclosures

1. Type 1 Enclosures

a). Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Zinc-coated galvanealed steel will not be acceptable.

b). Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.

c). Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.

d). Trim front shall be 4-piece surface.

e). Trim front door shall have rounded corners and edges free of burrs.

G. Basis of Design: Square D Company, I-Line type.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

A. Interior

1. Minimum short circuit current ratings as shown on the Contract Drawings, but not less than 10,000 AIC rms symmetrical amperes for 120/208V panelboards.

2. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat rise tests conducted in accordance with UL 67. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and –G.

3. All current carrying parts shall be insulated from ground and phase to phase by high dielectric strength thermoplastic.

4. Interior trim shall be of dead front construction to shield user from energized parts. Dead front trim shall have preformed twist-outs covering unused mounting space.

5. Interiors shall be field convertible for top or bottom incoming feed.

6. Main circuit breakers over 100A shall be vertically mounted.

7. Interior leveling provisions shall be provided for flush mounted applications.

B. Main Circuit Breakers

1. Main circuit breakers shall have an over-center, trip free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.

2. Two and three pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push to trip button for maintenance and testing purposes.

3. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.

C. Branch Circuit Breakers

1. Molded case branch circuit breakers shall have bolt-on type bus connectors.

2. Circuit breakers shall have an over-center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two and three pole circuit breakers shall have common tripping of all poles.

3. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI TRIP indicator appearing in the clear window of the circuit breaker housing.

4. Circuit breakers serving transformers or other panelboards shall be equipped with factory-installed, fixed, handle padlock attachment to allow padlocking circuit breakers in the OFF only position.

D. Enclosures

1. Type 1 Boxes

a). Boxes shall be galvanized steel constructed in accordance with UL 50 requirements per manufacturer's literature. Galv-annealed steel will not be acceptable.

b). Boxes shall have removable end-walls with knockouts located on one end. Boxes shall have welded interior mounting studs.

2. Type 1 Fronts

a). Fronts shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

b). Panelboards shall have hinged front cover with entire front trim hinged to box with standard door within hinged front cover.

c). Front shall not be removable with the door locked.

d). Doors on front shall have rounded corners and edges shall be free of burrs.

E. Basis of Design: Square D Company NQ type.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting: Plumb and rigid without distortion of box.

C. Panelboard dead fronts shall remain intact except where tabs are removed for circuit breakers. Install filler plates in unused pole spaces not filled by a circuit breaker that are

accidentally opened. Do not remove all tabs in dead front and fill the same with filler plates.

D. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

E. Two or three pole circuit breakers shall be common trip type. Single pole breakers with handle ties will not be permitted.

F. Tandem circuit breakers will not be permitted.

G. Multiple-section panelboards, as required by number of branch circuit breakers, shall consist of two or more cabinets with identical interiors mounted under separate trims. Cabinets, trims, and doors shall be the same size. Main lugs and busses of each section shall be rated as indicated on the Drawings. Where main breakers are indicated in multi-section panelboards the main breaker shall be contained in one section with feed-through lugs and sub-feed cables installed within panel, equal to the incoming feeder size. All buses and lugs shall have ampere capacity equal to or greater than the main breaker ampere rating. Loads shall be divided as evenly as practical between the sections in addition to being balanced over the phases.

H. Provide ground buses in panelboards as indicated on the Drawings. Ground bus shall be similar in all respects to neutral bus.

I. Provide handle lock-off clamps for all branch circuit breakers or switches serving telephone and communications equipment, refrigerators, exit signs, fire alarm system controls, etc. to prevent accidental operation.

J. Height: Six-feet, six-inches to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above the floor. Top breaker maximum height not to exceed 6 feet 7 inches per NEC Article 404.8.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Neutral and ground conductors shall be isolated and terminated only at their respective bus bars. There shall only be one neutral-ground connection in service-entrance equipment by means of a removable main bonding jumper. Neutral and ground terminations at one bus bar shall not be acceptable.

3.3 GROUNDING

A. Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus as indicated.

3.4 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section “Electrical Identification”.

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws. Refer to Division 26 Section “Electrical Identification” for nameplate requirements.

C. Panelboard Circuit Directories: Provide a typewritten directory, indicating plainly what each branch circuit of the panelboard serves and where. Provide additional information as required by NEC. Spaces and spare breakers shall be written in pencil. Copying of Contract Drawing Panel Schedules and Descriptions shall not be acceptable. Circuit directory shall reflect final circuit connections, loads and locations after balancing of panelboard loads.

3.5 FIELD QUALITY CONTROL

A. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers for all devices rated 100-amperes or larger. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

3. Reports: Prepare written report of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

4. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.

5. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.

B. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.

2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer’s instruction manual.

3. Check panelboard mounting, area clearances, and alignment and fit of components.

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

5. Perform visual and mechanical inspection and related work for over-current protective devices.

6. Verify that neutral-ground bonds do not exist at locations that are not service entrances or separately derived power sources.

C. Electrical Tests: Include the following items performed in accordance with manufacturer's instructions:

1. Insulation resistance test of buses and portions of control wiring that is disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.

2. Ground resistance test on system and equipment ground connections.

D. Retest: Correct deficiencies identified by tests and observations and provide retesting of panelboards. Verify by the system tests that the total assembly meets specified requirements.

3.6 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges as indicated in Coordination Study Report.

3.7 CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION

DIVISION 26
SECTION 262726
WIRING DEVICES
TABLE OF CONTENTS

SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. GFCI receptacles.
2. Device plates.

1.3 DEFINITIONS

A. GFCI: Ground-Fault Circuit Interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 SUBMITTALS

A. Product Data: For each product specified, indicating configurations, finishes, dimensions, and manufacturer's instructions.

B. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

C. Comply with NECA Standard of Installation.

D. Codes: Provide wiring devices conforming to the following:

1. American National Standards Institute (ANSI): Provide lugs and receptacle devices constructed in accordance with ANSI C73, *Attachment Plugs and Receptacles, Dimensions of.*

2. Institute of Electrical and Electronics Engineers (IEEE): Construct and install wiring devices in accordance with requirements of IEEE 241, *Recommended Practice for Electric Power Systems in Commercial Building.*

3. National Electrical Manufacturers Association (NEMA): Provide wiring devices constructed and configured in accordance with the requirements of

   a. WD1: General Requirements for Wiring Devices
   b. WD6: Wiring Devices - Dimensional Requirements.

4. National Fire Protection Association (NFPA): Comply with NFPA 70, *National Electrical Code*, as applicable to construction and installation of electrical wiring devices.

5. Underwriters Laboratories, Inc. (UL): Provide wiring devices which are UL listed and comply with the requirements of:

   a. 20: General-Use Snap Switches.
   b. 498: Attachments, Plugs and Receptacles
   c. 514A: Metallic Outlet Boxes.
   d. 514B: Fittings for Conduit and Outlet Boxes.
   e. 514C: Non-Metallic Outlet Boxes, Flush-Device Boxes, and Covers
   f. 943: Ground-Fault Circuit Interrupters

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work are limited to the following:

1. Wiring Devices:

   a. Hubbell, Inc.; Wiring Devices Div.
   b. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 GFCI RECEPTACLES

A. General Requirements

1. GFCI receptacles shall have the following basic features:

   a. Solid-state ground-fault sensing and signaling.
   b. Trip time of 0.025 seconds (nominal).
   c. Trip threshold of +/- 5mA.
   d. Indicator light that is lighted when device is tripped.
   e. Auto-ground clip to assure positive ground.
   f. Impact-resistant nylon face and thermoplastic base housing.
   g. #10 large head brass terminal and ground screws; back- and side-wired.

B. Weather-Resistant Duplex GFCI Receptacles

1. Weather-resistant duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V with the following features:

a. "WR" marking on face as required by UL Standard.
b. UV-resistant nylon face for longer life under adverse environmental conditions.

2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.

3. Hubbell GFTR20, Pass & Seymour 2095TRWR. No other manufacturers are acceptable.

2.3 WALL-BOX OCCUPANCY SENSOR SWITCHES

1. Product numbers for Watt Stopper are as follows:

    1. Single Relay: DSW 100

2. Wall switch sensors shall be capable of detection of motion at desk-top level up to 300 square feet, and gross motion up to 1,000 square feet.

3. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

4. Sensors shall be dual technology type using a combination of passive-infrared and ultrasonic detection method to distinguish between occupied and unoccupied conditions for area covered.

5. Sensors shall feature built-in light level sensing for field-adjustable ambient light override.

6. All sensors shall be capable of operating normally with any electronic ballast and PL lamp systems.

7. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioning or heating fans.

8. All sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering.

9. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005 percent tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

10. All sensors shall provide a method of indication to verify that motion is being detected during testing and that the unit is working.

11. All sensors shall have no leakage current to load, in manual or in Auto/Off Mode, for safety purposes and shall have voltage drop protection.

12. All sensors shall have UL rated, 94V-0 plastic enclosures.

13. Sensor finishes shall match finish of toggle switches as specified herein.

2.4 FINISHES

A. Wiring device catalog numbers in Section text do not designate device color. Device colors shall be as follows, unless otherwise indicated elsewhere in the Specifications and Drawings or as required by NFPA or device listing:

1. Wiring Devices connected to Normal Power System: White.

2.5 DEVICE PLATES

A. Device plates shall be provided for all switches and receptacles. Device plates shall be as manufactured to fit each type of single device, to fit devices which are ganged together, and they shall be same manufacturer as wiring devices with finish as follows:

1. Material for Unfinished Spaces: Galvanized steel.

2. Plate-Securing Screws: Metal with heads colored to match plate finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

1. Verify that outlet boxes are installed at proper height.

2. Verify that wall openings are neatly cut and will be completely covered by wall plates.

3. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

C. By beginning Work, accepts conditions and assume responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 INSTALLATION – GENERAL

A. Install devices and assemblies plumb, level, and secure.

B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top or as required by the local Authority Having Jurisdiction. Exception: Mount exterior GFCI weatherproof duplex receptacles horizontally with grounding terminals on the left, or as required by the local Authority Having Jurisdiction. Group adjacent switches under single, multi-gang wall plates.

C. Protect devices and assemblies during painting.

3.3 INSTALLATION – RECEPTACLES

A. All 15 ampere and 20 ampere, 125 volt and 250 volt, non-locking type receptacles installed in damp or wet locations shall be listed weather-resistant type in accordance with 2011 NEC Article 406.9(A) and 406.9(B) and shall be installed within an enclosure that is weather proof when an attachment plug is inserted.

B. All 15 ampere and 20 ampere, 125 volt, single-phase, non-locking type receptacles installed in the following locations shall have GFCI protection for personnel, in accordance with 2011 NEC Article 210.8(B).

1. Mechanical/Electrical Rooms

3.4 IDENTIFICATION

A. Comply with Division 26 Section “Electrical Identification”.

1. Receptacles: All device plates shall be labeled to identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes. Labels shall be clear with black lettering. Protect label from damage during construction. Replace all damaged and unclear labels.

2. Mark all conductors with the panel and circuit number serving the device at the device.

3. Mark the panel and circuit number serving the device on the back side of the device plate with a permanent marking system, machine-generated, that does not show through the front of the plate.

4. Faceplate labels shall be installed such that they are readable and do not cover any portion of the faceplate securing screw(s) or the wiring device itself.

3.5 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity, continuity, short circuits, and ground continuity. Operate each device at least six times.

B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

C. Replace damaged or defective components.

3.7 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

DIVISION 26
SECTION 262913
MOTOR CONTROLLERS
TABLE OF CONTENTS

SECTION 262913 - MOTOR CONTROLLERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes AC motor-control devices rated 600 V and less that are supplied as enclosed units.

B. Related Sections include the following:

1. Division 26 Section “Common Work Results for Electrical” for Mechanical - Electrical coordination requirements.

2. Division 26 Section “Common Work Results for Electrical” for general materials and installation methods.

3. Division 26 Section “Electrical Identification” for labeling materials.

1.3 DEFINITIONS

A. N.C.: Normally closed.

B. N.O.: Normally open.

1.4 SUBMITTALS

A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Maintenance Data: For products to include in the operation and maintenance manuals specified in Division 01.

C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

D. Submit a schedule of equipment to indicate motor controller ratings, sizes, and other electrical characteristics for each item of equipment.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 50 miles (80 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

C. Comply with NFPA 70.

D. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.

1. The Terms *Listed* and *Labeled*: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* as defined in OSHA Regulation 1910.7.

E. UL Compliance: NEMA ICS 2, *Industrial Control Devices, Controllers and Assemblies.*

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

1.8 COORDINATION

A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

C. The horsepower rating of all starters shall be checked against actual motor to be controlled, before installation and correct size overload elements shall be provided in all starters based on nameplate and manufacturer’s recommendation.

D. Provide all control devices and wiring, where not provided under Division 23, required for all equipment.

E. Motors and controllers shall be provided for voltage and current characteristics as indicated. In the event that equipment provided is of different electrical characteristics than the ones specified, any increase in electrical feeders, conduits, circuit breakers, etc., including increase of labor cost shall be the responsibility of the Contractor.

F. Provide branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with Liquid-Tight Flexible Metal Conduit (LFMC), Seal-tight "UA", or approved equal.

G. All conduits and wiring required for control work from the holding coil circuit of the starter, including the furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays, pilot lights, selector switches, alternators, etc., shall be provided and installed by other trades unless otherwise indicated.

H. Power Branch Circuits: Wire sizes for branch circuits not specifically called for on drawings or in Specifications shall be based on 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be used for motors in such calculations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers. No other manufacturers are acceptable.

1. Square D Company; Groupe Schneider. (Basis of Design).

2. Eaton Corporation; Westinghouse & Cutler-Hammer Products.

3. Siemens Energy and Automation, Inc.

4. General Electric.

B. All motor controllers shall be NEMA type controllers. IEC type controllers shall NOT be acceptable.

2.2 MANUAL MOTOR CONTROLLERS

A. Description: NEMA ICS 2, AC general-purpose Class A manually-operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit. Manual motor controllers shall be equipped with red pilot light, hand-off-automatic selector switch and toggle operator. Provide size and number of poles as required for a complete installation of the equipment being connected.

B. Thermal Overload Units:

1. Thermal overload units shall be melting alloy type, properly sized for the equipment being protected, and shall be interchangeable. Controller shall be inoperable if thermal overload unit is removed.

C. Enclosure: ANSI/NEMA ICS 6; Type 1 for interior use and Type 4X stainless steel or cast iron for damp or wet locations. Provide flush-mounted enclosures for units located in finished areas. Provide handle guard with locking provisions in the "off" position on all enclosures.

D. Furnish Square D, Class 2510 Type F motor controllers with 2510 FL1 handle guard, or approved equal.

2.3 ENCLOSURES

A. Description: All motor controllers shall be mounted in enclosures, flush or surface mounted as required. Provide flush-mounted enclosures for motor controls in finished locations.

B. Enclosures shall comply with requirements of NEMA 250 – “Enclosures for Electrical Equipment”, and NEMA ICS 6 – “Enclosures Standard”.

C. Enclosures shall be provided in accordance with the following requirements in order to meet environmental conditions at the installed location of each motor controller.

1. Dry, Interior Locations: NEMA Type 1.

PART 3 EXECUTION

3.1 APPLICATIONS

A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual motor controllers for single-phase motors, unless otherwise indicated.

D. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic motor controllers started and stopped by automatic controls or interlocked with other equipment.

E. Provide heaters and fuses correlated with full load nameplate current of motors provided. Set overload devices to suit motor provided.

3.2 INSTALLATION

A. Install motor controllers in locations as indicated, according to manufacturer's written instructions.

B. Install motor controllers level and plumb. Provide mounting brackets, wall bracing, and accessories as required.

C. Install motor controllers to have adequate working space in accordance with Article 110.26 of the National Electrical Code. Motor controllers shall not be installed beneath ductwork, piping, etc.

D. Install independently mounted motor-control devices according to manufacturer's written instructions.

E. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

F. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Division 26 Section “Hangers and Supports”.

3.3 IDENTIFICATION

A. Identify motor-control components and control wiring according to requirements specified in Division 26 Section “Electrical Identification”.

B. All motor controllers shall be provided with engraved nameplates which clearly identify the equipment served, circuit designation, and circuit voltage/phase.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Division 26 Section “Conductors and Cables”.

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

3.5 CONNECTIONS

A. Connect motor controllers and components to wiring system and to ground as indicated and instructed by manufacturer.

B. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections **[7.5][, 7.6,]** and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

B. Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

C. Visual and mechanical inspection: Include the following inspections and related work.

1. Motor-Control Device Ratings and Settings: Verify that ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective-device ratings and settings where differences are found. Use accepted revised ratings or settings to make the final system adjustments. Prepare and submit the load current and overload relay heater list.

2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current project drawings.

3. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instructions.

4. Check tightness of electrical connections of devices with calibrated torque wrench. Use Manufacturer's recommended torque values.

5. Clean devices using Manufacturer's approved methods and materials.

D. Electrical Tests: Perform the following in accordance with manufacturer's instructions:

1. Insulation resistance test of motor control devices conducting parts to the extent permitted by the manufacturer's instructions. Insulation resistance less than 100 megohms is not acceptable.

2. Use primary current injection to check performance characteristics of motor-circuit protectors and for overload relays of controllers for motors 15 horsepower and larger. Trip characteristics not within manufacturer's published time-current tolerances are not acceptable.

3. Make adjustments for final settings of adjustable-trip devices.

4. Check for improper voltages at terminals in controllers that have external control wiring when controller disconnect is opened. Any voltage over 30V is unacceptable.

E. Correct deficiencies and retest motor control devices. Verify by the system tests that specified requirements are met.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

END OF SECTION

DIVISION 26
SECTION 265100
INTERIOR LIGHTING
TABLE OF CONTENTS

SECTION 265100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.

B. Provide a lighting fixture for each fixture shown on the Drawings as described in this Specification, of the design and quality indicated herein. Provide fixtures complete, including lamps of the wattage and type indicated.

C. All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this contract shall be furnished by the Contractor.

D. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.

E. Specifications and scale Drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.

F. Minor details, not usually indicated on the Drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the Drawings.

G. Omissions: The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc., which may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this Specification rests with the Contractor.

1.3 SUBMITTALS

A. Product Data: Submit fixture shop drawings in booklet form with separate sheet for each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.

2. Certified results of independent laboratory test for fixtures and lamps for electrical ratings and photometric data. Test data shall include manufacturer and model number for fixture being submitted.

3. Emergency lighting unit battery and charger.

4. Fluorescent ballasts.

5. Types of lamps.

B. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.

C. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 01. Include technical data sheets and parts ordering information. Include testing and maintenance requirements and instructions for emergency lighting equipment.

1.4 QUALITY ASSURANCE

A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction. Provide only UL listed and labeled fixtures with UL listed wiring. Wiring shall be suitable for the fixture temperature listing.

B. Comply with NFPA 70.

C. UL Listing: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the Underwriters' Laboratories, Inc. (Standards for Safety), and others as they may be applicable. A UL listing shall be provided for each fixture type and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.

D. Installer: All Installers shall have not less than five (5) years' experience in the installation of lighting fixtures of the type and quality shown.

E. Materials, equipment and appurtenances, as well as workmanship provided under this Section, shall conform to the highest commercial standard as specified and as indicated on the drawings.

F. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 510 as applicable to installation, and construction of interior building lighting fixtures.

G. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publication Numbers LE1 and LE2 pertaining to lighting equipment and LE4 pertaining to recessed luminaires.

H. IES Compliance: Comply with IES RP-1 pertaining to office lighting practices and RP-15, regarding selection of illuminance values for interior office building.

I. UL Compliance: Comply with UL Standards, including UL 486A and B, pertaining to interior lighting fixtures. Provide interior lighting fixtures and components which are UL-listed and labeled and comply with the following UL Standards:

1. UL 1598 – Luminaires (Tri-national standard)

2. UL 935, UL 1029, UL 542 – Ballasts

3. UL 496 – Lampholders

4. UL 924 – Emergency Lighting and Power Equipment

J. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballasts Manufacturer's Association Standards and carries the CBM label.

K. NECA/IESNA Compliance: Comply with NECA/IESNA 500 – 1998 Standard, Installing Indoor Commercial Lighting Systems (ANSI).

1.5 COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction. Provide plaster frames, hangers, trim rings, and fittings, as required for each type of ceiling construction.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

C. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, the products indicated in this Specification.

B. Data listed and model number shown, in this Specification for each fixture type indicate minimum requirements and no exceptions will be made.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic for lenses and diffusers shall be formed of colorless 100% virgin acrylic as manufactured by Rhom & Haas, Dupont, or as acceptable. The quality of the raw material must equal or exceed IES, SPI and NEMA Specifications by at least 100%--which, as a minimum standard, shall not exceed a yellowness factor of 3 after 2,000 hours of exposure in the Fade-meter or as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 15 years.

2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

3. Glass used for lenses, refractors, and diffusers in incandescent lighting fixtures shall be tempered for high impact and heat resistance; the glass shall be crystal clear in quality with a transmittance of not less than 88%. For exterior fixtures, use tempered Borosilicate glass, Corning #7740, or as acceptable. For fixtures directly exposed to the elements and aimed above the horizontal with a radiant energy of 4.16 watts per square inch, or greater, use Vycor glass.

4. Where optical lenses are used, they shall be free from spherical and chromatic aberrations and other imperfections which may hinder the functional performance of the lenses.

5. Mechanical: All lenses, louvers, or other light diffusing elements shall be removable, but positively held so that hinging or other normal motion will not cause them to drop out.

6. Cleaning: All lenses shall be turned over to the Owner clean and free of dust.

2.3 LAMP HOLDERS

A. Fluorescent: Body - white urea plastic. Contacts: silver-plated phosphor bronze.

2.4 FINISHES

A. Painted Surfaces: Synthetic enamel, with acrylic, alkyd, epoxy, polyester, or polyurethane base, light stabilized, baked on at 350 degree Fahrenheit minimum, catalytically or photo-chemically polymerized after application.

B. Undercoat: Except for stainless steel, give ferrous metal surfaces a five-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.

C. Unpainted non-reflecting surfaces shall be satin finished and coated with a stoved clear lacquer to preserve the surface. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.

D. Unpainted Aluminum Surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg per square inch, of a color and surface finish as selected by the Architect. Finish exterior aluminum trims with an anodized coating of not less than 35 mg per square inch or a color and surface finish as selected by the Architect.

E. Porcelain Enamel Surfaces: Apply porcelain finishes smoothly. Finish shall be not less than 7.5 mils thick of non-yellowing, white, vitreous porcelain enamel with a reflectance of not less than 85%.

F. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.

2. Metallic Finish: Corrosion resistant.

G. White finishes: Minimum of 85 percent reflectance.

2.5 FLUORESCENT LAMP BALLASTS

A. Fluorescent Lamp Ballast Manufacturers: Provide quality ballasts by the Manufacturers listed below. Off-brand/generic ballasts shall NOT be acceptable.

1. Advance (Philips Lighting Electronics)

2. General Electric (GE) Lighting

3. Lutron.

4. Osram Sylvania.

5. Universal Lighting Technologies, Inc.

B. General Requirements: Unless otherwise indicated, features include the following:

1. Designed for type and quantity of lamps indicated at full light output.

2. Conform to UL 935 *Fluorescent - Lamp Ballasts*.

3. Total Harmonic Distortion Rating: Less than 10 percent.

4. Sound Rating: A.

5. Conform to ANSI C82.1 Specifications for Fluorescent Lamp Ballast.

6. Warranty: Minimum 2 years of warranty after the date of acceptance for all types of ballasts.

C. Electronic Ballasts for Linear Lamps: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:

1. Certified Ballast Manufacturer Certification: Indicated by label.

2. Lamp Starting Method: Programmed start.

3. Nominal Ballast Factor: 87 percent, minimum, unless otherwise indicated.

4. Power Factor: 90 percent, minimum.

5. Encapsulation: Without voids in potting compound.

6. Third Harmonic Content of Ballast Current: Less than 10 percent.

7. Conform to IEEE C62.41, Category A.

8. Conform to FCC Regulations, Part 15, Subpart J.

9. Lamp Current Crest Factor shall be less than 1.7.

10. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.

2.6 LAMPS

A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500K and 85 CRI, unless otherwise indicated.

B. Noncompact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.

C. Lamps shall conform to ANSI Standards C78 series and shall be as manufactured by General Electric, Philips, or Sylvania.

2.7 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Common Work Results for Electrical" and Division 26 Section "Hangers and Supports", for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

G. Recessed fixtures shall be removable from below to allow access to outlet/junction boxes in ceiling spaces.

H. Each fixture shall be supplied with necessary straps, supports, or hangers, or other miscellaneous materials and devices to install them in a satisfactory manner to conform to architectural treatment and finishes in area in which they are to be installed. Consult all Mechanical, Architectural and Structural Plans and related Contract Documents to be familiar with all necessary details for proper fixture placement. Failure to do so will not relieve the Contractor of responsibility of furnishing all necessary material, complete to perform function intended for indicated lighting system.

2.8 FIXTURES

A. Refer to "Interior Lighting Fixture Schedule" on the Contract Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

B. Support for Fixtures independent of ceiling systems, ducts, and piping.

1. Install a minimum of four support system rods or wires for each fixture from structure above. Locate not more than 6 inches (150 mm) from fixture corners.

2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.

3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

C. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.

D. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.

E. Each lighting fixture shall be rigidly supported from the building construction and shall include suspension hangers, devices, and extra steel work for fixture support where required.

1. Support all lighting fixtures adequately. Special supports shall be installed as required.

2. Luminaires shall be furnished with all necessary stems, plaster frames, hangers, for the safe support of the fixture. All supports for fixtures shall be adequate to support weight of the fixtures. All visible hanging devices and appurtenances shall have the same finish as the fixture unless specifically indicated otherwise.

F. Coordinate with the work of other trades to determine modifications required to make fixtures suitable for ceilings as installed and verify the types of ceiling construction prior to fixture fabrication. Determine that the suspension method and the flange arrangement for the fixtures coordinates with the ceiling type and its suspended system. Fixtures which are shipped to the project and do not fit, or which otherwise do not match the ceiling system, shall be returned for correction at no additional cost.

G. Lamping: Lamp units according to manufacturer's instructions.

H. Installation shall include receiving, checking, storage in a safe and approved area until they are required for installation, unpacking, assembly of separate fixture components where required, and complete wiring and connection including the provision of associated wiring and connection devices such as fittings, hangers, aligners, box covers, and similar hardware which may be required for certain fixtures, but are not detailed or scheduled with the fixtures.

I. All lighting fixtures, when installed, shall be set free of light leaks, warps, dents, or other irregularities.

J. Install all lamps required, including replacements for burned out lamps, until final acceptance of the completed work. No lighting fixture or sign will be installed without lamps.

K. If permanent lighting fixtures are to be used in lieu of temporary lighting facilities during the construction period, this shall be done only as permitted by the Owner's Representative, who may require that new lamps be installed and fixtures cleaned at the time of turnover to the Owner.

L. Lighting fixtures for general illumination, emergency lighting, and exterior lighting, shall be complete with all required accessories and attachments.

M. Fixtures shall bear UL label and shall be wired and installed in full compliance with applicable codes.

N. The omission of a type or quantity in this Specification or the Interior Lighting Fixture Schedule on the Contract Drawings shall not relieve the Contractor of the responsibility of installing all required fixtures, of proper type, as shown on the Drawings.

O. Fixtures shall be recessed, surface, or pendant type, as specified and shall include sockets, diffusers, ceiling canopies and stems, hickeys, and all other necessary accessories.

P. Where suspended ceilings with steel channels occur, outlets and fixtures shall be supported on members resting on the channel framework. In no case shall fixtures be supported from plasterboard, plaster, or acoustic material.

3.2 GENERAL INSTALLATION OF FIXTURES

A. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's *Standard of Installation*, NEMA Standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

B. All recessed fixtures mounted in dry wall or plaster ceilings shall be complete with a suitable plaster frame or trim ring. All fixtures shall be mounted on or in ceilings in accordance with published recommendations of the manufacturers using bar or swing-way hangers, etc. These items shall be furnished as part of the fixture whether called for by catalog number or not.

C. All fixtures shall be installed in strict accordance with NEC Article 410 and shall properly and suitably support the weight of any fixture installed. All fixtures shall be supported independently of ceiling suspension system being attached to building structure.

D. Every lighting fixture shall be of the type for the ceiling construction in or on which it is to be installed. It shall be the Electrical Contractor's responsibility to coordinate this with the Ceiling Contractor.

E. All fluorescent lighting fixtures having exposed (bare) lamps shall be provided with safety sleeves (one per each lamp). Sleeves shall be "Arm-a-lite", as manufactured by Thermoplastic Process, Inc., or approved equal. Fixtures with wire guards and/or shielding (louvers, baffles, lenses) beneath the lamps shall not be considered as exposed.

F. Install surface-mounted fixtures properly to eliminate light leakage between fixture frame and finished surface. Apply small bead of caulk or silicone around perimeter of fixture to conceal gaps between fixture and finished surface.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.3 CONNECTIONS

A. Ground equipment. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: As follows:

1. Verify normal operation of each fixture after installation.

2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.

3. Report results in writing.

E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

F. Corroded Fixtures: Replace during warranty period.

3.5 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

C. Touch up luminaire finish at completion of work.

D. Replace all lamps that fail within three (3) months of Substantial Completion.

E. Replacement Lamps: At the time of Substantial Completion, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed or burned out after Contractor's use and testing. Furnish stock or replacement lamps as specified in this Section, Paragraph "Extra Materials". Deliver replacement stock as directed. Refer to Division 01 Sections for the replacement/restoration of lamps in interior lighting fixtures, and where used, the temporary lighting prior to time of Substantial Completion.

3.6 DEMONSTRATION

A. Provide a minimum of four (4) hours of training and demonstration of luminaire operations, setting, aiming, adjustment, and maintenance.

END OF SECTION

GIPE ASSOCIATES, INC.
8719 Brooks Drive
Easton, MD 21601
ELECTRICAL SPECIFICATIONS

INDEX OF SECTIONS

DIVISION 26 – ELECTRICAL