INVITATION TO BID
from
COMMUNITY COLLEGE OF ALLEGHENY COUNTY
PURCHASING DEPARTMENT
800 ALLEGHENY AVENUE, PITTSBURGH, PENNSYLVANIA 15233

BID PROPOSAL NO. 1135
ADDITIONAL POWER AND COMPRESSED AIR (ELECTRICAL AND PLUMBING) FOR CEIT BUILDING – ALLEGHENY CAMPUS

Sealed proposals will be received and publicly opened by a Purchasing Agent of the Community College of Allegheny County.
Proposals must be received by the Purchasing Department, 800 Allegheny Avenue, Pittsburgh, Pennsylvania 15233 on or before 2:00 PM, on Friday, January 3, 2025.

Proposals received after this deadline will be considered as a "late bid" and returned unopened to the offerer.

BID SCOPE

Provide all labor, material, equipment, permits and supervision required to furnish and install additional power and compressed air (electrical and plumbing) for CEIT Building in accordance with specification, terms and conditions contained herein.

A MANDATORY pre-bid will be held on Tuesday, December 17, 2024, at 9:00 a.m. Meet at the entrance to the CEIT Building, Allegheny Campus, 808 Ridge Ave., Pittsburgh, PA 15212.

For technical questions contact Marty Palma at mpalma@ccac.edu.
For procedural questions, contact Mike Cvetic, Director of Purchasing, at mcvetic@ccac.edu.

BID REQUIREMENTS (where checked)

__X__ Bid Bond. . . . . 10% of total base bid amount (Submit with Bid)

__X__ Performance Bond. . . . . 100% of total contract amount (Awardee Only)

__X__ Payment Bond. . . . . 100% of total contract amount (Awardee Only)

__X__ Master Services Agreement (Awardee Only)

__X__ No Lien Agreement (Awardee Only)

__X__ Insurance Certificate (Awardee Only)

BID BOND: Bid must include the required bid bond or certified check, which will be returned to the unsuccessful bidder approximately 45 days after the bid due date.

PERFORMANCE BOND: The successful bidder will be required to enter into a written contract with the College and to furnish a contractor's bond conditioned for the faithful and full performance of the contract with sufficient surety in the amount stated above. Any surety cosigning the contractor's bond shall be an Incorporated surety company approved by the Court of Common Pleas of Allegheny County. Bond with surety must be furnished within 20 days after receipt of the contract. The Board of Trustees reserves the right to reject any bond furnished where it is in the best interest of the College to do so.
The College requires Power of Attorney attached to bonds to be dated concurrently, sealed, and executed by a proper **live** (not facsimile) **signature**.

PAYMENT BOND: The bidder to whom the contract is awarded shall furnish a bond to guarantee the payment of third-party subcontractors involved in fullment of services rendered against College contracts. Such bonds shall be with sufficient surety and in the amount stated above. Failure on the part of the contractor to furnish such bond shall be just cause for cancellation of award.

NO LIEN AGREEMENT AND/OR INSURANCE CERTIFICATES: As required by the College, the No Lien Agreement and/or Insurance Certificate may be requested of the successful bidder.

THE BOARD OF TRUSTEES RESERVES THE RIGHT TO REJECT ANY OR ALL BIDS.

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

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FOR

BID PROPOSAL NO. 1135

ADDITIONAL POWER AND COMPRESSED AIR (ELECTRICAL AND PLUMBING) FOR CEIT BUILDING – ALLEGHENY CAMPUS

The CCAC Purchasing Department is now publishing all bids via the CCAC website at https://ccac.edu/about/procurement.php. It will be each vendor's responsibility to monitor the bid activity within the given website ("Bid and RFP Opportunities") and ensure compliance with all applicable bid documents inclusive of any issued addenda. Failure to incorporate any applicable addenda in the final submittal may result in the rejection of your bid.

NOTE: FAX OR ELECTRONIC RESPONSES TO BID PROPOSALS ARE NOT ACCEPTABLE.

In the event a sealed bid is hand carried, it is the sole responsibility of the bidder to assure the bid is in possession of the CCAC Purchasing Department prior to the time set for opening.

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

INSTRUCTIONS TO BIDDERS

1. All prices quoted shall be F.O.B. destination and include all freight and delivery charges to actual point of delivery.

2. **Bids that vary from specifications/addendum(s) may be rejected by the College.** Any and all changes to specifications will be issued by addenda via fax/mail. It is the responsibility of bidders to provide the College with company name, address, telephone, and fax numbers and contact names if applicable.

3. Bidders must be recognized dealers in specified materials and qualified to advise in the application and/or use of the materials. When requested, the bidder must satisfy the Community College of Allegheny County that they have the organization, capital, and stock availability and experience to fulfill their bid offer.

4. Bids may be rejected or award cancelled by the College if a bidder intends to sublet any/all of the required work.

5. Completely executed bid documents must be submitted in a **sealed envelope bearing the offering company's name and address; and, the bid number must appear on the sealed envelope.** No College representative will bear any responsibility for the premature opening of a bid which is not properly addressed and identified.

6. Whenever the words "Purchasing Agent" or a pronoun referring to a College Agent appears in either the specifications and/or Articles of Agreement, the Agent is acting only under the authority of and subject to the approval of the Board of Trustees of the Community College of Allegheny County.

7. The College reserves the right to award all or any items, separately or in a lump sum whichever is in the best interest of the College.

8. Bids for supplies shall be submitted to the College in accordance with the numbered item(s) on the price sheet. Unit prices(s) shall prevail where extension of prices is requested.

9. Contracts will not be awarded by the College to any corporation, firm, or individual that has failed in any former contract with the College to perform work or complete work or, in the College's sole judgment, to satisfactorily deliver or provide the quality of materials, fulfill a guarantee(s) or complete work in accordance with the schedule for such prior contract."

10. If the College Agent is of the opinion that the awarded work/products are unnecessarily delayed, the rate of progress of delivery is unsatisfactory, or that the corporation, firm, or individual contractor is willfully violating any of the contract requirements or conditions or is acting in bad faith, the College's Agent shall take whatever action necessary for the completion of the work and/or delivery of the products to the College. Resulting expenses to the College will be deducted from monies due the contractor and the bondsman will be held liable for any balance due at the completion of the contract.

11. Inspection of materials and workmanship of the contractor by a College Agent will not lessen the responsibility of the contractor from the obligation to perform and deliver satisfactory work/materials to the College. The contractor is expected to pay for the cost of tests for defective materials. This cost may be deducted from any monies due the contractor from the College.

12. The contractor will not receive instructions from a College Agent relative to the work or delivery until a contract has been duly signed and the bond, if required, is approved.

13. Companies may quote price(s) on work/material to any and all bidders and may also directly submit a bid to the College for the work/material.

14. When samples are requested by the College, the bidder must supply them free of charge. Samples will not be returned to the bidder.

15. The bidder is solely at risk when using unauthorized patented material.

16. Quantities requested by the College are for bidding purposes only. The College may purchase more or less than the estimated quantities.

17. The College reserves the right to reject any and all bids, and to waive minor discrepancies in the bids or specifications, when in the best interest of the College. The College may purchase any part, all, or none of the materials specified.

18. The College will reject materials that do not meet specifications, even if the bidder lists trade names, or names of such materials on the bid.

19. All prices quoted must be held firm for the contract period. Bids containing escalation or other clauses for price change may be rejected. Discounts or other uncalled for allowances quoted will not be considered in making the award and the bid may be rejected.

20. Unless otherwise specified, materials, supplies, and/or equipment must be delivered thirty (30) days from the date of the purchase order.

21. Unless otherwise specified, materials, supplies, and/or equipment must be new, current stock, and unused.

SIGNING OF AGREEMENT AND BOND

22. Successful bidders are required to sign Contract Articles of Agreement and bond forms as follows:

    If trading as an Individual: All copies of Contract Articles of Agreement and bond(s) must be signed by the individual to whom the award is made and signature must be witnessed by the same witness.

    If trading as a Partnership: All copies of Contract Articles of Agreement and bond(s) must be signed by **every partner** comprising the Partnership, regardless of number, and these signatures must be witnessed by the same witness.

    If trading as a Corporation: All copies of Contract Articles of Agreement and bond(s) must be signed by the **President (or Vice President)** and attested by the Secretary or Assistant Secretary and Corporate seal must appear on all copies.

    The County requires that Power of Attorney forms be attached to bonds, bear the same date as that appearing on the bonds and that the forms are sealed and executed by a proper **live signature**.

FICTITIOUS NAME REGISTRATION

23. To comply with a provision of the law regarding registration under the Fictitious Name Act of the Commonwealth of Pennsylvania, successful bidders trading as an **Individual or a Partnership** must submit a certified copy of their Fictitious Name Registration with their contract. Fictitious Name Registration forms are issued by the Office of the Prothonotary of Allegheny County, or the county in which the business is located.

PREVENTION OF DELAY

24. A contractor will be considered in **default** if the contractor has work performed or means employed in the carrying out of the contract that would in any way cause or result in a suspension or delay of, or strike upon the work to be performed of any of the trades working in or about the premises described, or in or about any other building of the Community College of Allegheny County.

25. When trade names or catalog numbers are used, bidders may quote on any equal (unless otherwise stated by the College) but such bids must show trade names and/or catalog numbers of the products.

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

RETURN BID PROPOSAL FORM
FOR

BID PROPOSAL NO. 1135
ADDITIONAL POWER AND COMPRESSED AIR (ELECTRICAL AND PLUMBING) FOR CEIT BUILDING – ALLEGHENY CAMPUS

Complete this form and submit with your bid.

- **The undersigned agrees to comply with the Instructions to Bidders and Specifications for the price(s) quoted on the Return Price Form. Price(s) quoted include all allowable cash and/or credit discounts.**
- **The College may reject bids quoting unspecified discounts and/or allowances.**

Submitted by:

_____

Company Name Bidding (Please print)

Contact Person at Company (Please print)

_____ _____

Signature

Title

(Handwritten signature must appear here in ink.)

Address_____

_____ _____

Telephone Number (Include Area Code.)

Fax Number (Include Area Code.)

Trading as: (Check one.) **Please print.**

_____ Individual Owner _____

_____ Partnership Partner _____ Partner_____

_____Corporation Exact Name_____

State Incorporated_____

THE BOARD OF TRUSTEES OF THE COLLEGE RESERVES THE RIGHT TO REJECT ANY OR ALL BIDS.

Rev: 1/01

BID PROPOSAL NO. 1135
ADDITIONAL POWER AND COMPRESSED AIR (ELECTRICAL AND PLUMBING) FOR CEIT BUILDING – ALLEGHENY CAMPUS

BID SHEET

BASE BID E-1 - Electrical

Provide all labor, material equipment, permits, and supervision required for all electrical construction for additional power at the CEIT Building as specified herein.

E-1 Lump Sum Bid: $_____

BASE BID P-1 – Plumbing

Provide all labor, material equipment, permits, and supervision required for all plumbing construction for additional compressed air at the CEIT Building as specified herein.

P-1 Lump Sum Bid: $_____

BIDDER'S NAME (please print):_____

RETURN FORM 2.0

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

NON-COLLUSION AFFIDAVIT

Contract/Bid No. **1135**

State of _____ : :s.s.

County of _____ :

I state that I am _____of_____

(title) (name of my firm)

and that I am authorized to make this affidavit on behalf of my firm, and its owners, directors, and officers. I am the person responsible in my firm for the price(s) and the amount of this bid.

I state that:

(1) The price(s) and amount of this bid have been arrived at independently and without consultation, communication or agreement with any bidder or potential bidder.

(2) Neither the price(s) nor the amount of this bid, and neither the approximate price(s) nor approximate amount of this bid, have been disclosed to any other firm or person who is a bidder or potential bidder, and they will not be disclosed before bid opening.

(3) No attempt has been made or will be made to induce any firm or person to refrain from bidding on this contract, or to submit a bid higher than this bid, or to submit any intentionally high or noncompetitive bid or other form of complementary bid.

(4) The bid of my firm is made in good faith and not pursuant to any agreement or discussion with, or inducement from, any firm or person to submit a complementary or other noncompetitive bid.

(5) _____, its affiliates,

(name of my firm)

subsidiaries, officers, directors and employees are not currently under investigation by any governmental agency and have not in the last four years been convicted or found liable for any act prohibited by State or Federal law in any jurisdiction, involving conspiracy or collusion with respect to bidding on any public contract, except as follows:

I state that_____ understands and

(name of my firm)

acknowledges that the above representations are material and important, and will be relied on by the Community College of Allegheny County in awarding the contract(s) for which this bid is submitted. I understand and my firm understands that any misstatement in this affidavit is and shall be treated as fraudulent concealment from the Community College of Allegheny County of the true facts relating to the submission of bids for this contract.

Signature_____ Title_____

(MUST BE SIGNED HERE IN HANDWRITING, IN INK.)

Sworn to and subscribed before me this _____ day of _____, 20_____

Notary Public_____ My Commission Expires: _____

RRTURN FORM 3.0

INSTRUCTIONS FOR NON-COLLUSION AFFIDAVIT

1. This Non-collusion Affidavit is material to any contract awarded pursuant to this bid. According to the Pennsylvania Antibid-Rigging Act, 73 P.S. § 1611 et seq., governmental agencies may require Non-collusion Affidavits to be submitted together with bids.

2. This Non-collusion Affidavit must be executed by the member, officer or employee of the bidder who makes the final decision on prices and the amount quoted in the bid.

3. Bid rigging and other efforts to restrain competition and the making of false sworn statements in connection with the submission of bids are unlawful and may be subject to criminal prosecution. The person who signs the Affidavit should examine it carefully before signing and assure himself or herself that each statement is true and accurate, making diligent inquiry, as necessary, of all other persons employed by or associated with the bidder with responsibilities for the preparation, approval or submission of the bid.

4. In the case of a bid submitted by a joint venture, each party to the venture must be identified in the bid documents, and an Affidavit must be submitted separately on behalf of each party.

5. The term “complementary bid” as used in the Affidavit has the meaning commonly associated with that term in the bidding process, and includes the knowing submission of bids higher than the bid of another firm, any intentionally high or noncompetitive bid, and any other form of bid submitted for the purpose of giving a false appearance of competition.

6. Failure to file an Affidavit in compliance with these instructions will result in disqualification of the bid.

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

MBE/WBE PARTICIPATION: CCAC encourages the participation of minority and women-owned businesses in all of its contracts and is committed to providing maximum opportunities for qualified minority and/or women-owned business enterprises ("MBE/WBEs") to participate in its work. Bidder agrees (1) if qualified, to take reasonable and timely steps to obtain appropriate certification as an MBE and/or WBE, (2) to ensure that MBE and/or WBEs are appropriately considered as subcontractors and/or suppliers under this Agreement; and (3) to report moneys spent for MBE and/or WBE subcontractors and/or suppliers for work as CCAC may from time to time reasonably request. **CCAC's goal for MBE/WBE participation is 20% (13% MBE and 7% WBE/DBE).** Please provide documentation as to your firm's good faith effort to reach this goal by describing all applicable details of MBE/WBE participation that may be included in the resulting agreement.

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

MINORITY PARTICIPATION GOALS – BID PROPOSAL NO. 1135

The following must be included with your bid.

Reference: General Conditions for Construction and Renovation Contracts - Item 6, Page 2 – Minority & Disadvantaged Participation Goals

A 20**%** M/W/DBE work participation is established (13% MBE and 7% WBE/DBE). Document your firm's good faith effort to obtain the 20**%** Goal:

M/W/DBE Company	Contact Person	Phone Number	$Amount or Objective %
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

_____ I am an M/W/DBE. (ATTACH CERTIFICATION)

Total: _____

Bidder acknowledges that CCAC may communicate with listed firms to verify the extent of the contact.

Bidding Company's Name:_____

Signature:_____ Title:_____

Date:_____

Revised: 9/14/21

RETURN FORM 4.0

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

BID PROPOSAL NO. 1135

COMMONWEALTH OF PENNSYLVANIA
BID AWARD & RETENTION LAW
ACT NO. 1978-317, SENATE BILL 68, NOVEMBER 26, 1978

EXTENSION OF CONTRACT EXECUTION REQUIREMENTS

In the event the contract(s)/purchase order(s) resulting from the above specified bid proposal is/are in excess of $50,000.00, the above specified Act will apply.

This Act requires the awarding of a contract to the lowest responsible bidder within sixty (60) days of the date of bid opening and the execution of a contract within thirty (30) days after award by the College Board of Trustees. Thirty (30) day extensions of the date for award and for execution are permitted by the mutual written consent of the College and the successful bidder.

Due to the extent of the approval actions required prior to award and execution of any contract, it may not be possible for the College to complete contract award and execution within the sixty (60) day and thirty (30) day periods. Accordingly, each bidder is requested to indicate their agreement with a thirty (30) day extension of the sixty (60) day award date and thirty (30) day execution date by signing this form and returning it with their bid.

_____

Name of Company

_____

Authorized Company Representative

_____ _____

Signature Title

MUST BE SIGNED HERE IN HANDWRITING, IN INK

RETURN FORM 5.0

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

GENERAL CONDITIONS

FOR

CONSTRUCTION AND RENOVATION CONTRACTS

1. PERMITS

It is the responsibility of the contractor to obtain all permits and/or licenses required by Federal, State, County, City, or other local Municipalities or Authorities for work done or services performed under this contract.

2. ROLE OF CONTRACTOR

In the performance of the work hereunder, the contractor shall act as an independent contractor, and all of his agents, employees, and subcontractors shall be subject solely to the control, supervision, and authority of the contractor.

3. EMPLOYEES OF THE CONTRACTOR

It is understood that the contractor in signing the contract will employ only competent and first-class workmen and mechanics; that no workmen shall be regarded as competent and first-class except those who are duly skilled in their respective branches of labor.

4. BONDS

The College will accept only bonds written by surety companies authorized to do business in the Commonwealth of Pennsylvania and the County of Allegheny and included on the United States Treasury Department Annual List of Surety Companies published July first of each year. Limits for those companies appearing on the United States Treasury Department's list cannot be exceeded. This list is available for inspection in the Purchasing Department, Community College of Allegheny County, Administration Building, 800 Allegheny Avenue, Pittsburgh, Pennsylvania 15233. It is also available from the Surety Bond Branch, Financial Management Services, Department of the Treasury, Washington, D.C. 20226. Phone: 1.202.634.2214.

5. EQUAL OPPORTUNITY

Contractor and all subcontractors shall not discriminate against any employee or applicant for employment because of race, color, creed, national origin, or sex. Contractor and all subcontractors shall also comply with all applicable Federal, State, and local Fair Employment Practice Acts, or similar Acts, Rules, and Regulations and whether or not applicable will comply with the Federal Civil Rights Act of 1964. The Terms and Provisions of Executive Order 11246 and any Executive Order modifying or superseding same, are incorporated herein with respect to any work subject thereto.

The contractor and all subcontractors shall, in all solicitations or advertisements for employees placed by them or their behalf state all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, or national origin.

6. MINORITY & DISADVANTAGED PARTICIPATION GOALS

The College's goal is to obtain 20**%** MBE/WBE/DBE (13% Minority-owned Business enterprise/7% Woman-owned Business Enterprise/Disadvantaged Business Enterprise) participation in the work. This is to be based on the dollar value of employment, subcontracts, supplies, goods, and services as a percentage of the total contract amount. The bidder/contractor must demonstrate to the College prior to award of the contract, and periodically thereafter throughout the term of the contract, their compliance and continued ability to comply with these goals.

The contractor shall submit with their bid (on Return Form 4.0) a completed Minority & Disadvantaged Contractor Commitment Plan that will contain the details of how they plan to comply with this goal should they be awarded the contract.

If the plan is not submitted in the bid or is not acceptable, the College may deem the bid non-responsive and may award the work to the next lowest responsive bidder with an acceptable plan. Thus, it behooves all bidders to formulate their M/W/DBE plan before submitting a bid.

Finding Certified M/W/DBE's - All subcontractors and suppliers of goods and services used to comply with this goal must be **certified** minority or disadvantaged firms. They may be certified by any recognized and reputable organization such as the following: African American Chamber of Commerce, Allegheny County, Port Authority of Allegheny County, City of Pittsburgh, Pittsburgh Regional Minority Purchasing Council, Commonwealth of Pennsylvania, United States Federal Government.

If the firm is not certified and desires to be certified, it is suggested that they contact one of the following organizations. These organizations may also be used as references for sourcing M/W/DBE firms.

Allegheny County
M/W/DBE Department
County Office Building Rm 204
542 Forbes Avenue
Pittsburgh, Pennsylvania 15219
412.350.4309

EMSDC
Regional Enterprise Tower
425 Sixth Avenue
Suite 401
Pittsburgh, Pennsylvania 15219
412.391.4423

Diversity Business Resource Center
700 River Avenue Suite 231
Pittsburgh, PA 15212
412.322.3272

African American Chamber of Commerce
Koppers Building
436 Seventh Avenue, Suite 2220
Pittsburgh, PA 15219
412.391.0610

A list of PA certified M/W/DBE firms can be found on the Internet at **http://www.paucp.com**.

The College expects all firms to demonstrate a good faith effort to include M/W/DBE's when bidding on College contracts. A good faith effort as defined by the Code of Federal Regulations (49CFR26) means "*efforts to achieve a DBE goal or other requirement of this part which, by their scope, intensity, and appropriateness to the objective, can reasonably be expected to fulfill the program requirement".*

If you are not successful in securing M/W/DBE participation after a good faith effort is made, provide the following in your waiver request:

- A detailed account of your efforts;
- Your normal business practice and/or inventory profile; and
- An active diversity plan/policy

Reporting During and After Project Completion - The contractor shall submit with their monthly application for payment a written M/W/DBE Contractor Report demonstrating their compliance with the goal. The report shall state the dollar amount spent on labor, materials, services, and subcontracts and shall list firm names and vendor names. At the completion of the project, with final application for payment, the contractor shall submit a recap of their compliance which shall state the dollar amount spent on labor, materials, subcontracts, and services as a percentage of the total contract amount. Projects with shorter timeframes shall require a one-time only report at the completion of the project. Reports are to be accompanied by back-up documentation evidencing the business relationship with the M/W/DBE for the particular project (e.g.: copies of invoices, purchase orders, or evidence of payments).

Failure to Comply With M/W/DBE Goals – If the contractor fails to make a good faith effort (as determined by the College) to comply with the College's 20% M/W/DBE goal or fails to meet their M/W/DBE commitment or to submit documentation as required by the College, the College may consider such non-compliance or breach of contract and any one or more of the following may occur:

- Rejection of the bid
- Forfeiture of bid guaranty
- Termination of the contract
- The imposing of sanctions as deemed appropriate by the College
- Contractor being barred from bidding on College contracts for up to three (3) years
- Or such other remedy as the College deems appropriate

7. FINANCIAL INTEREST

All bidders for construction must be established firms competent to perform the required scope of work. All bidders must satisfy the Community College of Allegheny County that they have the requisite organization, capital, plant, stock, ability, and experience to satisfactorily execute and contract in accordance with the provisions of the contract in which they are interested.
If the contractor's base bid is $25,000.00 or more, the American Institute of Architects form, "Contractors Qualification Statement" form A305 - 1986 (or latest revision) may be requested by CCAC. This form is available from the American Institute of Architects, 1735 New York Avenue N.W., Washington, D.C. 20006. If requested by CCAC, a completed form A305 is to be submitted within 48 business hours and may be faxed to 412.237.3195.

8. EMPLOYMENT OF INDEPENDENT SUBCONTRACTORS

If you are a contractor to the College and the value of the base contract is $25,000.00 or more, you must secure approval of all proposed subcontractors from the College prior to beginning work. Information on your proposed subcontractors is to be submitted on the form entitled Proposed Subcontractors.

Each proposed subcontractor to be employed must be an independent contractor "in fact" and must meet the following criteria:

a. The subcontractor must have a Federal identification number.

b. The subcontractor must perform these same services for others.

c. The subcontractor must have an established place of business.

d. The subcontractor must use their own tools and equipment.

e. The subcontractor must pay all taxes and other items required by law to be paid by an employer with respect to compensation paid to their employees.

f. The subcontractor must provide and maintain all insurance required by law and the College.

If the proposed subcontractor does not meet all of these criteria, they will not be approved.

9. VERBAL AUTHORIZATIONS

No verbal agreement or understanding with any officer, agent, or employee of the College either before or after the execution of the contract shall alter, amend, modify, or rescind any of the terms or provisions contained in any of the contract documents. This provision shall not limit or affect the right to make changes or variations in the work. Any changes must be authorized in writing.

10. APPLICABLE LAW, ACTS, AND ORDINANCES

The contractor(s) shall agree to abide by and be bound by all applicable provisions and regulations of all laws, acts, and ordinances relating to and regulating the hours and conditions of employment.

11. PENNSYLVANIA PREVAILING WAGE ACT

The Pennsylvania Prevailing Wage Act shall be incorporated into and made part of all College construction related contract(s) having an estimated value of $25,000.00 or more.

It is the responsibility of the contractor to ensure that they have included the appropriate Pennsylvania prevailing wage rates in their proposal to the College. Failure to do this will not be a reason for the contractor to withdraw their bid or fail to perform the contract or to request additional payments from the College.

In accordance with the Prevailing Wage Determination Act, the contractor(s) shall:

a. Pay no less than the wage rates including contributions for employee benefits as determined in the decision of the Secretary of Labor and Industry and shall comply with the conditions of the Pennsylvania Prevailing Wage Act approved August 15, 1961 (Act No. 442) as amended August 9, 1963 and/or subsequent amendments thereof (Act No. 342) and the regulations issued pursuant thereto.

b. Apply all applicable provisions of the Acts and Laws to all work performed on the contract by the contractor(s) and subcontractor(s).

c. Insert in each of his subcontracts all of the stipulations contained in these required provisions and such other stipulations as may be required.

d. Assure that no workmen be employed on the public work except in accordance with the classifications set forth in the decisions of the Secretary. In the event that additional or different classifications are necessary, the procedure set forth in Section 7 of the above referenced Regulations shall be followed.

e. Assure that all workmen employed or working on this contract shall be paid unconditionally regardless of whether any contractual relationship exists or the nature of any contractual relationship which may be alleged to exist between any contractor, subcontractor, and workmen not less than once a week without deduction or debate on any account either directly or indirectly except authorized deductions, the full amounts due at the time of payment computed at the rates applicable to the time worked on the appropriate classification. Nothing in this contract, the Act or these Regulations, prohibits the payment of more than the general prevailing minimum wage rates as determined by the Secretary to any workmen on public work.

f. Each subcontractor shall post for the entire period of construction the wage determination decisions of the Secretary including the effective date of any charges thereof in a prominent and easily accessible place or places at the site of the work and at such place or places used by them to pay workmen their wages. The posted notice of wage rates must contain the following information:

    1. Name of project.

    2. Name of public body for which it is being constructed.

3. The crafts and classifications of workmen listed in the Secretary's general prevailing minimum wage rate determination for the particular project.
4. The general prevailing minimum wage rates determined for each craft and classification and the effective date of any changes.

5. A statement advising workmen that if they have been paid less than the general prevailing minimum wage rate for their job classification or that the contractor and/or subcontractor are not complying with the Act or these Regulations in any manner whatsoever they may file a protest with the Secretary of Labor and Industry. Any Workmen paid less than the rate specified in the contract shall have a civil right of action for the difference between the wage paid and the wages stipulated in the contract, which right of action must be exercised within six months from the occurrence of the event creating such right.

g. All subcontractors shall keep an accurate record showing the name, craft, and/or classification, number of hours worked per day, and the actual hourly rate of wage paid (including employee benefits) to each workman employed by him in connection with the public work and such record must include any deductions from each workman. The record shall be preserved for two years from the date of payment and shall be open at all reasonable hours to the inspection of the public body awarding the contract and to the Secretary or his duly authorized representative.

h. Assure that apprentices shall be limited to such numbers as shall be in accordance with a bonafide apprenticeship program registered with and approved by the Pennsylvania Apprenticeship and Training Council and only apprentices whose training and employment are in full compliance with the provisions of the Apprenticeship and Training Act approved July 14, 1961 (Act No. 304) and the Rules and Regulations issued pursuant thereto shall be employed on the public work project. Any workman using the tools of a craft who does not qualify as an apprentice within the provisions of this subsection shall be paid at the rate predetermined for journeymen in that particular craft and/or classification.

i. Pay wages without any deductions except authorized deductions. Employers not parties to a contract requiring contributions for employee benefits which the Secretary has determined to be included in the general prevailing minimum wage rate shall pay the monetary equivalent thereof directly to the workmen.

j. Be advised that payment of compensation to workmen for work performed on public work on a lump sum basis, or a piece work system, or a price certain for the completion of a certain amount of work, or the production of a certain result shall be deemed a violation of the Act and these Regulations regardless of the average hourly earnings resulting therefrom.

k. Each subcontractor shall file a statement each week and a final statement at the conclusion of the work on the contract with the contracting agency under oath and in form satisfactory to the Secretary certifying that all workmen have been paid wages in strict conformity with the provisions of the contract as prescribed by Section 3 of these Regulations; or, if any wages remain unpaid, to set forth the amount of wages due and owing to each workman respectively. The College shall require the contractor and all subcontractors to file weekly wage certifications utilizing form WH-347. (Reference: Section 10(a) of Act and Section 10 of Regulations). Prior to making final payment the College will require final wage certifications from all contractors and subcontractors.

12. PAYMENT TO CONTRACTORS

The College maintains the right to withhold a percentage of monies requested by contractors for work done under this contract in accordance with the American Institute of Architects Application for Payment form G-702 as indicated in Section 01152--Applications for Payment of the technical specifications.

13. INSURANCE REQUIREMENT

A properly executed certificate of insurance must be submitted with the signed Contract Articles of Agreement. The certificate of insurance must show that the contractor and subcontractors comply with the College's insurance requirements. The certificate of insurance must state that in the event any coverage shown is to be cancelled the College will be given a thirty day advance notice of the cancellation.

14. MINORITY BIDDERS

The Community College of Allegheny County hereby notifies all bidders that it will affirmatively ensure that minority business enterprises will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

15. MODIFICATION AND WITHDRAWAL OF BIDS

a. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

b. Bidders may withdraw their bid within two (2) business days of the bid opening only within accordance of Commonwealth of Pennsylvania public bidding law.

16. TAXES

CCAC is a governmental entity and is generally exempt from sales and use tax with respect to purchases of building machinery and equipment. A tax exemption certificate will be provided upon request. It is the bidder's responsibility to pay any/all applicable taxes on non-exempt equipment, supplies and services in accordance with applicable law.

17. PENNSYLVANIA STEEL PRODUCTS PROCUREMENT ACT

Contractor acknowledges that CCAC is a public agency subject to the requirements of the Pennsylvania Steel Products Procurement Act, 73 P.S. Section 1881 et. seq (the "SPPA"). Contractor therefore represents and warrants that any and all steel products purchased, used or supplied by it in the performance of the Contract will be melted and manufactured in the United States, and that its performance hereunder will otherwise comply with requirements of the SPPA at all times. Contractor further agrees to provide CCAC with documentation and/or certification of its compliance with the foregoing requirements, as required under the SPPA, and acknowledges that it shall not be entitled to receive payment hereunder until such documentation and/or certification has been provided.

18. MARKUPS ON CHANGE ORDERS

Markups on change order requests shall not exceed 15%. This would apply to overhead and profit, labor, materials, equipment, etc.

Revised 9/14/21

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project Name:	Additional Power and Compressed Air (Electrical and Plumbing) for CEIT Building – Allegheny Campus
General Description:	Additional Power and Compressed Air (Electrical and Plumbing) for CEIT Building – Allegheny Campus
Project Locality	Pittsburgh
Awarding Agency:	Community College of Allegheny County
Contract Award Date:	1/6/2025
Serial Number:	24-10542
Project Classification:	Building
Determination Date:	12/6/2024
Assigned Field Office:	Pittsburgh
Field Office Phone Number:	(412)565-5300
Toll Free Phone Number:	(877)504-8354
Project County:	Allegheny County

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-10542 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	8/1/2023		$42.40	$29.01	$71.41
Asbestos & Insulation Workers	8/1/2024		$43.40	$29.51	$72.91
Boilermakers	6/1/2016		$40.90	$27.61	$68.51
Bricklayer	12/1/2022		$36.99	$24.95	$61.94
Bricklayer	6/1/2024		$40.25	$25.34	$65.59
Bricklayer	12/1/2024		$41.00	$25.59	$66.59
Carpenters - Piledriver/Welder	1/1/2023		$40.63	$21.22	$61.85
Carpenters - Piledriver/Welder	1/1/2024		$42.13	$21.97	$64.10
Carpenters - Piledriver/Welder	1/1/2025		$43.38	$22.72	$66.10
Carpenters - Piledriver/Welder	1/1/2026		$44.63	$23.47	$68.10
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2023		$39.69	$19.93	$59.62
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2024		$41.49	$19.93	$61.42
Carpenters, Drywall Hangers, Framers, Instrument Men, Lathers, Soft Floor Layers	6/1/2025		$43.34	$19.93	$63.27
Cement Masons	6/1/2023		$33.07	$23.59	$56.66
Cement Masons	7/1/2024		$34.57	$25.09	$59.66
Drywall Finisher	6/1/2023		$32.39	$23.75	$56.14
Drywall Finisher	6/1/2024		$34.01	$24.88	$58.89
Electricians & Telecommunications Installation Technician	12/22/2023		$48.61	$31.80	$80.41
Electricians & Telecommunications Installation Technician	12/27/2024		$51.76	$31.80	$83.56
Electricians & Telecommunications Installation Technician	12/26/2025		$55.06	$31.80	$86.86
Elevator Constructor	1/1/2023		$56.14	$42.83	$98.97
Elevator Constructor	1/1/2024		$58.55	$43.87	$102.42
Glazier	9/1/2023		$35.65	$30.05	$65.70
Iron Workers	6/1/2023		$38.89	$35.02	$73.91
Iron Workers	6/1/2024		$39.89	$36.47	$76.36
Laborers (Class 01 - See notes)	1/1/2023		$25.82	$19.46	$45.28
Laborers (Class 01 - See notes)	1/1/2024		$26.82	$19.46	$46.28
Laborers (Class 01 - See notes)	1/1/2025		$27.32	$19.96	$47.28
Laborers (Class 01 - See notes)	1/1/2026		$27.82	$20.46	$48.28
Laborers (Class 02 - See notes)	1/1/2023		$25.97	$19.46	$45.43
Laborers (Class 02 - See notes)	1/1/2024		$26.97	$19.46	$46.43
Laborers (Class 02 - See notes)	1/1/2025		$27.47	$19.96	$47.43
Laborers (Class 02 - See notes)	1/1/2026		$27.97	$20.46	$48.43
Laborers (Class 03 - See notes)	1/1/2023		$28.97	$19.46	$48.43
Laborers (Class 03 - See notes)	1/1/2024		$29.97	$19.46	$49.43
Laborers (Class 03 - See notes)	1/1/2025		$30.47	$19.96	$50.43
Laborers (Class 03 - See notes)	1/1/2026		$30.97	$20.46	$51.43
Laborers (Class 04 - See notes)	1/1/2021		$23.57	$19.32	$42.89
Landscape Laborer (Skilled)	1/1/2023		$23.79	$18.28	$42.07
Landscape Laborer (Skilled)	1/1/2024		$24.79	$18.53	$43.32

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-10542 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Landscape Laborer (Skilled)	1/1/2025		$25.79	$18.78	$44.57
Landscape Laborer (Skilled)	1/1/2026		$26.79	$19.03	$45.82
Landscape Laborer (Tractor Operator)	1/1/2023		$24.09	$18.28	$42.37
Landscape Laborer (Tractor Operator)	1/1/2024		$25.09	$18.53	$43.62
Landscape Laborer (Tractor Operator)	1/1/2025		$26.09	$18.78	$44.87
Landscape Laborer (Tractor Operator)	1/1/2026		$27.09	$19.03	$46.12
Landscape Laborer	1/1/2023		$23.37	$18.28	$41.65
Landscape Laborer	1/1/2024		$24.37	$18.53	$42.90
Landscape Laborer	1/1/2025		$25.37	$18.78	$44.15
Landscape Laborer	1/1/2026		$26.37	$19.03	$45.40
Millwright	6/1/2020		$41.68	$20.32	$62.00
Operators (Class 01 - see notes)	6/1/2022		$38.89	$23.69	$62.58
Operators (Class 01 - see notes)	6/1/2023		$40.69	$23.89	$64.58
Operators (Class 01 - see notes)	6/1/2024		$41.69	$24.39	$66.08
Operators (Class 02 -see notes)	6/1/2022		$32.82	$23.69	$56.51
Operators (Class 02 -see notes)	6/1/2023		$34.62	$23.89	$58.51
Operators (Class 02 -see notes)	6/1/2024		$35.62	$24.39	$60.01
Operators (Class 03 - See notes)	6/1/2022		$30.03	$23.69	$53.72
Operators (Class 03 - See notes)	6/1/2023		$31.83	$23.89	$55.72
Operators (Class 03 - See notes)	6/1/2024		$32.83	$24.39	$57.22
Painters Class 6 (see notes)	6/1/2023		$30.56	$24.01	$54.57
Painters Class 6 (see notes)	6/1/2024		$32.14	$24.93	$57.07
Painters Class 6 (see notes)	6/1/2025		$34.16	$25.81	$59.97
Piledrivers	1/1/2023		$39.13	$21.22	$60.35
Piledrivers	1/1/2024		$40.63	$21.97	$62.60
Piledrivers	1/1/2025		$41.88	$22.72	$64.60
Piledrivers	1/1/2026		$43.13	$23.47	$66.60
Plasterers	6/1/2023		$32.14	$20.54	$52.68
Plasterers	6/1/2024		$33.14	$21.04	$54.18
plumber	6/1/2023		$48.65	$25.87	$74.52
plumber	6/1/2024		$51.75	$25.87	$77.62
plumber	6/1/2025		$54.95	$25.87	$80.82
plumber	6/1/2026		$58.05	$25.87	$83.92
plumber	6/1/2027		$61.15	$25.87	$87.02
Pointers, Caulkers, Cleaners	12/1/2022		$35.47	$20.88	$56.35
Pointers, Caulkers, Cleaners	6/1/2024		$38.59	$21.36	$59.95
Pointers, Caulkers, Cleaners	12/1/2024		$39.69	$21.61	$61.30
Roofers	6/1/2023		$37.00	$19.92	$56.92
Roofers	6/2/2024		$38.00	$20.67	$58.67
Sheet Metal Workers	8/1/2023		$41.00	$32.94	$73.94
Sheet Metal Workers	7/1/2024		$43.00	$33.96	$76.96
Sign Makers and Hangars	7/15/2023		$31.76	$24.63	$56.39
Sign Makers and Hangars	7/15/2024		$32.32	$25.82	$58.14
Sprinklerfitters	7/1/2023		$43.84	$25.50	$69.34

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-10542 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sprinklerfitters	1/1/2024		$43.28	$26.06	$69.34
Sprinklerfitters	7/1/2024		$45.38	$26.46	$71.84
Steamfitters	6/1/2023		$46.10	$28.37	$74.47
Steamfitters	6/1/2024		$48.15	$29.57	$77.72
Stone Masons	6/1/2024		$42.35	$23.97	$66.32
Stone Masons	12/1/2024		$43.10	$24.22	$67.32
Terrazzo Finisher	12/1/2022		$36.13	$18.03	$54.16
Terrazzo Finisher	6/1/2023		$39.79	$18.47	$58.26
Terrazzo Finisher	12/1/2024		$41.04	$18.72	$59.76
Terrazzo Mechanics	12/1/2022		$35.49	$20.32	$55.81
Terrazzo Mechanics	6/1/2024		$39.14	$20.77	$59.91
Terrazzo Mechanics	12/1/2024		$40.39	$21.02	$61.41
Tile Finisher	12/1/2022		$28.76	$17.34	$46.10
Tile Finisher	6/1/2024		$31.56	$17.74	$49.30
Tile Finisher	12/1/2024		$32.51	$17.99	$50.50
Tile Setter	12/1/2022		$35.64	$21.81	$57.45
Tile Setter	6/1/2024		$38.46	$22.19	$60.65
Tile Setter	12/1/2024		$39.41	$22.44	$61.85
Truckdriver class 1(see notes)	1/1/2023		$33.18	$22.21	$55.39
Truckdriver class 1(see notes)	1/1/2024		$34.93	$22.71	$57.64
Truckdriver class 1(see notes)	1/1/2025		$36.43	$23.21	$59.64
Truckdriver class 1(see notes)	1/1/2026		$37.93	$23.71	$61.64
Truckdriver class 2 (see notes)	1/1/2023		$33.64	$22.52	$56.16
Truckdriver class 2 (see notes)	1/1/2024		$35.39	$23.02	$58.41
Truckdriver class 2 (see notes)	1/1/2025		$36.89	$23.52	$60.41
Truckdriver class 2 (see notes)	1/1/2026		$38.39	$24.02	$62.41
Window Film / Tint Installer	10/1/2019		$25.00	$2.63	$27.63

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-10542 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Carpenter	1/1/2023		$38.60	$20.59	$59.19
Carpenter	1/1/2024		$40.10	$21.34	$61.44
Carpenter	1/1/2025		$41.35	$22.09	$63.44
Carpenter	1/1/2026		$42.60	$22.84	$65.44
Carpenter Welder	1/1/2023		$40.10	$20.59	$60.69
Carpenter Welder	1/1/2024		$41.60	$21.34	$62.94
Carpenter Welder	1/1/2025		$42.85	$22.09	$64.94
Carpenter Welder	1/1/2026		$44.10	$22.84	$66.94
Carpenters - Piledriver/Welder	1/1/2023		$40.63	$21.22	$61.85
Carpenters - Piledriver/Welder	1/1/2024		$42.13	$21.97	$64.10
Carpenters - Piledriver/Welder	1/1/2025		$43.38	$22.72	$66.10
Carpenters - Piledriver/Welder	1/1/2026		$44.63	$23.47	$68.10
Cement Finishers	1/1/2023		$34.14	$25.05	$59.19
Cement Finishers	1/1/2024		$35.14	$26.30	$61.44
Cement Finishers	1/1/2025		$35.94	$27.50	$63.44
Cement Masons	1/1/2020		$32.84	$21.10	$53.94
Electric Lineman	5/29/2023		$52.56	$29.99	$82.55
Electric Lineman	6/3/2024		$53.97	$31.05	$85.02
Electricians & Telecommunications Installation Technician	12/22/2023		$48.61	$31.80	$80.41
Electricians & Telecommunications Installation Technician	12/27/2024		$51.76	$31.80	$83.56
Electricians & Telecommunications Installation Technician	12/26/2025		$55.06	$31.80	$86.86
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	6/1/2023		$38.89	$35.02	$73.91
Iron Workers (Bridge, Structural Steel, Ornamental, Precast, Reinforcing)	6/1/2024		$39.89	$36.47	$76.36
Laborers (Class 01 - See notes)	1/1/2023		$29.95	$25.50	$55.45
Laborers (Class 01 - See notes)	1/1/2024		$32.20	$25.50	$57.70
Laborers (Class 01 - See notes)	1/1/2025		$33.70	$26.00	$59.70
Laborers (Class 01 - See notes)	1/1/2026		$34.70	$27.00	$61.70
Laborers (Class 02 - See notes)	1/1/2023		$30.11	$25.50	$55.61
Laborers (Class 02 - See notes)	1/1/2024		$32.36	$25.50	$57.86
Laborers (Class 02 - See notes)	1/1/2025		$33.86	$26.00	$59.86
Laborers (Class 02 - See notes)	1/1/2026		$34.86	$27.00	$61.86
Laborers (Class 03 - See notes)	1/1/2023		$30.50	$25.50	$56.00
Laborers (Class 03 - See notes)	1/1/2024		$32.75	$25.50	$58.25
Laborers (Class 03 - See notes)	1/1/2025		$34.25	$26.00	$60.25
Laborers (Class 03 - See notes)	1/1/2026		$35.25	$27.00	$62.25
Laborers (Class 04 - See notes)	1/1/2023		$30.95	$25.50	$56.45
Laborers (Class 04 - See notes)	1/1/2024		$33.20	$25.50	$58.70
Laborers (Class 04 - See notes)	1/1/2025		$34.70	$26.00	$60.70
Laborers (Class 04 - See notes)	1/1/2026		$35.70	$27.00	$62.70
Laborers (Class 05 - See notes)	1/1/2023		$31.36	$25.50	$56.86
Laborers (Class 05 - See notes)	1/1/2024		$33.61	$25.50	$59.11

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-10542 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 05 - See notes)	1/1/2025		$35.11	$26.00	$61.11
Laborers (Class 05 - See notes)	1/1/2026		$36.11	$27.00	$63.11
Laborers (Class 06 - See notes)	1/1/2023		$28.20	$25.50	$53.70
Laborers (Class 06 - See notes)	1/1/2024		$30.45	$25.50	$55.95
Laborers (Class 06 - See notes)	1/1/2025		$31.95	$26.00	$57.95
Laborers (Class 06 - See notes)	1/1/2026		$32.95	$27.00	$59.95
Laborers (Class 07 - See notes)	1/1/2023		$30.95	$25.50	$56.45
Laborers (Class 07 - See notes)	1/1/2024		$33.20	$25.50	$58.70
Laborers (Class 07 - See notes)	1/1/2025		$34.70	$26.00	$60.70
Laborers (Class 07 - See notes)	1/1/2026		$35.70	$27.00	$62.70
Laborers (Class 08 - See notes)	1/1/2023		$32.45	$25.50	$57.95
Laborers (Class 08 - See notes)	1/1/2024		$34.70	$25.50	$60.20
Laborers (Class 08 - See notes)	1/1/2025		$36.20	$26.00	$62.20
Laborers (Class 08 - See notes)	1/1/2026		$37.20	$27.00	$64.20
Millwright	6/1/2023		$45.50	$23.72	$69.22
Millwright	6/1/2024		$47.59	$23.72	$71.31
Millwright	6/1/2025		$49.72	$23.72	$73.44
Operators (Class 01 - see notes)	1/1/2023		$36.79	$23.58	$60.37
Operators (Class 01 - see notes)	1/1/2024		$38.59	$24.03	$62.62
Operators (Class 01 - see notes)	1/1/2025		$40.39	$24.23	$64.62
Operators (Class 02 -see notes)	1/1/2023		$36.53	$23.58	$60.11
Operators (Class 02 -see notes)	1/1/2024		$38.33	$24.03	$62.36
Operators (Class 02 -see notes)	1/1/2025		$40.13	$24.23	$64.36
Operators (Class 03 - See notes)	1/1/2023		$32.88	$23.58	$56.46
Operators (Class 03 - See notes)	1/1/2024		$34.68	$24.03	$58.71
Operators (Class 03 - See notes)	1/1/2025		$36.48	$24.23	$60.71
Operators (Class 04 - See notes)	1/1/2023		$32.42	$23.58	$56.00
Operators (Class 04 - See notes)	1/1/2024		$34.22	$24.03	$58.25
Operators (Class 04 - See notes)	1/1/2025		$36.02	$24.23	$60.25
Operators (Class 05 - See notes)	1/1/2023		$32.17	$23.58	$55.75
Operators (Class 05 - See notes)	1/1/2024		$33.97	$24.03	$58.00
Operators (Class 05 - See notes)	1/1/2025		$35.77	$24.23	$60.00
Operators Class 1-A	1/1/2023		$39.79	$23.58	$63.37
Operators Class 1-A	1/1/2024		$41.59	$24.03	$65.62
Operators Class 1-A	1/1/2025		$43.39	$24.23	$67.62
Operators Class 1-B	1/1/2023		$38.79	$23.58	$62.37
Operators Class 1-B	1/1/2024		$40.59	$24.03	$64.62
Operators Class 1-B	1/1/2025		$42.39	$24.23	$66.62
Painters Class 1 (see notes)	6/1/2022		$34.45	$22.82	$57.27
Painters Class 2 (see notes)	6/1/2023		$36.01	$24.01	$60.02
Painters Class 2 (see notes)	6/1/2024		$38.09	$24.93	$63.02
Painters Class 2 (see notes)	6/1/2025		$40.36	$25.81	$66.17
Painters Class 3 (see notes)	6/1/2023		$38.33	$24.01	$62.34
Painters Class 3 (see notes)	6/1/2024		$40.66	$24.93	$65.59

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 24-10542 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Painters Class 3 (see notes)	6/1/2025		$43.69	$25.81	$69.50
Painters Class 4 (see notes)	6/1/2019		$28.20	$20.06	$48.26
Painters Class 5 (see notes)	6/1/2019		$22.91	$20.06	$42.97
Pile Driver Divers (Building, Heavy, Highway)	1/1/2023		$58.70	$21.22	$79.92
Pile Driver Divers (Building, Heavy, Highway)	1/1/2024		$60.95	$21.97	$82.92
Pile Driver Divers (Building, Heavy, Highway)	1/1/2025		$62.82	$22.72	$85.54
Pile Driver Divers (Building, Heavy, Highway)	1/1/2026		$64.70	$23.47	$88.17
Piledrivers	1/1/2023		$39.13	$21.22	$60.35
Piledrivers	1/1/2024		$40.63	$21.97	$62.60
Piledrivers	1/1/2025		$41.88	$22.72	$64.60
Piledrivers	1/1/2026		$43.13	$23.47	$66.60
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2022		$48.43	$40.28	$88.71
Truckdriver class 1(see notes)	1/1/2023		$33.18	$22.21	$55.39
Truckdriver class 1(see notes)	1/1/2024		$34.93	$22.71	$57.64
Truckdriver class 1(see notes)	1/1/2025		$36.43	$23.21	$59.64
Truckdriver class 1(see notes)	1/1/2026		$37.93	$23.71	$61.64
Truckdriver class 2 (see notes)	1/1/2023		$33.64	$22.52	$56.16
Truckdriver class 2 (see notes)	1/1/2024		$35.39	$23.02	$58.41
Truckdriver class 2 (see notes)	1/1/2025		$36.89	$23.52	$60.41
Truckdriver class 2 (see notes)	1/1/2026		$38.39	$24.02	$62.41

COMMUNITY COLLEGE OF ALLEGHENY COUNTY
800 ALLEGHENY AVENUE, PITTSBURGH PA 15233

_____
Bond Number

P E R F O R M A N C E B O N D

Know all men by these Presents that we _____**"TO BE COMPLETED ONLY BY AWARDEE"**____ (hereinafter called "Principal") as Principal, and _____ authorized to do business in the Commonwealth of Pennsylvania (hereinafter called "Surety") as Surety, are held and firmly bound unto the Community College of Allegheny County, through its Board of Trustees, _____ in the sum of _____

_____

to be paid to the said College aforesaid, its certain attorney, or assigns. To which payment will and truly be made, said principal and said surety to bind themselves their respective successors or assigns jointly and severally, firmly by these presents.

WITNESS our hands and seals, the _____ day of _____ 20____.

WHEREAS the above bounded _____ has filed with the Community College of Allegheny County, proposals for the _____

The Condition of the above Obligation is such that if the said _____ shall perform _____

_____

In accordance with the agreement between _____ and the Community College of Allegheny County of even date herewith and the specifications and proposals attached to and made part of the agreement, and shall indemnify and save harmless the said Community College of Allegheny County from all liens, charges, demands, loss and damages of every kind and nature, whatsoever. Then this obligation to be void, otherwise to be and remain in full force and virtue.

Attest:

_____ (SEAL)
CONTRACTOR

_____ _____ (SEAL)
SECRETARY PRESIDENT

Signed, Sealed and delivered in presence of

_____ (SEAL)
SURETY COMPANY

_____ _____ (SEAL)
ADDRESS

_____ (SEAL)
TITLE

COMMUNITY COLLEGE OF ALLEGHENY COUNTY
800 ALLEGHENY AVENUE, PITTSBURGH PA 15233

LABOR AND MATERIAL

P A Y M E N T B O N D

KNOW ALL MEN BY THESE PRESENTS:

That we_____ **"TO BE COMPLETED ONLY BY AWARDEE"** _____

_____ as Principal

hereinafter called Principal, and _____

_____ as Surety, hereinafter called Surety, are held and firmly bound unto the

COMMUNITY COLLEGE OF ALLEGHENY COUNTY, through its Board of Trustees as Obligee, hereinafter called Owner, for the use and benefit of claimants as hereinbelow defined, in the amount of _____

_____ Dollars ($_____),

for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement, dated _____ 20_____, entered into a contract with Owner for _____

in accordance with drawings and specifications prepared by_____

(Here insert full name, title and address)

_____which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

(1) A claimant is defined as one having a direct contract with the Principal or with a sub-contractor of the Principal for labor, material, or both used or reasonably required for use in the performance of the contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

(2) The above-named Principal and Surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for the use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.

(3) No suit or action shall be commenced hereunder by any claimant.

  (a) Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: The Principal, the Owner, or the Surety above-named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

  (b) After the expiration of one (1) year following the date on which Principal ceased work on said Contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

  (c) Other than in a state court of competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated, or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

(4) The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this bond.

Signed and sealed this _____ day of _____ 20_____

_____ By_____
Witness (Seal) Principal

_____ By_____
Witness (Seal) Surety

This bond is issued simultaneously with performance bond in favor of the Owner conditioned on the full and faithful performance of the Contract.

Original – January 1980

MASTER SERVICES AGREEMENT

"Awardee Only"

Bid 1135

THIS MASTER SERVICES AGREEMENT ("Agreement") is made and entered into as of this ---- day of ----------, 2018, by and between **Community College of Allegheny County**, with a business office located at 800 Allegheny Avenue, Pittsburgh, PA 15233 (hereinafter referred to as the "College"), and ---------- (hereinafter referred to as "Contractor").

RECITALS

WHEREAS, the College has issued a Request for Quotation, Bid Solicitation, Request for Proposal, and/or a Purchase Order (hereinafter individually and collectively referred to as the "Order"), pursuant to

Bid Proposal No.	**Awardee Only**

which College seeks to procure certain work and services, as more fully described on the Order; and

WHEREAS, Contractor has submitted a proposal to the College to provide the services described in the Order, a copy of which is attached hereto as Exhibit A (hereinafter the "Proposal") and incorporated by reference;

WHEREAS, the College desires to engage Contractor to provide the services, pursuant to and in accordance with the terms and conditions that this Agreement set forth herein.

NOW, THEREFORE, in consideration of the premises and covenants that this Agreement contains, the receipt and adequacy of which are hereby acknowledged, the parties, intending to be legally bound, agree as follows:

1. Term. The term of this Agreement shall be as specified in the Order unless otherwise stated in the section below. If no date is specified, this Agreement shall begin with the date first stated above and terminate upon satisfactory completion of the services described herein.

AWARDEE ONLY

2. Services. Contractor shall fully and faithfully perform the work and services described in the Order and the Proposal and any specifications, scope of work or other documentation attached thereto. Contractor warrants that all work and services performed by or on behalf of it under this Agreement will conform to all terms and specifications set forth in the Order and in the Proposal.

3. Price/Fees: The College shall pay Contractor for the services and work performed by Contractor in accordance with the fees and/or prices set forth in the Proposal.

4. Terms and Conditions: This Agreement, and the services to be performed by Contractor hereunder, will be subject to and governed by College's Standard Terms and Conditions for the Purchase of Goods and Services ("Master Terms"), which are incorporated herein by reference. The Master Terms can be viewed and downloaded at https://www.ccac.edu/business/_files-business/purchase-terms-and-conditions.pdf. By signing below, Contractor acknowledges its receipt and acceptance of the Master Terms.

5. Insurance Requirements: In addition to the Master Terms, Contractor shall comply with the insurance and indemnification requirements set forth on Exhibit B, which are incorporated herein by reference. Prior to commencing performance of the Services, Contractor shall furnish to the College a properly executed certificate(s) of insurance which evidence all insurance required by Exhibit B. Said certificate(s) of insurance shall be attached herein as Exhibit C.

6. Assignment. Contractor may not assign or subcontract this Agreement or its performance thereof, in whole or in part, without the College's prior written consent.

7. Entire Agreement; Modification. This Agreement, together with the Exhibits and other documents referenced and incorporated herein, sets forth the entire agreement of the parties on the subject matter hereof and supersedes all previous or concurrent agreements between them, whether oral or written. Any proposal, quotation, acknowledgment, confirmation or other writing submitted by Contractor to the College shall not be deemed to amend or modify this Agreement, and will be of no legal effect except to the extent that it serves to identify the work and services to be performed by the Contractor. This Agreement, and the terms set forth in the Master Terms, will control over any conflicting terms or provisions contained in any proposal, invoice or other documentation submitted by Contractor to College. The terms of this Agreement may not be modified or changed except by a writing that both parties sign. This Agreement shall inure to the benefit of the College and Contractor and the College's successors and assigns.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the day and year first above written.

AWARDEE ONLY – COMPANY NAME	**COMMUNITY COLLEGE OF ALLEGHENY COUNTY**
By: _____	By: Constance Dyer
Signature: _____	Signature: _____
Title: _____	Title: Vice President for Finance
Date: _____	Date: _____

Revised 3/3/15

EXHIBITS - The following Exhibits are attached hereto and made a part of this Agreement for all purposes:

- ☐ **Exhibit A - Contractor's Proposal Response**
- ☐ **Exhibit B - Insurance Requirements**
- ☐ **Exhibit C - Contractor's Certificate(s) of Insurance.**
- ☐ **Exhibit D – Performance and Payment Bonds**
- ☐ **Exhibit E – No-Lien Agreement**

COMMUNITY COLLEGE OF ALLEGHENY COUNTY
800 ALLEGHENY AVENUE, PITTSBURGH, PA 15233

NO-LIEN AGREEMENT

"TO BE COMPLETED ONLY BY AWARDEE"
Bid 1135

Made the _____day of_____, 20_____between_____

_____Pittsburgh, Pennsylvania Contractor and Community College of Allegheny County, Pittsburgh, Pennsylvania, Owner.

Whereas, by separate written contract dated and executed the day and year first above written. The Owner and Contractor have entered into a No-Lien Contract (herein described for convenience as the Contract) to furnish all labor, materials, supplies, tools, and equipment necessary to complete the Contract in accordance with the specifications prepared by the Owner, and the provisions on the Contract between the Owner and Contractor, as more particularly recited therein.

NOW, THEREFORE, in consideration of the execution of said Contract for the purchases of and delivery on the premises of the owner and terms and conditions thereof, the Contractor covenants and agrees as follows:

1. The contractor covenants and agrees that no mechanics' claims or liens shall be entered or filed by the Contractor or by any subcontractor or materialsman or by an other person against the building or property of the Owner described more particularly hereinafter, for or on account of any work or labor done, materials, supplies, tools and equipment furnished in, upon, or about the building and property of the Owner described more particularly hereinafter.

2. Any and all right of lien is hereby waived and the Contractor, all subcontractors, all materialsmen, all persons supplying labor, and/or materials and all other persons shall look exclusively to and hold the Contractor and not the property liable for any sums due, however arising.

3. The property as to which this No-Lien Agreement is filed is located at Community College of Allegheny County, _____.

Block/Lot_____

IN WITNESS WHEREOF, the parties hereto, with the intent to be bound legally thereby have duly executed this No-Lien Agreement the day and year first above written.

COMMUNITY COLLEGE OF ALLEGHENY COUNTY (OWNER)

_____
CCAC - VICE PRESIDENT FOR FINANCE (revised 3/16/15)

_____ _____
(CONTRACTOR) WITNESS

COMMUNITY COLLEGE OF ALLEGHENY COUNTY

800 ALLEGHENY AVENUE PITTSBURGH, PA 15233

INSURANCE REQUIREMENTS

FORM B

Indemnification. To the fullest extent permitted by law, Contractor shall defend, indemnify and hold harmless the Community College of Allegheny County (CCAC), its agents, officers, employees, and volunteers from and against all claims, damages, losses, and expenses (including but not limited to attorney fees and court costs) arising from the acts, errors, mistakes, omissions, work or service of Contractor, its agents, employees, or any tier of its subcontractors in the performance of this Contract. The amount and type of insurance coverage requirements of this Contract will in no way be construed as limiting the scope of indemnification in this Paragraph.

Insurance. Contractor shall maintain during the term of this Contract insurance policies described below issued by companies licensed in Pennsylvania with a current A.M. Best rating of A- or better. At the signing of this Contract, and prior to the commencement of any work, Contractor shall furnish the CCAC Purchasing Department with a **Certificate of Insurance** evidencing the required coverages, conditions, and limits required by this Contract at the following address: Community College of Allegheny County, Purchasing Department, 800 Allegheny Avenue, Pittsburgh, PA 15233.

The insurance policies, except Workers' Compensation and Professional Liability, shall be endorsed to name Community College of Allegheny County, its agents, officers, employees, and volunteers as Additional Insureds with the following language or its equivalent:

> Community College of Allegheny County, its agents, officers, employees, and volunteers are hereby named as additional insureds as their interest may appear.

All such Certificates shall provide a 30-day notice of cancellation. Renewal Certificates must be provided for any policies that expire during the term of this Contract. Certificate must specify whether coverage is written on an Occurrence or a Claims Made Policy form.

Insurance coverage required under this Contract is:

1) **Commercial General Liability** insurance with a limit of not less than $1,000,000 per occurrence for bodily injury, property damage, personal injury, products and completed operations, and blanket contractual coverage, including but not limited to the liability assumed under the indemnification provisions of this Contract.
2) **Automobile Liability** insurance with a combined single limit for bodily injury and property damage of not less than $1,000,000 each occurrence with respect to Contractor's owned, hired, and non-owned vehicles.
3) **Workers' Compensation** insurance with limits statutorily required by any Federal or State law and **Employer's Liability** insurance of not less than $100,000 for each accident, $100,000 disease for each employee, and $500,000 disease policy limit.
4) **Professional Liability** insurance (where applicable) covering acts, errors, mistakes, and omissions arising out of the work or services performed by the Contractor, or any person employed by the Contractor, with a limit of not less than $1,000,000 each claim.

DIVISION 22 - PLUMBING

DIVISION 26 - ELECTRICAL

SECTION 220000 - PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 1 - General Requirements, and shall include all Sections of Division 22 and shall apply to all Work specified, indicated in the Drawings, and as required to furnish a complete installation of mechanical systems for the Project. Review all Sections of the Specifications for related work and coordinate the work of this Section with all other Sections.

B. Furnish all labor, services, materials, tools, equipment, appliances, facilities, transportation and incidental work and appurtenances required to furnish a complete and properly operating system.

C. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and shall coordinate the work with that of the other trades to avoid interference. The plans are diagrammatic and show the general arrangement of the conduit, panels, transformers and equipment. All dimensions and existing conditions shall be the responsibility the Contractor. Before proceeding with work check and verify all dimensions.

D. The Contractor shall assume all responsibility for fitting of materials and equipment to other parts of equipment and structure. Make adjustments that may be necessary or as requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades. Where existing pipes, conduits and/or ducts prevent installation of new work as indicated, relocate, or arrange for relocation with the applicable trades, existing pipes, conduits and/or ducts.

E. Where the project involves interface with existing building and site systems, the Consultant has used reasonable care to identify existing utilities and services. The Contractor is responsible to thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available i.e. concealed conditions, which exist in the existing building affected by this work.

F. Documents do not represent to show or list every item to be provided. When an item not shown or listed, is necessary for proper operation of the system and/or equipment, the Contractor shall provide the item which will allow the system to function properly at no increase in Contract Sum.

G. Work shall include, but shall not be limited to, the following:

1. Tie-ins to the existing plumbing system.
2. Relocation of existing systems which interfere with new construction.

3. Removal of existing piping, fixtures, equipment and appurtenances, to be abandoned.
4. Coordinate maintenance of existing services during construction with Owner.
5. Special coordination of chases and shafts.
6. Hoisting and rigging required to complete work of this section.
7. Sleeves, inserts and hangers.
8. Equipment bases and supports.
9. Motors.
10. Prime painting.
11. Equipment and major component identification.
12. Instruction manual and start up instructions.
13. Testing and balancing.
14. Commissioning.
15. Cleaning.

H. Related work specified elsewhere: The following work, unless otherwise noted is not included in this section shall be performed in other sections:

1. Cutting and patching of masonry, concrete, tile and other parts of structure, with the exception of drilling for hangers and providing holes and openings in metal deck shall be by trade contractor.
2. Flashing of wall and roof penetrations shall be by trade contractor.
3. Installation of access panels in floors, walls, furred spaces or above ceilings shall be by trade contractor.
4. Partitions and Painting (except as specifically indicated) shall be by trade contractor.
5. Structural supports necessary to distribute loading from equipment to roof or floor, except as specified herein shall be by trade contractor.

1.2 APPLICABLE PUBLICATIONS

A. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. American Society of Plumbing Engineers (ASPE)
3. American Water Works Association (AWWA)
4. American Society of Mechanical Engineers (ASME)
5. American Welding Society (AWS)
6. American National Standards Institute (ANSI).
7. American Society of Testing and Materials (ASTM).
8. Underwriter’s Laboratories (UL).
9. National Fire Protection Association (NFPA).
10. Occupational Safety and Health Act (OSHA)

B. All materials and equipment shall be listed by Underwriters” Laboratories (UL), and approved by ANSI, and ASTM for intended service.

C. Most recent editions of applicable specifications and publications of the following organizations form part of these Contract Documents.

1. American National Standards Institute (ANSI)
2. American Water Works Association (AWWA)
3. American Society of Mechanical Engineers (ASME)
4. American Welding Society (AWS)
5. American Society of Testing and Materials (ASTM)
6. American Society of Plumbing Engineers (ASPE)
7. Underwriter's Laboratories (UL).
8. National Fire Protection Association (NFPA).
9. Occupational Safety and Health Act (OSHA)

1.3 DEFINITIONS

A. "Provide" means "furnish and install", complete, the specified material, equipment or other item and perform all required labor to make a finished and properly operational installation.

B. "Furnish" means to purchase and deliver to project site complete with all appurtenance and support. "Install" means to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project

C. "Consultant" means "Prime Design Consultant". An individual or organization engaged by the owner or the architect to render professional engineering consulting services complementing or supplementing the architect's services concerning the content of the Mechanical, Electrical, Plumbing & Fire Protection sections of specifications.

D. "Owner" means the individual or entity with whom Contractor has entered into the Agreement for whom the Work is to be performed

E. "Construction Manager Advisor" or "CMA" means the Construction Manager that provides services to advise the Owner and Architect on design and materials decisions during the design and document development process. The CMA coordinates the entire design process using his skills and knowledge of construction to clarify cost and time considerations of design decisions, to advise on feasibility of single, multiple-contract or fast-track delivery systems, recommend the construction process, and to handle the bidding and award, as well as to manage the construction of the Project.

F. "Construction Manager Constructor" or "CMC" means the Construction Manager that in addition to acting as an advisor to the Owner during a design period, assumes responsibility for the construction of the Project. The CMC become contractually bound to provide the labor and material for the Project. The CMC may also serve as administrator of multiple prime contract construction; however, some states prohibit that practice.

G. General Contractor/ Prime Contractor means the contractor who contracts with a property owner and, in turn, employs a subcontractor or subcontractors to perform some of all of the work.

H. “Contractor” or “Subcontractor” means the trade contractor responsible for the work in this Division of the specification.

I. “Owner’s Representative” means the Consultant, Engineer, or other Specialty Consultant retained by the Owner.

J. “RFI” means “Contractor’s Request for Information”.

K. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

L. “Accessible”: Ability to perform recommended maintenance without removal of services or equipment and requiring no special platforms.

M. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

N. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

O. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

P. "Connect": Complete hook-up of item with required service.

Q. "Exposed": Not installed underground or "concealed."

R. "Indicated," "Shown" or " "Noted": As indicated, shown or noted on Drawings or Specifications.

S. "Install": To erect, mount and connect complete with related accessories.

T. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

U. "Reviewed," "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner.

V. "Rough-In": Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

W. "Shall": An exhortation or command to complete the specified task.

X. "Similar" or "Equal": Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

Y. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

Z. “Typical” or “Typ”: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

AA. "Will": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

BB. "Wiring": Raceway, fittings, wire, boxes and related items.

CC. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

DD. Reference by abbreviation may be made in the specifications and the Contract Drawings for Mechanical and Electrical Work in accordance with the following list:

1. HVAC Heating, Ventilating and Air Conditioning
2. GC General Contractor
3. USS United States Standards
4. ASTM American Society of Testing Materials
5. ASA American Standards Association
6. ADA: Americans with Disabilities Act.
7. ANSI: American National Standards Institute.
8. HP: Horsepower.
9. ICEA: Insulated Cable Engineers Association
10. IEEE: Institute of Electrical and Electronic Engineers.
11. NEMA: National Electrical Manufacturers' Association.
12. NETA: National Electrical Testing Association, Inc.
13. NFPA: National Fire Protection Association.
14. OSHA: Occupational Safety and Health Act.
15. ABS: Acrylonitrile-butadiene-styrene plastic.
16. CPVC: Chlorinated polyvinyl chloride plastic.
17. PE: Polyethylene plastic.
18. PVC: Polyvinyl chloride plastic.
19. EPDM: Ethylene-propylene-diene terpolymer rubber.
20. NBR: Acrylonitrile-butadiene rubber.
21. UBC: Uniform Building Code.
22. UL: Underwriters' Laboratories,

1.4 SCOPE

A. Perform work and provide material and equipment as shown on the drawings and/or as specified and/or as indicated in this section of the specifications. Completely coordinate all work of this section with work of other trades and provide a complete and fully functional installation

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly require by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and back-charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

D. Contractor shall be responsible with obtaining all the final inspection as required by Local Code and ordinances.

1.5 CONTRACT DOCUMENTS

A. Listing of Documents does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to the Consultant's, Plumbing, Electrical, HVAC and Fire Protection, Structural, Site Utility and all other drawings and other sections that types of and work of other trades with which work of this section must be coordinated

B. Except where modified by a specific notation to the contrary; it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify coordinated routings and component. The purpose of the document is to indicate systems concept, the main components of the systems, and the approximate geometric relationships. Based on the systems concept, the main components and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational

E. Information and components shown on riser diagrams, but not shown on plans, and vice versa, shall apply and be provided as if expressly required on both

F. Data that may be furnished electronically by the Consultant is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not be substitute for Consultant's sealed or stamped construction documents.

1.6 ELECTRONIC MEDIA FILES

A. Construction drawings for this project have been prepared utilizing AutoCAD 2013.

B. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

C. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Release" form provided by Buro Happold.

D. The electronic contract documents can be used to assist in the preparation of shop drawings and as-built drawings however the electronic media files obtained from Buro Happold are for reference only. The information may not be used in whole or in part for any other project.

E. The drawings prepared for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

F. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

G. The information is provided to expedite the project and assist the Contractor with no guarantee by Buro Happold as to the accuracy or correctness of the information provided. Buro Happold accepts no responsibility or liability for the Contractor's use of these documents.

1.7 REVIEW OF CONTRACT DOCUMENTS AND SITE

A. With the submission of his bid, Contractor shall give written notice to the Owner of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction, and any necessary items of work omitted. In the absence of such written notice it is mutually agreed that the Contractor has included the cost of all required items in his proposal for a complete project.

B. Contractor shall acknowledge that he has examined the Plans, Specifications and Site, and from his own investigations he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials; availability of labor, water, electric power, roads and uncertainties of weather; the conformation and condition of the ground; the character, quality and quantity of surface and subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the work; all federal, state, county, township and municipal laws, ordinances and regulations particularly those relating to employment of labor, rates of wages, and construction methods; and all other matters which can in any way affect work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.

C. The location and elevation of the underground utilities, such as sewers, electrical power, water piping, steam and steam condensate return piping, conduit, etc., is as exact as can be determined from available information and its accuracy cannot be guaranteed. Exact location and elevation of these services shall be verified prior to excavation or installation of any portion of the work indicated. Exercise special care when excavating at or near the general location of underground utilities to avoid damage to the utility services. The Contractors is responsible to insure worker safety.

D. The contractor shall also acknowledge having been to the site and examined conditions under which work must be performed including preparatory work done under other Sections or other Contracts or by the Owner. Report conditions to the Consultant. Do not proceed until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

E. Owner assumes no responsibility for any understanding or representation made during or prior to the negotiation and execution of this Contract unless such understanding or representations are expressly stated in the Contract, and the Contract expressly provides that the responsibility, therefore, is assumed by the Owner.

1.8 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, advise the Consultant in writing before award of Contract. Otherwise, Consultant’s interpretation of the Contract documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguousness thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturer’s recommendations, or with applicable codes and standards, alert the Consultant in writing before installation. Otherwise, make changes in installed work as the Consultant requires within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specification, this contractor shall provide material, installation, or work which is of higher standard.

D. It is the requirement of these documents to have contractor provide systems and components that are fully complete and fully operational and fully suitable for intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of the component or its coordination with other building elements. In cases such as this, where the contractor has failed to notify the Consultant of the situation in accordance with paragraph (A) above, the contractor shall provide specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. In cases covered by paragraph (D) above, where the contractor believes he needs the engineering guidance, he shall submit a sketch identifying his proposed solution and the Consultant shall review, note if necessary, and approve the sketch.

1.9 MODIFICATION IN LAYOUT

A. Plumbing, Electrical, HVAC, and Fire Protection Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show exact routings and locations needed to coordinate with structure and other trades to meet the Consultant’s requirements

B. In order to obtain the Architect’s desired aesthetics in spaces used by building occupants; prior to installation of visible materials, finishes and equipment (including access panels, review Consultant’s Drawings for desired locations and where not definitely indicated, request information from the Architect/Consultant.

C. Check Contract Drawings, as well as Shop Drawings, of all subcontractors to verify and coordinate spaces in which work of this section will be installed

D. Maintain maximum headroom at all locations. All conduit, piping, duct and associated components to be as tight to underside of structure as possible.

E. Make reasonable modifications in layout and components to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C, and D above. Systems shall be run in an organized and rectilinear fashion.

F. Where conflicts or potential conflict exists and engineering guidance is desired, submit sketch of proposed resolution to the Consultant for review and approval

1.10 RFIs

A. If the RFI is a request to resolve a conflict or a un-clarity, or a request for additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraph 1.9(E) above

1.11 PROJECT COMMUNICATION

A. The specification references communication and submittal of information and documents by the Contractor to the Engineers of Record and CM or vice versa. In all cases such communication shall be submitted to the CM who will review it before forwarding to the relevant party for review and response.

B. If the information provided is not in conformance with the specification the CM shall return it to the relevant Contractor for re-submission. The time taken for this process shall be factored into all work schedules and submissions.

1.12 MEASUREMENTS

A. Contractor shall base all his measurements, both horizontal and vertical from established benchmark. All work shall agree with these established lines and levels. He shall verify all measurements at site; and check the correctness of same as related to the work.

1.13 MATERIALS AND WORKMANSHIP

A. Materials shall be new, meet detailed requirements of the Contract Documents and be identifiable as being specified or substitute products.

B. Materials which do not conform to the requirements of the Contract Documents, are not equal to approved samples or are unsatisfactory or unsuited to the purpose for which they are intended, will be rejected.

C. All work shall be performed in the best and most workmanlike manner by tradesmen skilled in their respective trades and properly licensed.

D. All equipment shall be installed in accordance with the recommendation of the manufacturer.

E. Defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or other cause shall be removed within ten (10) days after written notice is given by the Owner's Representative and the work shall be re-executed by the Contractor. The fact that the Owner's Representative may have previously overlooked such defective work shall not constitute total or partial acceptance of it.

F. In no case shall a Bidder base his bid on a class of material or workmanship less than that required by the contract documents nor the governing codes and ordinances.

1.14 CHECKING AND TESTING EQUIPMENT BY CONTRACTORS AND MANUFACTURER'S REPRESENTATIVE

A. All equipment shall be installed in strict accordance with manufacturer's instructions. During construction request supervisory assistance from equipment manufacturer's representatives so the equipment will be correctly installed. After installation, request the Owner's Representative to inspect and see the equipment is in proper working order.

B. Manufacturer's representative shall review the overall system design relative to the proper application of his equipment in the particular system. He shall note conduit, wiring, control, location, and other relevant relationships, and furnish appurtenances necessary for satisfactory operation.

C. Before final payment is issued the following shall be complete:

D. The Contractor's representative shall submit to the CM a signed statement certifying:

1. The equipment is properly installed and ready for operation
2. The owner's maintenance representatives have been thoroughly trained
3. Maintenance and operation manuals issued and accepted by the Owner's Representative.

1.15 TEMPORARY FACILITIES

A. Temporary water and waste per Division 1 requirements.

B. All temporary facilities shall be removed at completion of project.

1.16 SUBMITTALS

A. This paragraph supplements Division 1.

B. Definitions:

1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than shown in Contract Documents.
2. Coordination Drawings are detailed, large scale layout Shop Drawings showing Electrical, HVAC, Plumbing and Fire protection work superimposed in order to identify conflicts and ensure inter-coordination of Electrical, Mechanical, Plumbing, Fire Protection, Structural and other work.

C. Submittal Cover Sheet

1. Shop drawing submittal for each product shall include the copy of following cover sheet completely filled out. Incomplete or incorrect cover sheet submittal shall constitute reason for rejection.
2. Shop drawings shall be submitted according to specification section with a separate cover sheet completed for each product, rather than one cover sheet for multiple products, whether or not supplied by one manufacturer or vendor.
3. In order to maintain the shop drawing review schedule described hereafter, it is important that all submittals include a completed submittal cover sheet for each type of equipment submitted. This requirement will be enforced by the engineer.

SHOP DRAWING COVER SHEET		
PROJECT	CONTRACTOR	
DIVISION NO:	SECTION NO:	
DESCRIPTION:		
CONTRACT DRAWING REFERENCE NO:		
EQUIPMENT TAG:		
SUBMISSION (CIRCLE ONE): I II III IV		
DATE:		
INFORMATION AND CHECKLIST	REPLY	COMMENTS
1. Contractor's Log # ID		
2. Name, address, and phone number of supplier		
3. Are all specified or scheduled items included and exactly match scheduled/specified items.	Yes No	
4. Is this item a substitution?	Yes No	
5. Are deviations clearly identified?	Yes No	
6. Does this equipment fit space shown on construction documents, coordination drawings, and actual field conditions?	Yes No	
7. Has support, erection, weights, and installation been coordinated with all trades?	Yes No	
8. Does the proposed installation void warranties and/or violate UL or code requirements?	Yes No	
9. Does this material/equipment add expense to any other trade or project costs?	Yes No	
10. Does equipment require interface with	Yes No	

other trades? Lists divisions and specifics requiring coordination?		
11. Is control interface coordinated?	Yes No	
12. List electrical characteristics (V/Ph/A)	Yes No	

4.

D. A single set of coordination drawings shall be mutually prepared by all mechanical and electrical trades.

E. The initiation of these drawings begins with Sheet Metal Subcontractor.

F. The Sheet Metal Subcontractor shall prepare a complete set of electronic background drawings at scale not less than 3/8” equals 1’-0”, showing structure and other information as needed for coordination. He shall show sheet metal layout thereon. These will be Coordination Drawings.

G. Each of the mechanical, electrical, plumbing and other specialty trade shall add its work to these background drawings with appropriate elevations and grid dimensions. Specialty trade information is require for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers, and for spaces in and above ceilings where congestion of work may occur such as corridors, and even entire floors. Drawings shall indicate horizontal and vertical dimensions, to avoid interference with structural framing, ceilings, partitions, and other services.

H. Each specialty trade shall sign and date each coordination drawing. Return drawing to the Sheet Metal Subcontractor, who shall route them sequentially to all specialty trades.

I. Where conflicts occur with placement of materials of various trades, the Sheet Metal Subcontractor will be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by specialty trade. The Sheet Metal Subcontractor shall then final date and sign each drawing. If he cannot resolve conflicts, the decision of the General Contractor/Construction Manager shall be final.

J. A Subcontractor who fails to promptly review and incorporate his work on the drawings shall assume full responsibility of any installation conflicts affecting his work and of any schedule ramifications.

K. Sheet Metal Subcontractor shall make prints of all coordination drawings. Fabrication shall not start until such transparencies of completed coordination drawings are received by the Consultant/Engineer and have been reviewed and approved.

L. The review of coordination drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with the other trades, structural and other work.

M. After review:

1. After review of coordination drawings, the method used to resolve interferences not previously identified shall be as in “MODIFICATIONS IN LAYOUT” above.
2. All changes to reviewed coordination drawings shall be in writing by the Consultants/Engineer prior to start of work in affected area.

N. Distribution of Coordination Drawings:

1. The Sheet Metal Subcontractor shall provide the following distribution of documents:

    a. One sepia (reproducible) of each Coordination Drawing to each specialty trade and affected Contractor for their use.
    b. One reproducible of each Coordination drawing to Owner.
    c. One sepia (reproducible) of each coordination drawing to the General Contractor/Construction Manager.
    d. The above documents can be submitted as electronic media upon agreement of all parties.

O. ALL FIREWALLS AND SMOKE PARTITIONS SHALL BE HIGHLIGHTED ON COORDINATION DRAWINGS FOR APPROPRIATE COORDINATION.

P. The main paths of egress and for equipment removal from main mechanical and electrical rooms must be clearly shown on coordination drawings.

Q. Coordination Drawings shall include, but not limited to:

1. Plumbing systems, piping and equipment.
2. HVAC piping, systems and equipment.
3. Control systems.
4. Structural.
5. Environmental Rooms and associated refrigeration/heating systems.
6. Partition/room layout.
7. Ceiling tile and grid.
8. Access panels.
9. Smoke and fire dampers.
10. Major electrical conduit runs, panel-boards, feeder conduit and racks of branch conduit.
11. Heat tracing of piping.
12. Minimum access space requirements for all equipment for both installation and maintenance.

1.17 COORDINATION BUILDING INFORMATION MODEL (BIM)

A. General Requirements:

1. The General Contractor shall appoint a BIM Coordination Manager to prepare a BIM Execution Plan developed specifically for the project, and based on the Computer Integrated Construction (CIC) Research Program's BIM Planning procedures. The BIM Execution Plan will establish the protocols, expected levels of development, and authorized uses of Building Information Models on this Project and assigns specific responsibility for the development of each Model Element to a defined Level.

B. Services to be modelled:

1. All piping (above ½") and all equipment shall be modelled based on the proposed submitted products. The model may be used for production of shop drawings.

C. Clash Detection:

1. Perform three-dimensional component conflict analysis as part of coordination process with all other trades, including but not limited for Mechanical, Plumbing, Fire Protection and Fire Alarm. Resolve component conflicts prior to submittal of shop drawings. Indicate where conflict resolution requires modification of design requirements by Construction Manager.

D. 3D Assets:

1. The contractor shall hand over all digital data files related to the BIM execution plan at the end of the construction process, including all, but not limited to the shop drawings and as built conditions.

1.18 REGULATIONS, CODES, PERMITS, AND FEES

A. Conform to all rules, regulations, standards, ordinances and laws of local, state, and Federal governments and other authorities that have legal jurisdiction over the site.

B. Prior to commencement of work, notify State and applicable authorities as required and submit all of the applicable notifications for construction, operation and demolition. Secure required permits and inspections from any of the authorities having jurisdiction, for this work and pay for all fees required for permits, inspections and review, including special agency construction.

C. Include all utility and local building department charges for providing temporary and permanent electric services to buildings.

D. Provide Owner, Owner's Representative and Inspectors from any of the authorities / agencies having jurisdiction access to work at all times.

E. Contractor shall be responsible for all law violations caused by the work under this Division. Notify Construction Manager in writing when a discrepancy occurs between code requirements and work shown on drawings and resolve matter before proceeding with work.

F. When requirements cited in this specification conflict with each other or with Contract Documents, most stringent shall govern work. Consultants may relax this requirement when such relaxation does not violate ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

G. Make corrections in the work as required by the Owner's Representative or Inspector to pass local regulations.

H. Contractor shall deliver to the Construction Manager any and all certificates of inspections, permits, and approvals. Contractor shall submit final inspection certificates signed by governing authorities to the Owner.

I. Make all necessary submissions to the Department of Environmental Protection, Bureau of Air Resources and Management, Department of Labor and Industry and other agencies having jurisdiction. Pay all required fees for review, registration and sign off.

1.19 OPERATING AND MAINTENANCE MANUALS

A. Obtain at time of purchase of equipment, three copies of operation and maintenance manuals for all items. Assemble literature in coordinated "D" ring notebooks. All information shall also be provided in electronic PDF format. Divide the manuals into three sections or books as follows:

B. System General Description and Information. Section shall include a general description of the systems used and contain names and addresses of manufacturers and local representatives who stock or furnish or repair parts for items or equipment. List of all major equipment as installed and include model number, capacities, nameplate data and manufacturer's location and purchase order information. Include in the manuals, parts catalogs for each item of equipment furnished with the components identified by number for replacement ordering. This section shall also include:

1. Letters from manufacturers certifying their supervision of equipment installation and startup procedures as required.
2. Factory certification test certificates.
3. Equipment test certificates.

C. Operation, Start-up and Shutdown Procedures. Section shall include directions for and sequence of operation for each item of the Plumbing, Mechanical and Electrical systems.

D. Provide a step-by-step write-up and video of the operation, start-up and shut down procedures for all major equipment.

E. Problems, Solutions and Troubleshooting. Section shall include detailed procedures to be followed in case of equipment or system malfunctions. Include manufacturer's printed troubleshooting procedures into the operating manual for reference.

F. Preventative Maintenance. Section shall include preventative maintenance requirements and schedule for each piece of equipment.

G. Furnish three copies of manuals to the Consultant for approval and distribution to Owner. Deliver manuals no less than 30 days prior to project close-out or 10 days prior to commissioning whichever is sooner.

1.20 RECORD DOCUMENTS (AS-BUILTS)

A. As work progresses and for duration of Contract, maintain current complete and separate sets of prints of Contract drawings at job site. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to original design. Include actual location of existing utilities if they differ from design documents.

B. Underground utility services, both inside and outside of buildings, shall be dimensioned from permanent structures or benchmark. Utility services outside of buildings shall also show depth of burial with reference to the finished ground floor elevation.

C. Drawings shall show record condition of details, sections, riser diagrams, control changes and correction to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation. All elements shall be dimensioned from grid lines or benchmarks and all elevations shall be noted. Construction notes (such as component numbers, conflict notes, etc.) shall be removed and the drawings shall clearly be noted in the title block as being as-built drawings.

D. At the completion of the project, prepare a complete set of record drawings, showing all systems actually installed, as well as electronic files on latest CAD version.

E. The design tracings will be made available for Contractor’s copying, at his expense, into reproducible to serve as background drawings. The quantity of design tracings, which are made available shall in no way be interpreted as setting a limit to the number of drawings necessary to show required information. Contractor’s professional draftsperson shall transfer changes to record files and then submit the electronic files and three sets of prints to the Consultant for comments as to compliance with this section.

F. The record set reproducible, as corrected and recorded by the Contractor, shall be submitted to the Owner's Representative for approval prior to authorization for final payment. Record drawings shall be certified as to their correctness by the signature of the Contractor, and shall be stamped or otherwise identified as record drawings. THE CONSULTANT WILL NOT CERTIFY THE ACCURACY OF THE RECORD DRAWINGS – THIS IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

G. Each trade shall submit a record set for approval by the building department in a form acceptable to the department, when required by the jurisdiction. Such drawing format size changes, and supplemental information required for the submittal are the requirement of the contractor.

1.21 COOPERATION BETWEEN TRADES

A. Cooperate with all other Divisions performing work on this project as necessary to achieve a complete neatly fitted installation for each condition. Consult the Drawings and Specifications to determine nature and extent of work specified in other Divisions that adjoins or attaches to the work of this Division. Confer with other Divisions at the site to coordinate this work with theirs in view of job conditions to the end that interferences may be eliminated and that maximum head room and clearance may be obtained. In the event that interferences develop, the Owner's Representative's decision will be final as to which Division shall relocate its work, and no additional compensation will be allowed for the moving of piping, ductwork, conduit, or equipment, to clear such interferences. Provide templates, information, and instructions to other divisions to properly locate holes and openings to be cut or provided

1.22 HOIST, RIGGING, TRANSPORTATION AND SCAFFOLDING

A. Provide all scaffolding, staging, cribbing, tackle hoist and rigging necessary for placing all materials and equipment in their proper places in the Project. All temporary work shall be removed from the premises when its use is no longer required.

1.23 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Perform all handling and shipping in accordance with manufacturer's recommendations. Provide protective coverings during construction.

B. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed Shop Drawings.

C. Keep all materials clean, dry and free from damaging environments during construction.

D. Cap all openings in piping daily to protect against entry by foreign matter.

E. Protect premises and Work of other Divisions from damage arising out of installation of Work of this Division.

F. Perform Work in manner precluding unnecessary safety and hazard.

G. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no increase in Contract Sum. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed. Provide temporary storage facilities for material and equipment. Material, equipment or apparatus damaged because of improper storage or protection will be rejected. Remove from Site and provide new, duplicate material, equipment or apparatus in replacement of that rejected.

H. All stock piled piping shall be placed on dunnage, and protected from weather and from entry of foreign material. All stored materials and equipment shall be carefully inspected prior to installation and replaced with new material or equipment if found to be damaged, corroded, etc.

1.24 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee the Work of this section for one year following the date of Substantial Completion or successful system performance whichever requires later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the owner.

B. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Consultant’s satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

C. In addition to guarantee requirements of Division 1 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer’s published data without exclusion or limitation, in Owner’s name.

D. Replace material and equipment that require excessive service during guarantee period as defined and as directed by the Consultant.

E. Provide 24 hour service beginning on the date of substantial completion and lasting until the termination of guarantee period. Service shall be at no cost to Owner. Service can be provided by this Contractor or a separate service organization. Choice of service organization shall be subject to the Consultant and Owner approval. Submit name and phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

F. Submit copies of equipment and material warranties to Consultants before final payment.

G. At end of guarantee period, transfer manufacturer's equipment and warranties still in force to Owner.

H. This paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws under this Contract.

I. Part 2 Paragraphs of the Specification sections may specify warranty requirements that may exceed those of this Paragraph.

J. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute guarantee period.

K. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise the Consultant in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Consultants will suggest course of action.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment and materials shall be as described in the respective Sections of Division 21, 22, 23 and Division 26 and as shown.

2.2 MATERIALS

A. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified. And or/as required to provide a fully operational installation.

B. Equipment, material damaged during transportation, installation, and operation is considered as totally damaged. Replace with new. Payment for this equipment shall not be approved. Variance from this permitted only with written acceptance.

C. All items of materials in each category of equipment shall be of one manufacturer.

D. Material and Equipment–General Requirements:

1. All equipment and components shall be New.
2. Testing agency labeled or with other identification wherever standards have been established.
3. Owner's Representative reserves right to reject items not in accordance with Specification either before or after installation.
4. Comprised to render complete and operable systems; provide additional items needed to complete installation to realized design.
5. Installed fully operating and without objectionable noise or vibration.

PART 3 - EXECUTION

3.1 COMMISSIONING OF EQUIPMENT AND SYSTEMS

A. General

1. Completion of startup and commissioning shall be accomplished as a prerequisite for substantial completion and shall be completed for each phase of construction.
2. Operate and maintain systems and equipment until final acceptance by Owner.
3. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner. Acceptance requires, at a minimum complete systems and commissioning.
4. The Owner maintains the right to have access to the entire project site to develop his own operational procedures.

B. Comprehensive Work Plan and Reporting

1. Provide detailed, methodical, scheduled, start up and commissioning procedures and execution of same and every system and piece of equipment provided.
2. Attend start up and commissioning meetings on a regular basis, as directed by the General Contractor or Construction Manager.
3. Develop and provide a written work plan with detailed procedures for this work and submit, using shop drawing submittal procedure, within 6 weeks of the contract award. The work plan shall include provisions for an integrated start up plan and schedule. The plan and schedule shall identify tasks, start and completion dates, critical path items, interface requirements with other trades and major equipment start up, as minimum requirements of the plan. The plan and schedule shall clearly identify work in each construction phase, as well.

4. The purpose of this work plan is to provide for smooth, quick, and efficient start up and commissioning of systems and equipment and for a smooth transition to turn the complete, correctly operating building over to the Owner, at each phase of construction.
5. The Owner and the Consultant will have input to and be part of approval process for startup and commissioning plan.
6. Develop and submit for approval a specific start up, check out and sign off form for every piece of major equipment.
7. Develop and submit for approval a specific start up, check out and sign off form for every piece of major system.
8. Systems shall be operated under actual or simulated full load conditions. Identify the operating conditions in the work plan.
9. Work plan shall incorporate the below specified “Demonstration of Successful Operation”
10. The Consultant/Owner may check the completed and commissioned installation either sequentially as different parts are completed, and/or when the entire installation is complete, at sole option of the Consultant/Owner.
11. Each contractor shall arrange that an officer of his contracting company shall certify that each and every system has been tested. At the conclusion of the tests, this contractor shall submit a letter and enclosed commissioning forms signed by the officer stating:

    a. That he/she is the officer of the company.
    b. That he/she certifies that the specified testing of the systems has been performed by the company (give the name and dates of system testing).
    c. The results of testing as compared to specified performance, listing the name, title, and company affiliation of all those witnessing and performing these tests.

C. Commissioning

1. Commission equipment and systems in accordance with the approved work plan, completing the startup, check out and sign off forms for each piece of equipment and each system.
2. Provide qualified personnel, equipment, apparatus and services for startup and testing of equipment and systems, to obtain the performance shown in schedules, as specified or on commissioning forms, and as required by codes, standards, regulations and authorities having jurisdiction including Municipal Inspectors, Owners and Consultants.
3. Start up and testing procedures as may be outlined in various mechanical and electrical sections of the specifications are the minimum effort required for the project. Contractor shall use any additional procedures he feels will be necessary to properly start up and test the systems and equipment actually installed on the job at no additional cost to the Owner.
4. Provide capacity and performance of equipment by field testing. Install thermowells and gauge connections and, at no additional cost to Owner, equipment and instruments required for testing.
5. Qualified representative of equipment manufacturer shall be present at test.

6. For each piece of equipment, copy nameplate data and include with the letter and start up, check out and sign off forms referred to above.
7. Do not cover or conceal work before testing and inspection and obtaining approval.
8. Leaks, damage and defects discovered or resulting from startup and testing shall be repaired or replaced by this contract to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

D. Demonstration of Successful Operation: After all components and every system has been completely commissioned, provide a two week, 24 hour per day fully functional automatic operation period of all systems simultaneously. This shall be successfully concluded before systems are accepted by the Owner.

3.2 SPECIAL RESPONSIBILITIES:

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed.
2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.
3. Obtain detailed installation information from manufacturers of equipment provided under this section.
4. Obtain final roughing dimensions or other information needed for complete installation of items furnished under other Sections or by Owner.
5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information on proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Consultants.
6. Provide information as requested as to sizes, number and locations of pads necessary for floor mounted equipment provided under this Section.
7. Notify Consultants of location and extent of existing piping, conduit, ductwork and equipment that interferes with new construction. In coordination with and with approval of Consultants, relocate piping, ductwork and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned piping, ductwork and equipment as directed by Consultants. Dispose of or store items as requested by Consultants.

B. Installation Only Items

1. Where this contractor is required to install items which it does not purchase, it shall coordinate delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to time of installation. This trade shall be responsible for:

    a. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt to Consultant's and structural conditions.
    b. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

2. This contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted this contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

C. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

D. Use of premises: Use of premises shall be restricted as directed by the Consultant and as required below:

1. Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove equipment and unused material. Put building and premises in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of the Consultant.
2. Store materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets of racks and covered with tarpaulins.
3. Do not interfere with function of existing sewers and water and gas mains, electrical or mechanical systems and services. Extreme care shall be observed to prevent debris from entering pipe, ductwork and equipment. Confer with the Consultant as to the disruption of services or other utilities due to testing, connection of new work to existing. Interruption of services shall be performed at time of day or night deemed by Owner to provide minimal interference with normal operation. Obtain Owner's approval of the method proposed for minimizing service interruption.

E. Surveys and Measurements:

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct laying out of work.
2. In event of discrepancy between actual measurements and those indicated, notify the Consultant in writing and do not proceed with work until written instructions have been issued by the Consultant.

F. Fireproofing:

1. Clip, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible prior to start of spray fiber work.
2. Conduit and other items which would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.
3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this section shall be shall be performed by installer of fireproofing and paid for by the trade responsible for damage and shall not constitute grounds for an extra to Owner.

G. Temporary Utilities:

1. Refer to Division 1 regarding requirements.
2. Furnish temporary equipment, and piping as needed during the construction phase. Remove temporary items after use.

3.3 MATERIAL AND WORKMANSHIP

A. Work shall be neat and rectilinear. Conduit shall run concealed except in mechanical rooms and areas where no hung ceiling exists. Install material and equipment to comply with manufacturers. Recommended Requirements. Rough Work will be rejected. Work shall be properly and effectively protected, and conduit openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents.

C. Finish of materials, components and equipment shall be as approved by the Consultant and shall be resistant to corrosion and weather as necessary.

D. Owner will not be responsible for material and equipment before testing, commissioning, and acceptance.

3.4 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner’s approval.

B. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at such times of day and work so that they have minimal impact to Owner's operations.

D. Subcontractor shall coordinate any shutdowns of existing systems as follows:

1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days are required.
2. Minimize shutdowns of any system.
3. Provide temporary services where required and perform shutdown and tie-ins at a time convenient to Owner.
4. Subcontractor shall be responsible for completing and filing Owner's shutdown notice questionnaire.
5. Perform required survey and inspection work required by the notice for shutdown.

E. Include premium time work associated with interruption of services and/or shutdown as necessary to avoid disruption to Owner's operations.

3.5 ANCHORS AND INSERTS:

A. Inserts shall be iron or steel of type to receive machine bolt head or nut after installation. Insert shall permit adjustment of bolt in one horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

B. Provide anchors as necessary for attachment of equipment support and hangers.

3.6 CORE DRILLING

A. Core drilling is to be avoided.

B. Set sleeves prior to installation of structure for passage of conduits, etc.

C. Where core drilling is unavoidable, or required by renovation projects, locate all required openings prior to coring and submit to the Consultant for review.

D. Coordinate openings with General Contractor/Construction Manager and all other trades.

E. Core drilling is to be provided by the Contractor for General Construction and not by the M/E subcontractors.

F. Do not disturb existing systems.

G. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.

3.7 CUTTING AND PATCHING:

A. Complete cutting and patching in accordance with Division 1, Cutting and Patching Article, and as follows.

B. Provide all sleeves, core drilling, carpentry, cutting and patching required for proper installation of material and equipment specified in this Division.

C. Do not cut or drill structural members without written approval of Owner's Representative and structural engineer.

D. No cutting or patching should be done without first receiving the Consultant's and Structural Engineer's written approval.

E. Any damage caused by cutting and patching shall be restored to the original condition as required by the Consultant.

3.8 WATERPROOF CONSTRUCTION:

A. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashing at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls and floors. Provide membrane clamps at penetrations of waterproof membranes.

B. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rainwater. This requirement applies to damper operators and bearing, damper motors, controls, and instruments. See other paragraphs in this Division for application of this requirement to panels, motors, and devices.

3.9 RESTORATION OF DAMAGE:

A. Repair or replace, as directed by the Consultant and/or Owner's Representative, materials and parts of premises which become damaged as result of installation of Work of this Division. Remove replaced parts from premises.

3.10 TOOLS AND EQUIPMENT

A. Furnish all tools and equipment necessary for the proper installation, protection and upkeep of the Work.

3.11 ADJUSTMENTS

A. Preliminary Operation:

1. Operate any portion of installation for Owner's convenience if so requested by Construction Manager. Such operation does not constitute acceptance of Work as complete. Cost of utilities, such as gas and electrical power, will be borne by Owner if Owner requests operation.

B. Start-up Service:

1. Prior to startup, ensure that systems are ready for their intended use.

C. Start and operate all systems. Provide services of factory trained technicians for startup of major equipment and systems.

D. Adjusting:

1. Adjust all equipment and system components as shown or as otherwise required to result in intended system operation.
2. Thereafter, as a result of system operation or as directed by Owner’s Representative, make readjustments as necessary to refine performance and to effect complete system "tune-up".
3. After completion of testing and adjustment, operate the different systems and equipment under normal working conditions for 72 hours continuously and show specified performance.
4. If, in the opinion of the Consultant, performance of equipment or systems is not in accordance with specifications or submitted data, alter or replace equipment at no increase in Contract Sum. The Contractor, at his option, may order tests from an independent approved laboratory to prove compliance. All such tests shall be at no increase in Contract Sum. Repeat process as often as required. If the reason for unsatisfactory operation is design errors all additional cost for corrective measures will be reimbursed to the contractor.
5. At completion of Work, provide written certification that all systems are functioning properly without defects.

E. Noise:

1. Cooperate in reducing any objectionable noise or vibration caused by electrical systems to the extent of adjustments to specified and installed equipment and appurtenances.
2. Cooperate in adjustment of mechanical systems and terminal devices, as directed by Owner’s Representative, to obtain specified acoustic properties.
3. Completely correct noise problems caused by failure to make installation in accordance with Contract Documents, including labor and materials required as a result of such failure, at no increase in Contract Sum. Includes refinish walls, floors etc.

3.12 INSTALLATION OF EQUIPMENT

A. Use printed descriptions, specifications and recommendations of manufacturers as a guide for installation of Work.

B. Assemble equipment required to be field assembled under the direct supervision of the manufacturers' agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.

C. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to the satisfaction of the Consultant and in accordance with code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

D. Install equipment so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof mounted equipment shall be installed and supported on structural steel provided under other Sections.

E. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall of ceiling mounting of equipment as required.

F. Provide steel supports and hardware for proper installation of hangers, anchors, guides, etc.

G. Provide cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installations.

H. Structural steel and hardware shall conform to Standard specifications of ASTM; use of steel and hardware shall conform to requirements of Section V of Code of Practice of American Institute of Steel Construction.

I. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly, which will void warrantee. Report in writing to the Consultant, prior to purchase or shipment of equipment involved, on conditions which may prevent proper installation.

3.13 PAINTING

A. Equipment installed shall have shop coat of non-lead paint. Hangers and supports shall have one coat of non-lead primer. Finish painting, including painting of various conduit or wire way systems, shall be done under other Sections.

B. Paint all outside exposed equipment and equipment supports with two coats of weather resistant enamel.

C. Properly prepare Work under this Division to be finish painted under Division 9.

D. Refer to standard paint colors for all Plumbing equipment inside the Building.

3.14 SELECTIVE DEMOLITION

A. Refer to all drawings for general description of areas requiring demolition.

B. Refer to General Contractor's/Construction Manager's Instructions for all existing equipment and materials that shall remain the property of the Owner.

C. Items of value which are not directed to be returned to the Owner shall become the property of the Contractor. Storage or sale of items on the project site is prohibited.

D. Protection: Ensure the safe passage of persons in and around building during demolition. Prevent injury to persons and damage to property. Provide adequate shoring and bracing to prevent collapse. Immediately repair damaged property to the condition before being damaged. Take effective measures to prevent windblown dust.

E. Utilities: Maintain all utilities except those requiring removal or relocation. Keep utilities in service and protect from damage. Do not interrupt utilities serving used areas without first obtaining permission from the utility company and the Owner. Provide temporary services as required.

3.15 JOBSITE SAFETY

A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employees and sub-consultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insured's under the Contractor's general liability insurance policy.

3.16 FINAL JOBSITE OBSERVATION

A. As the work nears completion, the Contractor is to review the requirements of the Contract Documents, inspect the work and inform all parties involved of the work to be corrected or completed before the project can be deemed substantially complete.

B. When the Project is substantially complete, In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation. Notify the Owner's Representative in writing of this fact, listing any items of Work remaining incomplete, the reason therefore, and the anticipated date that all remaining work will be completed. The Contractor shall inform the certification that the project is complete and ready for a final punch; the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

C. It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineers additional time and expenses will be deducted from the Contractor’s contract retainage prior to final payment at the completion of the job.

D. The Contractor shall carry out their own final inspection and satisfy the Work.

E. The Owner's Representative reserves the right to cancel and reschedule the inspection in the event considerable more work remains to be completed or corrected than indicated in the written request for inspection.

F. All items not completed or found not complying with drawings or specifications by the Owner’s Representative will be identified in their inspection report.

G. Correct all items on inspection report. Make the correction and initial and date each item on the report after corrections have been completed.

H. Include the fee for all local inspections.

3.17 INSTRUCTING THE OWNER’S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Owner has the option to video tape all instructions. Coordinate schedule of instructions to facilitate this recording.

D. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

3.18 PROJECT CLOSE-OUT PROCEDURE

A. General

1. The requirements of this section are in addition to and supplement the requirements outlined in Division 1.
2. It shall be each contractor's responsibility to personally hand-deliver all of the required project close-out checklist items and to obtain Owner's authorized representative(s) signed receipt on all items requiring Owner sign-off.

B. Project Close-Out Checklist

1. Review requirements of each section of the specifications and submit for approval to Consultants the sign-off forms which shall become the project close-out checklist. These, at a minimum, shall include the following information shown in attached Project Closeout Checklist Example. The Consultants and/or Owner may incorporate additional specific items to the following checklist which shall become part of project requirements.
2. Close-Out Checklist Example:

PROJECT CLOSE-OUT			
PROJECT:			
DIVISION NO:			
CONTRACTOR:			
ITEM1	DATES		OWNER'S SIGN-OFF
	COMPLETED	RECEIVED BY OWNER	
Permits			
City and County Inspection			
Manufacturer's Warranties			
Factory Startup Reports Submitted			
Copy of Final Shop Drawings			
List and Possession of Spare Parts			
Pressure Tests			
Equipment Tests Required by Specs			
O&M Manuals			
Record Documents			
Coordination Drawings			
Sanitization Reports			
Commissioning Reports/Letters/Forms			
On Site Training Complete			
Protective Device Settings			
Valve Tags and Charts			
Final ATC Installation Drawings			
Insurance Underwriters Approvals			

Final Punch List (Initialed by contractor that items are complete)			
Building Certificate of Occupancy			
24 Hr. Phone No. for Service During Guarantee Period.			
1 Provide separate line item for each specified item (do not group items).			

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

3. 1. Penetrations fire sealed and labeled in accordance with specifications.
4. 2. All pumps operating and balanced.
5. 3. All plumbing fixtures installed and caulked.
6. 4. Pipe insulation complete, pipes labeled and valves tagged.
7. 5. Factory startup reports for water softener and hot water systems
8. 6. Factory startup reports for pressure boosting system
9. 7. Factory startup reports for grey water treatment system
10. 8. Factory startup reports for black water treatment system

Accepted by:

Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Engineer so that the final observation can be scheduled.

It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

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 piping and related specialties for general-service compressed-air systems operating at 200 psig or less.

B. Related Sections include the following:

1. Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. HDPE: High-density polyethylene plastic.

E. NBR: Acrylonitrile-butadiene rubber.

F. PE: Polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.

I. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures." Insert applicable code requirement.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Plastic pipes, fittings, and valves.
2. Dielectric fittings.
3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.
8. Lubricators. Include rated capacities and operating characteristics.
9. Quick couplings.
10. Hose assemblies.

1.6 INFORMATIONAL SUBMITTALS

A. Brazing and welding certificates.

B. Qualification Data: For Installers.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.

3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
7. Grooved-End Fittings and Couplings:

a. Grooved-End Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron casting; with grooves according to AWWA C606 and dimensions matching steel pipe.
b. Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300-psig minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gaskets for oil-free compressed air. Provide NBR gaskets if compressed air contains oil or oil vapor.

B. Copper Tube: ASTM B 88, Type K or L seamless, drawn-temper, water tube.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
3. Copper Unions: ASME B16.22 or MSS SP-123.
4. Press-Type Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

5. Press-Type Fittings, NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
6. Grooved-End Fittings and Couplings:

a. Grooved-End Fittings: ASTM B 75, copper tube or ASTM B 584, bronze castings.
b. Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.

C. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

D. Blue ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are light blue and sizes are in millimeters.

1. Transition Fittings, 20 to 63 mm: Composite union with ABS socket end, CR O-ring, and malleable-iron union nut and threaded end; with construction similar to MSS SP-107, transition union.
2. Transition Fittings, 90 to 110 mm: Flange assembly with ABS flange, CR gasket, and metal flange of material matching piping to be connected.
3. Valves, 20 to 63 mm: ABS union ball valve with socket ends.
4. Valves, 90 to 110 mm: ABS butterfly valve with lever handle.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

2.3 VALVES

A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

    a. Standard: ASSE 1079.
    b. Pressure Rating: 125 psig minimum at 180 deg F.
    c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 125 psig minimum at 180 deg F.
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Description:

    a. Nonconducting materials for field assembly of companion flanges.
    b. Pressure Rating: 150 psig.
    c. Gasket: Neoprene or phenolic.
    d. Bolt Sleeves: Phenolic or polyethylene.
    e. Washers: Phenolic with steel backing washers.

2.5 FLEXIBLE PIPE CONNECTORS

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:

B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

E. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

F. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded.

G. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock.

H. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal.

1. Provide with automatic feed device for supplying oil to lubricator.

2.7 QUICK COUPLINGS

A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

B. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Flow-sensor-bleeder, check-valve Straight-through type with barbed outlet for attaching hose.

C. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
2. Plug End: With barbed outlet for attaching hose.

2.8 HOSE ASSEMBLIES

A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.

1. Hose: Reinforced single- or double double-wire-braid, CR-covered hose for compressed-air service.
2. Hose Clamps: Stainless-steel clamps or bands.
3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Piping between Air Compressors and Receivers: Use one of the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, galvanized-steel pipe; threaded, malleable-iron fittings; and threaded joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:

1. Insert pipe size and Smaller: Schedule 40, galvanized-steel pipe; threaded, malleable-iron fittings; and threaded joints.

C. Drain Piping: Use one of the following piping materials:

1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.

3.2 VALVE APPLICATIONS

A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Articles in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping,"according to the following:

1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
2. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
3. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
4. Grooved-end valves may be used with grooved-end piping and grooved joints.

B. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.

1. Blue ABS Piping System: Ball and butterfly valves.
2. Green ABS Piping System: Ball valves.
3. HDPE Piping System: Ball valves.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and brazed or soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2014.

K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

L. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

M. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

N. Install piping to permit valve servicing.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."

G. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

I. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.

J. Heat-Fusion Joints for PE Piping: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 for socket-fusion joints.

K. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.

L. Solvent-Cemented Joints for ABS Piping: Clean and dry joining surfaces. Join according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2235 Appendix.

M. Solvent-Cemented Joints for PVC Piping: Clean and dry joining surfaces. Join according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.

N. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.7 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air-line pressure regulators in branch piping to equipment and tools.

D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.

E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.

F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated.

G. Install quick couplings at piping terminals for hose connections.

H. Install hose assemblies at hose connections.

3.8 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches of each fitting and coupling.

H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

I. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
3. NPS 1-1/2: 12 feet with 3/8-inch rod.

J. Install supports for vertical, Schedule 40, steel piping every 15 feet.

K. Install hangers for Schedule 5, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/2: 72 inches with 3/8-inch rod.
2. NPS 3/4: 84 inches with 3/8-inch rod.
3. NPS 1: 96 inches with 3/8-inch rod.
4. NPS 1-1/4: 108 inches with 3/8-inch rod.
5. NPS 1-1/2: 10 feet with 3/8-inch rod.
6. NPS 2: 11 feet with 3/8-inch rod.

L. Install supports for vertical, Schedule 5, steel piping every 10 feet.

M. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.

9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
13. NPS 6: 20 feet with 5/8-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

N. Install supports for vertical copper tubing every 10 feet.

O. Install vinyl-coated hangers for ABS piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F.
2. NPS 3/8 and NPS 1/2: 30 inches with 3/8-inch rod.
3. NPS 3/4: 38 inches with 3/8-inch rod.
4. NPS 1: 40 inches with 3/8-inch rod.
5. NPS 1-1/4: 45 inches with 3/8-inch rod.
6. NPS 1-1/2: 52 inches with 3/8-inch rod.

P. Install supports for vertical ABS piping every 48 inches.

Q. Install vinyl-coated hangers for HDPE piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with compressed air at normal operating temperature above 100 deg F.
2. NPS 1/2: 30 inches with 3/8-inch rod.
3. NPS 3/4: 35 inches with 3/8-inch rod.
4. NPS 1: 40 inches with 3/8-inch rod.

R. Install supports for vertical HDPE piping every 48 inches.

3.10 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Piping Leak Tests for ABS Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 110 deg F or less, to pressure of 40 psig above system operating pressure, but not less than 80 psig or more than 120 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
3. Piping Leak Tests for HDPE Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen, at temperature of 100 deg F or less, to pressure of 40 psig above system operating pressure, but not less than 125 psig or more than 180 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
4. Repair leaks and retest until no leaks exist.
5. Inspect pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION

SECTION 260010 - ELECTRICAL GENERAL CONDITIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 1 - General Requirements, and shall include all Sections of Division 26 and shall apply to all Work specified, indicated in the Drawings, and as required to furnish a complete installation of electrical systems for the Project. Review all Sections of the Specifications for related work and coordinate the work of this Section with all other Sections.

B. Furnish all labor, services, materials, tools, equipment, appliances, facilities, transportation and incidental work and appurtenances required to furnish a complete and properly operating system.

C. The Contractor shall refer to other trades' interior details, floor plans, elevations, and the structural and other Contract Drawings and shall coordinate the work with that of the other trades to avoid interference. The plans are diagrammatic and show the general arrangement of the conduit, switchboards, panelboards, transformers, generators, transfer switches and equipment. All dimensions and existing conditions shall be the responsibility the Contractor. Before proceeding with work check and verify all dimensions.

D. The Contractor shall assume all responsibility for fitting of materials and equipment to other parts of equipment and structure. Make adjustments that may be necessary or as requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades. Where existing pipes, conduits and/or ducts prevent installation of new work as indicated, relocate, or arrange for relocation with the applicable trades, existing pipes, conduits and/or ducts.

E. Where the project involves interface with existing building and site systems, the Consultant has used reasonable care to identify existing utilities and services. The Contractor is responsible to thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available i.e. concealed conditions, which exist in the existing building affected by this work.

F. Documents do not represent to show or list every item to be provided. When an item not shown or listed, is necessary for proper operation of the system and/or equipment, the Contractor shall provide the item which will allow the system to function properly at no increase in Contract Sum.

G. Work shall include, but shall not be limited to, the following:
   1. Coordinate maintenance of existing services during construction with Owner.
   2. Special coordination of chases and plenums.

3. Hoisting and rigging required to complete work of this section.
4. Sleeves, inserts and hangers.
5. Equipment bases and supports.
6. Low Voltage Transmission System
7. Prime painting.
8. Panelboard and major component identification.
9. Power wiring to all DDC control panels and controls.
10. Power and disconnects to all Division 21, 22, 23, 27 and 28 equipment.
11. Instruction manual and start up instructions.
12. Testing.
13. Commissioning.
14. Cleaning.

H. Related work specified elsewhere: The following work, unless otherwise noted is not included in this section shall be performed in other sections:

1. Fire-stopping shall be by the trade contractor.
2. Cutting and patching of masonry, concrete, tile and other parts of structure, with the exception of drilling for hangers and providing holes and openings in metal deck.
3. Flashing of wall and roof penetrations.
4. Partitions and Painting (except as specifically indicated) shall be by trade contractor.
5. Structural supports necessary to distribute loading from equipment to roof or floor, except as specified herein.

1.2 QUALITY ASSURANCE

A. General:

1. All equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacturer.
2. All equipment and accessories shall be new and free from defects.
3. Supply all equipment and accessories in compliance with the applicable standards listed in this Section and with all applicable National, State and Local Codes.
4. All items of a given type shall be the product of the same manufacturer.
5. Install work by craftsmen skilled in trade involved and by apprentices as indicated in the general conditions. Rough work will be rejected.
6. The subcontractor must, within the last five years, prior to the bid opening, have successfully completed in a timely fashion at least three projects similar in scope and type to the required work.

B. Requirement of regulatory agencies:

1. In accordance with requirements of Division 1 and as specified herein.
2. Nothing in the Drawings or Specifications shall be construed to permit Work not conforming to applicable laws, ordinances, rules or regulations.

3. When Drawings or Specifications exceed requirements of applicable laws, ordinances, rules or regulations, Drawings and Specifications take precedence.
4. It is not the intent of Drawings and Specifications to repeat requirements of codes except where necessary for completeness or clarity.
5. If any of the requirements of the above are in conflict with one another, or with the requirements of these specifications, the most stringent requirements shall govern.

C. Green Building Performance Requirements

1. The Contractor shall implement practices and procedures to meet the targeted LEED requirements.

1.3 APPLICABLE PUBLICATION

A. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. American National Standards (ANSI).
3. American Society of Testing and Materials (ASTM).
4. Underwriter's Laboratories (UL).
5. National Electrical Code (NEC)
6. Insulated Cable Engineers Association (ICEA).
7. Institute of Electrical and Electronic Engineers (IEEE).
8. National Electrical Manufacturers' Association (NEMA).
9. National Electrical Testing Association, Inc (NETA).
10. National Fire Protection Association (NFPA).
11. Occupational Safety and Health Act (OSHA)
12. Certified Ballast Manufacturers (CBM).
13. Owner's Insurance Underwriter.

B. All materials and equipment shall be listed by Underwriters• Laboratories (UL), and approved by ANSI, ASTM, and NEC for intended service.

C. Most recent editions of applicable specifications and publications of the following organizations form part of these Contract Documents.

1. American National Standards Institute (ANSI)
2. American Society of Testing and Materials (ASTM).
3. Underwriter's Laboratories (UL).
4. National Electrical Code (NEC)
5. Insulated Cable Engineers Association (ICEA).
6. Institute of Electrical and Electronic Engineers (IEEE).
7. National Electrical Manufacturers' Association (NEMA).
8. National Electrical Testing Association, Inc (NETA).
9. National Fire Protection Association (NFPA).

10. Occupational Safety and Health Act (OSHA)
11. Certified Ballast Manufacturers (CBM)
12. Illuminating Engineering Society (IES)

D. Specific reference is made to following NFPA codes which contain an exceptionally high quantity of mechanical, electrical, and fire protection requirements.

1. No. 20 - Installation of centrifugal fire pumps.
2. No. 70 - National Electric Code
3. No. 72D - Proprietary Protective Signaling Systems
4. No. 72E - Automatic Fire Detectors
5. NFPA 110 - Standard for Emergency and Standby Power Systems

1.4 DEFINITIONS

A. Provide - means furnish and install, complete, the specified material, equipment or other item and perform all required labor to make a finished and properly operational installation.

B. Furnish - means to purchase and deliver to project site complete with all appurtenance and support.

C. Install - means to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project

D. Consultant - means 'Prime Design Consultant'. An individual or organization engaged by the owner to render professional engineering consulting services concerning the content of the Mechanical, Electrical, Plumbing & Fire Protection sections of specifications.

E. Owner - means the individual or entity with whom Contractor has entered into the Agreement for whom the Work is to be performed.

F. Construction Manager Advisor - means the Construction Manager that provides services to advise the Owner on design and materials decisions during the design and document development process. The CMA coordinates the entire design process using his skills and knowledge of construction to clarify cost and time considerations of design decisions, to advise on feasibility of single, multiple-contract or fast-track delivery systems, recommend the construction process, and to handle the bidding and award, as well as to manage the construction of the Project.

G. Construction Manager Constructor or 'CMC' - means the Construction Manager that in addition to acting as an advisor to the Owner during a design period, assumes responsibility for the construction of the Project. The CMC become contractually bound to provide the labor and material for the Project. The CMC may also serve as administrator of multiple prime contract construction; however, some states prohibit that practice.

H. General Contractor/ Prime Contractor means the contractor who contracts with a property owner and, in turn, employs a subcontractor or subcontractors to perform some of all of the work.

I. Contractor or Subcontractor - means the trade contractor responsible for the work in this Division of the specification.

J. Owner's Representative - means the Consultant, Engineer, or other Specialty Consultant retained by the Owner.

K. RFI - means Contractor's Request for Information

L. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

M. Accessible: Ability to perform recommended maintenance without removal of services or equipment and requiring no special platforms.

N. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

O. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

P. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

Q. "Connect": Complete hook-up of item with required service.

R. "Exposed": Not installed underground or "concealed."

S. "Indicated," "Shown" or " "Noted": As indicated, shown or noted on Drawings or Specifications.

T. "Install": To erect, mount and connect complete with related accessories.

U. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

V. "Reviewed," "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Engineer/Owner.

W. "Rough-In": Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

X. "Shall": An exhortation or command to complete the specified task.

Y. "Similar" or "Equal": Of base bid manufacture, equal in performance, materials, weight, size, design, and efficiency of specified products.

Z. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

AA. Typical or Typ: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

BB. "Will": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

CC. "Wiring": Raceway, fittings, wire, boxes and related items.

DD. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

EE. Reference by abbreviation may be made in the specifications and the Contract Drawings for Mechanical and Electrical Work in accordance with the following list:

HVAC Heating, Ventilating and Air Conditioning

GC General Contractor

AWG American Wire Gauge

USS United States Standards

ASTM American Society of Testing Materials

ASA American Standards Association

AC: Alternating Current.

AIC: Ampere Interrupting Capacity.

ADA: Americans with Disabilities Act.

ANSI: American National Standards Institute.

AWG: American Wire Gauge.

CBM: Certified Ballast Manufacturers.

DC: Direct Current.

ETL: Electrical Testing Laboratory.

HID: High Intensity Discharge.

HP: Horsepower.

ICEA: Insulated Cable Engineers Association

IEEE: Institute of Electrical and Electronic Engineers.

NEMA: National Electrical Manufacturers' Association.

NETA: National Electrical Testing Association, Inc.

NFPA: National Fire Protection Association.

OSHA: Occupational Safety and Health Act.

PVC: Polyvinyl chloride.

UBC: Uniform Building Code.

UL: Underwriters' Laboratories,

1.5 SCOPE

A. Perform work and provide material and equipment as shown on the drawings and/or as specified and/or as indicated in this section of the specifications. Completely coordinate all work of this section with work of other trades and provide a complete and fully functional installation

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly require by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and back-charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

D. Contractor shall be responsible with obtaining all the final inspection as required by Local Code and ordinances.

1.6 CONTRACT DOCUMENTS

A. Listing of Documents does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to the Consultant's, Electrical, HVAC, Plumbing and Fire Protection, Structural, Site Utility and all other drawings and other sections that types of and work of other trades with which work of this section must be coordinated

B. Except where modified by a specific notation to the contrary; it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify coordinated routings and component. The purpose of the document is to indicate systems concept, the main components of the systems, and the approximate geometric relationships. Based on the systems concept, the main components and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational

E. Information and components shown on riser diagrams, but not shown on plans, and vice versa, shall apply and be provided as if expressly required on both

F. Data that may be furnished electronically by the Consultant is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not be substitute for Consultant's sealed or stamped construction documents.

1.7 ELECTRIONIC MEDIA FILES

A. Construction drawings for this project have been prepared utilizing Revit 2018.

B. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

C. Upon request for electronic media, the Contractor shall complete and return a signed Electronic File Release form provided by Buro Happold.

D. The electronic contract documents can be used to assist in the preparation of shop drawings and as-built drawings however the electronic media files obtained from Buro Happold are for reference only. The information may not be used in whole or in part for any other project.

E. The drawings prepared for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

F. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

G. The information is provided to expedite the project and assist the Contractor with no guarantee by Buro Happold as to the accuracy or correctness of the information provided. BuroHappold accepts no responsibility or liability for the Contractor's use of these documents.

1.8 REVIEW OF CONTRACT DOCUMENTS AND SITE

A. With the submission of his bid, Contractor shall give written notice to the Owner of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction, and any necessary items of work omitted. In the absence of such written notice it is mutually agreed that the Contractor has included the cost of all required items in his proposal for a complete project.

B. Contractor shall acknowledge that he has examined the Plans, Specifications and Site, and from his own investigations he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials; availability of labor, water, electric power, roads and uncertainties of weather; the conformation and condition of the ground; the character, quality and quantity of surface and subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the work; all federal, state, county, township and municipal laws, ordinances and regulations particularly those relating to employment of labor, rates of wages, and construction methods; and all other matters which can in any way affect work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.

C. The location and elevation of the underground utilities, such as sewers, electrical power, water piping, steam and steam condensate return piping, conduit, etc., is as exact as can be determined from available information and its accuracy cannot be guaranteed. Exact location and elevation of these services shall be verified prior to excavation or installation of any portion of the work indicated. Exercise special care when excavating at or near the general location of underground utilities to avoid damage to the utility services. The Contractors is responsible to insure worker safety.

D. The contractor shall also acknowledge having been to the site and examined conditions under which work must be performed including preparatory work done under other Sections or other Contracts or by the Owner. Report conditions to the Consultant. Do not proceed until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

E. Owner assumes no responsibility for any understanding or representation made during or prior to the negotiation and execution of this Contract unless such understanding or representations are expressly stated in the Contract, and the Contract expressly provides that the responsibility, therefore, is assumed by the Owner.

1.9 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, advise the Consultant in writing before award of Contract. Otherwise, Consultant's interpretation of the Contract documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguousness thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturer's recommendations, or with applicable codes and standards, alert the Consultant in writing before installation. Otherwise, make changes in installed work as the Consultant requires within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specification, this contractor shall provide material, installation, or work which is of higher standard.

D. It is the requirement of these documents to have contractor provide systems and components that are fully complete and fully operational and fully suitable for intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of the component or its coordination with other building elements. In cases such as this, where the contractor has failed to notify the Consultant of the situation in accordance with paragraph (A) above, the contractor shall provide specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. In cases covered by paragraph (D) above, where the contractor believes he needs the engineering guidance, he shall submit a sketch identifying his proposed solution and the Consultant shall review, note if necessary, and approve the sketch.

1.10 MODIFICATION IN LAYOUT

A. Electrical, HVAC, Plumbing and Fire Protection Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show exact routings and locations needed to coordinate with structure and other trades to meet the Consultant's requirements

B. In order to obtain the desired aesthetics in spaces used by building occupants; prior to installation of visible materials, finishes and equipment (including access panels, review Consultant's Drawings for desired locations and where not definitely indicated, request information from the Consultant.

C. Check Contract Drawings, as well as Shop Drawings, of all subcontractors to verify and coordinate spaces in which work of this section will be installed

D. Maintain maximum headroom at all locations. All conduit, piping, duct and associated components to be as tight to underside of structure as possible.

E. Make reasonable modifications in layout and components to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C, and D above. Systems shall be run in an organized and rectilinear fashion.

F. Where conflicts or potential conflict exists and engineering guidance is desired, submit sketch of proposed resolution to the Consultant for review and approval.

1.11 RFI'S

A. If the RFI is a request to resolve a conflict or an un-clarity, or a request for additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraph 1.9(E) above.

1.12 PROJECT COMMUNICATION

A. Communication and Submittals:

1. The specification references communication and submittal of information and documents by the Contractor to the Engineers of Record and CM or vice versa. In all cases such communication shall be submitted to the CM who will review it before forwarding to the relevant party for review and response.
2. If the information provided is not in conformance with the specification the CM shall return it to the relevant Contractor for re-submission.
3. The time taken for this process shall be factored into all work schedules and submissions.

1.13 MEASUREMENTS

A. Contractor shall base all his measurements, both horizontal and vertical from established benchmark. All work shall agree with these established lines and levels. He shall verify all measurements at site; and check the correctness of same as related to the work.

1.14 MATERIALS AND WORKMANSHIP

A. Materials shall be new, meet detailed requirements of the Contract Documents and be identifiable as being specified or substitute products.

B. Materials which do not conform to the requirements of the Contract Documents, are not equal to approved samples or are unsatisfactory or unsuited to the purpose for which they are intended, will be rejected.

C. All work shall be performed in the best and most workmanlike manner by tradesmen skilled in their respective trades and properly licensed.

D. All equipment shall be installed in accordance with the recommendation of the manufacturer.

E. Defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or other cause shall be removed within ten (10) days after written notice is given by the Owners Representative and the work shall be re-executed by the Contractor. The fact that the Owner's Representative may have previously overlooked such defective work shall not constitute total or partial acceptance of it.

F. In no case shall a Bidder base his bid on a class of material or workmanship less than that required by the contract documents nor the governing codes and ordinances.

1.15 CHECKING AND TESTING EQUIPMENT BY CONTRACTORS AND MANUFACTURER'S REPRESENTATIVE

A. All equipment shall be installed in strict accordance with manufacturer's instructions. During construction request supervisory assistance from equipment manufacturer's representatives so the equipment will be correctly installed. After installation, request the Owner's Representative to inspect and see the equipment is in proper working order.

B. Manufacturer's representative shall review the overall system design relative to the proper application of his equipment in the particular system. He shall note conduit, wiring, control, location, and other relevant relationships, and furnish appurtenances necessary for satisfactory operation.

C. Before final payment is issued the following shall be complete:

D. The Contractor's representative shall submit to the CM a signed statement certifying:

1. The equipment is properly installed and ready for operation
2. The owners maintenance representatives have been thoroughly trained
3. Maintenance and operation manuals issued and accepted by the Owner's Representative.

1.16 TEMPORARY FACILITIES

A. Temporary Light and Power:

B. All temporary facilities shall be removed at completion of project.

1.17 SUBMITTALS

A. This paragraph supplements Division 1.

B. Definitions:

1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than shown in Contract Documents.
2. Coordination Drawings are detailed, large scale layout Shop Drawings showing Electrical, HVAC, Plumbing and Fire protection work superimposed in order to identify conflicts and ensure inter-coordination of Electrical, Mechanical, Plumbing, Fire Protection, Structural and other work.

C. Submittal Cover Sheet

1. Shop drawing submittal for each product shall include the copy of following cover sheet completely filled out. Incomplete or incorrect cover sheet submittal shall constitute reason for rejection.
2. Shop drawings shall be submitted according to specification section with a separate cover sheet completed for each product, rather than one cover sheet for multiple products, whether or not supplied by one manufacturer or vendor.
3. In order to maintain the shop drawing review schedule described hereafter, it is important that all submittals include a completed submittal cover sheet for each type of equipment submitted. This requirement will be enforced by the engineer.

SHOP DRAWING COVER SHEET		
PROJECT CONTRACTOR		
DIVISION NO: SECTION NO:		
DESCRIPTION:		
CONTRACT DRAWING REFERENCE NO:		
EQUIPMENT TAG:		
SUBMISSION (CIRCLE ONE): I II III IV		
DATE:		
INFORMATION AND CHECKLIST	REPLY	COMMENTS
4. Contractor's Log # ID		
5. Name, address, and phone number of supplier		
6. Are all specified or scheduled items included and exactly match scheduled/specified items.	Yes No	
7. Is this item a substitution?	Yes No	
8. Are deviations clearly identified?	Yes No	

9.	Does this equipment fit space shown on construction documents, coordination drawings, and actual field conditions?	Yes No	
10.	Has support, erection, weights, and installation been coordinated with all trades?	Yes No	
11.	Does the proposed installation void warranties and/or violate UL or code requirements?	Yes No	
12.	Does this material/equipment add expense to any other trade or project costs?	Yes No	
13.	Does equipment require interface with other trades? Lists divisions and specifics requiring coordination?	Yes No	
14.	Is control interface coordinated?	Yes No	
15.	List electrical characteristics (V/Ph/A)	Yes No	

1.18 SUBMITTALS PROCEDURE AND FORMAT

A. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment.

B. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or Drawing and Detail number, identify deviations, if any.

C. Organize submittals in same sequence as they appear in Specification Sections, articles or paragraphs.

D. Shop Drawings shall show physical arrangement, construction details and finishes:

1. Drawings shall be drawn to scale and dimensioned where applicable.

Catalog cuts and published material shall be included to supplement scale drawings.

Internal wiring diagrams of equipment shall show wiring as actually furnished for this project, with all optional items clearly identified as included or excluded. Clearly identify external wiring connections. Identify and obliterate superfluous material.

Submittal literature, drawings and wiring diagrams shall be specifically applicable to this Project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item. Submittals shall include, but not be limited to those items listed in individual Sections.

Include all physical and performance data, including materials, manufacturer's names, model numbers, weights, sizes, capacities, performance curves, finishes, colors, accessories, installation instructions, and all other data required to completely describe equipment and to indicate complete compliance with Specifications and Drawings.

Include with complete submittals above, complete, large scale, dimensioned Shop Drawings, certified by manufacturer, of all major equipment.

Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of all materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.

Submittals shall be reviewed for general compliance with Specifications only. The Contractor shall be responsible for deviations from the Drawings or Specifications and for errors or omissions of any sort in submittals.

The Contractor shall add and sign the following paragraph on all equipment and materials submitted for review:

"It is hereby certified that the equipment, material shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and Specifications and can be installed in the allocated spaces."

Failure to add the above written statement for compliance shall result in return of submittals to be reviewed.

The Contractor shall verify dimensions of equipment and be satisfied per Applicable Code Requirements for fit prior to submitting Shop Drawings for approval.

Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.

For any material specified to meet Underwriters' Laboratories, Inc. (UL) or trade standards, furnish the manufacturer's or vendor's certification that the material furnished for the work does in fact equal or exceed such Specifications.

Submit on all materials and equipment even if they are as specified or shown on the Drawings.

Equipment Floor Plans: After approval of material is secured, prepare a floor plan of each electrical equipment closet enclosures and room drawn to, scale of 1/2 inch equals 1 foot, and submit for approval in the same manner as for Shop Drawings. The layout drawings shall be to exact scale, and indicate location of all electrical equipment.

Resubmittals shall include written response to each item in review of previous submittal.

Special Submissions.

Test reports for the following:

2. Ground fault devices, including ground fault interrupter (GFI) receptacles.
3. Megger Readings: Ground system, motors, feeders and switchgear.
4. Voltage Readings: Distribution, service and motors.
5. Emergency lighting systems.

6. Fire Alarm system.
7. Acceptance testing per NETA Specifications for all power system equipment. Include manufacturer's testing standards used to verify the test results.
8. Field inspection reports by manufacturer's engineer confirming that the respective equipment is installed correctly, and it meets the manufacturer's requirements.
9. Report indicating compliance with Contractor furnished Overcurrent Protective Device Short-Circuit Study• .
10. Report indicating compliance with Contractor furnished Overcurrent Protective Device Coordination Study.
11. Report indicating compliance with Contractor furnished Overcurrent Protective Device Arc-Flash Study.
12. 1/2" scale equipment layout for each electrical, and mechanical equipment room, indicating all working clearance.

E. Acceptable Manufacturers: The Consultant's mechanical/electrical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications certain Alternate Manufacturers are listed as being acceptable. These are acceptable only if, as a minimum, they:

1. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, an air handling unit must deliver equal CFM against equal external static pressure using equal or less horsepower, equal or better coil thermal performance, equal or better acoustic performance as the air handler listed in schedules.
2. Have identical operating characteristics to those called for in the specifications. For example, a two stroke diesel generator will not be acceptable if a four stroke is specified.
3. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either space or product. Clearances to walls, ceilings and other equipment will be least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Consultants has determined that the manufacturer's products will fit within the available space. This determination is solely the responsibility of the contractor.
4. Products must adhere to all Consultant's considerations including, but not limited to: being of same color as the product scheduled or specified, fitting within Consultant's enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and physical appearance as scheduled or specified products.
5. The proposed substitution shall meet performance and quality of scheduled equipment, whether it requires additional accessories or not.
6. There is no increase in Contract Sum and this Contractor shall pay for any additional work required by other trades as a result of the substitution.
7. Submit all equipment sound power and pressure level for review and compliance.

F. Required Use of Acceptable Manufacturers on this Project: Substitution of products other than those of the Acceptable Manufacturers specified herein shall not be made. Only the specified items or the comparable product by one of the specified Alternate Manufacturers shall be submitted. Products by other manufacturers shall not be used on this project.

G. Deviations:

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice or other cause. Submit letter with transmittal of shop drawings, which flags deviation to the attention of the Consultants.
2. Without letters flagging the deviation to the Consultants, it is possible that the Consultants may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Consultants, the contractor shall hold the Consultants and his consultants harmless for any adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Consultants has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
3. Approval of proposed deviations, if any, will be made at discretion of Consultants.
4. Any of the approved deviations shall be deemed acceptable to this Contractor with no change in contract sum, unless the Consultant also receives a written notice to the contrary.

H. Submittal Notations: Submittals will be returned from the Consultants marked as illustrated below:

1. Review Status:

   a. NO EXCEPTION TAKEN: Reviewed and found generally acceptable.•
   b. MAKE CORRECTIONS NOTED: Submittal contains deviations which must be corrected and/or notations are complied with.•
   c. NOT REVIEWED: Submittal is incorrect to such an extent that the material is unacceptable, or in incomplete to such an extent that a review cannot be made. Resubmit in accordance with requirements of the Contract Documents.•

2. Resubmission Requirement:

   a. RESUBMISSION NOT REQUIRED: No further submittal required if notations are complied with.•
   b. RESUBMIT FOR REVIEW: Submittal contains deviations which must be corrected and confirmed by a new submittal.•
   c. RESUBMIT FOR RECORD ONLY: Return submittal with corrected deviations and/or notations for records.•

I. Responsibility:

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. Contractor shall ensure that the work meets the requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this or other Sections. Work shall comply with submittals marked REVIEWED to the extent they agree with the Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor shop drawing errors or deviations from requirements of Contract Documents. The Consultant's noting of some errors while overlooking the others will not excuse the contractor from proceeding in error. Contract Documents are not limited, waived nor superseded in any way by review.
2. INFORM SUBCONTRACTORS, MANUFACTURERS, SUPPLIERS, ETC. OF SCOPE AND LIMITED NATURE OF REVIEW PROCESS AND ENFOREC COMPLIANCE WITH CONTRACT DOCUMENTS.

J. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following review time requirements into his project schedule. Working days listed reference the time in Engineer's office. It does not include transmittal time or review time of Contractor or the Consultant. Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that 20 working days, exclusive of transmittal time, are required for the following:

1. Coordination Drawings.
2. If more than five shop drawings of a single trade are received in one calendar week.

1.19 LIST OF PROPOSED EQUIPMENT AND MATERIALS:

A. Within four weeks of Award of Contract and before ordering materials or equipment, submit complete list of materials and equipment and indicate manufacturer's name, addresses and telephone numbers. No consideration will be given to partial lists submitted out of sequence.

B. If the List of Materials and Equipment is not received within the prescribed time limit, provide the first-named manufacturer for all material and equipment on this project.

1.20 EQUIPMENT SUPPLIER'S INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Generator
2. Automatic Transfer Switch
3. Fire Seal Systems
4. Equipment Bracing

B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Engineer and include copies IN THE Project Close-Out and Owner's Operation and Maintenance Manuals. Refer to each Section for specific equipment inspection requirements and procedure .

1.21 COORDINATION DRAWINGS:

A. A single set of coordination drawings shall be mutually prepared by all mechanical and electrical trades.

B. The initiation of these drawings begins with Sheet Metal Subcontractor.

C. The Sheet Metal Subcontractor shall prepare a complete set of electronic background drawings at scale not less than 3/8" equals 1'-0", showing structure and other information as needed for coordination. He shall show sheet metal layout thereon. These will be Coordination Drawings.

D. Each of the mechanical, electrical and other specialty trade shall add its work to these background drawings with appropriate elevations and grid dimensions. Specialty trade information is require for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers, and for spaces in and above ceilings where congestion of work may occur such as corridors, and even entire floors. Drawings shall indicate horizontal and vertical dimensions, to avoid interference with structural framing, ceilings, partitions, and other services.

E. Each specialty trade shall sign and date each coordination drawing. Return drawing to the Sheet Metal Subcontractor, who shall route them sequentially to all specialty trades.

F. Where conflicts occur with placement of materials of various trades, the Sheet Metal Subcontractor will be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialled and dated by specialty trade. The Sheet Metal Subcontractor shall then final date and sign each drawing. If he cannot resolve conflicts, the decision of the General Contractor/Construction Manager shall be final.

G. A Subcontractor who fails to promptly review and incorporate his work on the drawings shall assume full responsibility of any installation conflicts affecting his work and of any schedule ramifications.

H. Sheet Metal Subcontractor shall make prints of all coordination drawings. Fabrication shall not start until such transparencies of completed coordination drawings are received by the Consultant/Engineer and have been reviewed and approved.

I. The review of coordination drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with the other trades, structural and other work.

J. After Review:

1. After review of coordination drawings, the method used to resolve interferences not previously identified shall be as in MODIFICATIONS IN LAYOUT above.
2. All changes to reviewed coordination drawings shall be in writing by the Consultants/Engineer prior to start of work in affected area.

K. Distribution of Coordination Drawings:

1. The Sheet Metal Subcontractor shall provide the following distribution of documents:

    a. One sepia (reproducible) of each Coordination Drawing to each specialty trade and affected Contractor for their use.
    b. One reproducible of each Coordination drawing to Owner.
    c. One sepia (reproducible) of each coordination drawing to the General Contractor/Construction Manager.
    d. The above documents can be submitted as electronic media upon agreement of all parties.

L. ALL FIREWALLS AND SMOKE PARTITIONS SHALL BE HIGHLIGHTED ON COORDINATION DRAWINGS FOR APPROPRIATE COORDINATION.

M. The main paths of egress and for equipment removal from main mechanical and electrical rooms must be clearly shown on coordination drawings.

N. Coordination Drawings shall include, but not limited to:

1. Plumbing systems, piping and equipment.
2. HVAC piping, systems and equipment.
3. Control systems.
4. Electrical distribution, systems and equipment.
5. Lighting systems and fixtures.
6. Sheet metal work, components and accessories, costs and boxes in terminals, etc.
7. Fire protection and sprinkler system, piping and heads.
8. Structural.
9. Electrical Equipment Room layouts.
10. Environmental Rooms and associated refrigeration/heating systems.
11. Partition/room layout.

12. Ceiling tile and grid.
13. Access panels.
14. Smoke and fire dampers.
15. Roof drain piping.
16. Major electrical conduit runs, panel-boards, feeder conduit and racks of branch conduit.
17. Above ceiling miscellaneous metal.
18. Minimum access space requirements for all equipment for both installation and maintenance.

1.22 COORDINATION BUILDING INFORMATION MODEL (BIM)

A. General Requirements:

B. ~~The General Contractor shall appoint a BIM Coordination Manager to prepare a BIM Execution Plan developed specifically for the project, and based on the Computer Integrated Construction (CIC) Research Program's BIM Planning procedures. The BIM Execution Plan will establish the protocols, expected levels of development, and authorized uses of Building Information Models on this Project and assigns specific responsibility for the development of each Model Element to a defined Level.~~

C. Services to be modelled:

D. All piping (above ½") and all equipment shall be modelled based on the proposed submitted products. The model may be used for production of shop drawings.

E. Clash Detection:

F. Perform three-dimensional component conflict analysis as part of coordination process with all other trades, including but not limited for Mechanical, Plumbing, Fire Protection and Fire Alarm. Resolve component conflicts prior to submittal of shop drawings. Indicate where conflict resolution requires modification of design requirements by Construction Manager.

G. 3D Assets:

H. The contractor shall hand over all digital data files ~~related to the BIM execution plan~~ at the end of the construction process, including all, but not limited to the shop drawings and as built conditions.

1.23 REGULATIONS**,** CODES, PERMITS, AND FEES

A. Conform to all rules, regulations, standards, ordinances and laws of local, state, and Federal governments and other authorities that have legal jurisdiction over the site.

B. Prior to commencement of work, notify State and applicable authorities as required and submit all of the applicable notifications for construction, operation and demolition. Secure required permits and inspections from any of the authorities having jurisdiction, for this work and pay for all fees required for permits, inspections and review, including special agency construction.

C. Include all utility and local building department charges for providing temporary and permanent electric services to buildings.

D. Provide Owner, Owner's Representative and Inspectors from any of the authorities / agencies having jurisdiction access to work at all times.

E. Contractor shall be responsible for all law violations caused by the work under this Division. Notify Construction Manager in writing when a discrepancy occurs between code requirements and work shown on drawings and resolve matter before proceeding with work.

F. When requirements cited in this specification conflict with each other or with Contract Documents, most stringent shall govern work. Consultants may relax this requirement when such relaxation does not violate ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

G. Make corrections in the work as required by the Owner's Representative or Inspector to pass local regulations.

H. Contractor shall deliver to the Construction Manager any and all certificates of inspections, permits, and approvals. Contractor shall submit final inspection certificates signed by governing authorities to the Owner.

I. Make all necessary submissions to the Department of Environmental Protection, Bureau of Air Resources and Management, Department of Labor and Industry and other agencies having jurisdiction. Pay all required fees for review, registration and sign off.

1.24 ACOUSTICAL COMPLIANCE FOR GENERATORS, TRANSFORMERS, CENTRAL BATTERY INVERTERS

A. Contractor shall provide provision to bring on board, at contractor cost and no cost to the owner, the service of an Acoustical consultant for evaluation of submitted units (outdoor equipment or indoor equipment) and system exposed to ambient surrounding and noise level criteria set forth by the local code and law.

B. Contractor shall certify noise level compliance and provide potential alteration(s) in the submissions of the equipment for noise level compliance installation.

C. Contractor confirm that the installation of any equipment in communication with outdoor shall comply with Local Law and regulations.

D. Contractor shall provide ambient noise level testing and report to establish the existing noise level at the site prior to new construction. Contractor shall also provide noise level testing upon completion of the installation to warranty the level pre code compliance.

1.25 OPERATING AND MAINTENANCE MANUALS

A. Obtain at time of purchase of equipment, three copies of operation and maintenance manuals for all items. Assemble literature in coordinated D-ring notebooks. All information shall also be provided in electronic PDF format. Divide the manuals into three sections or books as follows:

B. System General Description and Information. Section shall include a general description of the systems used and contain names and addresses of manufacturers and local representatives who stock or furnish or repair parts for items or equipment. List of all major equipment as installed and include model number, capacities, nameplate data and manufacturer's location and purchase order information. Include in the manuals, parts catalogues for each item of equipment furnished with the components identified by number for replacement ordering. This section shall also include:

1. Letters from manufacturers certifying their supervision of equipment installation and startup procedures as required.
2. Factory certification test certificates.
3. Equipment test certificates.

C. Operation, Start-up and Shutdown Procedures. Section shall include directions for and sequence of operation for each item of the Mechanical and Electrical systems; e.g., UPS generator, etc. Include detailed approved electrical diagrams for each electrical system.

D. Provide a step-by-step write-up and video of the operation, start-up and shut down procedures for all major equipment.

E. Problems, Solutions and Troubleshooting. Section shall include detailed procedures to be followed in case of equipment or system malfunctions. Include manufacturer's printed troubleshooting procedures into the operating manual for reference.

F. Preventative Maintenance. Section shall include preventative maintenance requirements and schedule for each piece of equipment.

G. Furnish three copies of manuals to the Consultant for approval and distribution to Owner. Deliver manuals no less than 30 days prior to project close-out or 10 days prior to commissioning whichever is sooner.

1.26 RECORD DOCUMENTS (AS-BUILTS)

A. As work progresses and for duration of Contract, maintain current complete and separate sets of prints of Contract drawings at job site. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to original design. Include actual location of existing utilities if they differ from design documents.

B. Underground utility services, both inside and outside of buildings, shall be dimensioned from permanent structures or benchmark. Utility services outside of buildings shall also show depth of burial with reference to the finished ground floor elevation.

C. Drawings shall show record condition of details, sections, riser diagrams, control changes and correction to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation. All elements shall be dimensioned from grid lines or benchmarks and all elevations shall be noted. Construction notes (such as component numbers, conflict notes, etc.) shall be removed and the drawings shall clearly be noted in the title block as being as-built drawings.

D. At the completion of the project, prepare a complete set of record drawings, showing all systems actually installed, as well as electronic files on latest CAD version.

E. The design tracings will be made available for Contractor's copying, at his expense, into reproducible to serve as background drawings. The quantity of design tracings, which are made available shall in no way be interpreted as setting a limit to the number of drawings necessary to show required information. Contractor's professional draftsperson shall transfer changes to record files and then submit the electronic files and three sets of prints to the Consultant for comments as to compliance with this section.

F. The record set reproducible, as corrected and recorded by the Contractor, shall be submitted to the Owner's Representative for approval prior to authorization for final payment. Record drawings shall be certified as to their correctness by the signature of the Contractor, and shall be stamped or otherwise identified as record drawings. THE CONSULTANT WILL NOT CERTIFY THE ACCURACY OF THE RECORD DRAWINGS - THIS IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

G. Each trade shall submit a record set for approval by the building department in a form acceptable to the department, when required by the jurisdiction. Such drawing format size changes, and supplemental information required for the submittal are the requirement of the contractor.

1.27 COOPERATION BETWEEN TRADES

A. Cooperate with all other Divisions performing work on this project as necessary to achieve a complete neatly fitted installation for each condition. Consult the Drawings and Specifications to determine nature and extent of work specified in other Divisions that adjoins or attaches to the work of this Division. Confer with other Divisions at the site to coordinate this work with theirs in view of job conditions to the end that interferences may be eliminated and that maximum head room and clearance may be obtained. In the event that interferences develop, the Owner's Representative's decision will be final as to which Division shall relocate its work, and no additional compensation will be allowed for the moving of piping, ductwork, conduit, or equipment, to clear such interferences. Provide templates, information, and instructions to other divisions to properly locate holes and openings to be cut or provided.

1.28 HOIST, RIGGING, TRANSPORTATION AND SCAFFOLDING

A. Provide all scaffolding, staging, cribbing, tackle hoist and rigging necessary for placing all materials and equipment in their proper places in the Project. All temporary work shall be removed from the premises when its use is no longer required.

1.29 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Perform all handling and shipping in accordance with manufacturer's recommendations. Provide protective coverings during construction.

B. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed Shop Drawings.

C. Keep all materials clean, dry and free from damaging environments during construction.

D. Cap all openings in conduit daily to protect against entry by foreign matter.

E. Protect premises and Work of other Divisions from damage arising out of installation of Work of this Division.

F. Perform Work in manner precluding unnecessary safety and hazard.

G. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no increase in Contract Sum. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed. Provide temporary storage facilities for material and equipment. Material, equipment or apparatus damaged because of improper storage or protection will be rejected. Remove from Site and provide new, duplicate material, equipment or apparatus in replacement of that rejected.

H. All stock piled conduit shall be placed on dunnage, and protected from weather and from entry of foreign material. All stored materials and equipment shall be carefully inspected prior to installation and replaced with new material or equipment if found to be damaged, corroded, etc.

1.30 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee the Work of this section for one year following the date of Substantial Completion or successful system performance whichever requires later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the owner.

B. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Consultant's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

C. In addition to guarantee requirements of Division 1 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

D. Replace material and equipment that require excessive service during guarantee period as defined and as directed by the Consultant.

E. Provide 24 hour service beginning on the date of substantial completion and lasting until the termination of guarantee period. Service shall be at no cost to Owner. Service can be provided by this Contractor or a separate service organization. Choice of service organization shall be subject to the Consultant and Owner approval. Submit name and phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

F. Submit copies of equipment and material warranties to Consultants before final payment.

G. At end of guarantee period, transfer manufacturer's equipment and warranties still in force to Owner.

H. This paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws under this Contract.

I. Part 2 Paragraphs of the Specification sections may specify warranty requirements that may exceed those of this Paragraph.

J. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute guarantee period.

K. Provide manufacturer's engineering and technical staff at site to analyse and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise the Consultant in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Consultants will suggest course of action.

1.31 GENERAL

A. Equipment and materials shall be as described in the respective Sections of Division 21, 22,23 , 26, 27 and Division 28 and as shown.

1.32 MATERIALS

A. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalogue as standard with equipment. Furnish optional or additional accessories as specified. And or/as required to provide a fully operational installation.

B. Equipment, material damaged during transportation, installation, operation is considered as totally damaged. Replace with new. Payment for this equipment shall not be approved. Variance from this permitted only with written acceptance.

C. All items of materials in each category of equipment shall be of one manufacturer.

D. Material and Equipment - General Requirements:

1. All equipment and components shall be New.
2. Testing agency labeled or with other identification wherever standards have been established.
3. Owner's Representative reserves right to reject items not in accordance with Specification either before or after installation.
4. Comprised to render complete and operable systems; provide additional items needed to complete installation to realized design.

5. Compatible with space allocated. Modifications necessary to adjust items to space limitations at Contractor's expense.
6. Installed fully operating and without objectionable noise or vibration.

1.33 COMMISSIONING OF EQUIPMENT AND SYSTEMS

A. General

1. Completion of startup and commissioning shall be accomplished as a prerequisite for substantial completion and shall be completed for each phase of construction.
2. Operate and maintain systems and equipment until final acceptance by Owner.
3. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner. Acceptance requires, at a minimum complete systems and commissioning.
4. The Owner maintains the right to have access to the entire project site to develop his own operational procedures.

B. Comprehensive Work Plan and Reporting

1. Provide detailed, methodical, scheduled, start up and commissioning procedures and execution of same and every system and piece of equipment provided.
2. Attend start up and commissioning meetings on a regular basis, as directed by the General Contractor or Construction Manager.
3. Develop and provide a written work plan with detailed procedures for this work and submit, using shop drawing submittal procedure, within 6 weeks of the contract award. The work plan shall include provisions for an integrated start up plan and schedule. The plan and schedule shall identify tasks, start and completion dates, critical path items, interface requirements with other trades and major equipment start up, as minimum requirements of the plan. The plan and schedule shall clearly identify work in each construction phase, as well.
4. The purpose of this work plan is to provide for smooth, quick, and efficient start up and commissioning of systems and equipment and for a smooth transition to turn the complete, correctly operating building over to the Owner, at each phase of construction.
5. The Owner and the Consultant will have input to and be part of approval process for startup and commissioning plan.
6. Develop and submit for approval a specific start up, check out and sign off form for every piece of major equipment.
7. Develop and submit for approval a specific start up, check out and sign off form for every piece of major system.
8. Systems shall be operated under actual or simulated full load conditions. Identify the operating conditions in the work plan.
9. Work plan shall incorporate the below specified Demonstration of Successful Operation•
10. The Consultant/Owner may check the completed and commissioned installation either sequentially as different parts are completed, and/or when the entire installation is complete, at sole option of the Consultant/Owner.

11. Each contractor shall arrange that an officer of his contracting company shall certify that each and every system has been tested. At the conclusion of the tests, this contractor shall submit a letter and enclosed commissioning forms signed by the officer stating:
12. That he/she is the officer of the company.
    a. That he/she certifies that the specified testing of the systems has been performed by the company (give the name and dates of system testing).
13. The results of testing as compared to specified performance, listing the name, title, and company affiliation of all those witnessing and performing these tests.

C. Commissioning

1. Commission equipment and systems in accordance with the approved work plan, completing the startup, check out and sign off forms for each piece of equipment and each system.
2. Provide qualified personnel, equipment, apparatus and services for startup and testing of equipment and systems, to obtain the performance shown in schedules, as specified or on commissioning forms, and as required by codes, standards, regulations and authorities having jurisdiction including Municipal Inspectors, Owners and Consultants.
3. Start up and testing procedures as may be outlined in various mechanical and electrical sections of the specifications are the minimum effort required for the project. Contractor shall use any additional procedures he feels will be necessary to properly start up and test the systems and equipment actually installed on the job at no additional cost to the Owner.
4. Provide capacity and performance of equipment by field testing. Install thermowells and gauge connections and, at no additional cost to Owner, equipment and instruments required for testing.
5. Qualified representative of equipment manufacturer shall be present at test.

    a. For each piece of equipment, copy nameplate data and include with the letter and start up, check out and sign off forms referred to above.
6. Do not cover or conceal work before testing and inspection and obtaining approval.

    a. Leaks, damage and defects discovered or resulting from startup and testing shall be repaired or replaced by this contract to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

D. Demonstration of Successful Operation: After all components and every system has been completely commissioned, provide a two week, 24 hour per day fully functional automatic operation period of all systems simultaneously. This shall be successfully concluded before systems are accepted by the Owner.

1.34 SPECIAL RESPONSIBILITIES:

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed.
2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.
3. Obtain detailed installation information from manufacturers of equipment provided under this section.
4. Obtain final roughing dimensions or other information needed for complete installation of items furnished under other Sections or by Owner.
5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information on proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Consultants.
6. Provide information as requested as to sizes, number and locations of pads necessary for floor mounted equipment provided under this Section.
7. Notify Consultants of location and extent of existing piping, conduit, ductwork and equipment that interferes with new construction. In coordination with and with approval of Consultants, relocate piping, ductwork and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned piping, ductwork and equipment as directed by Consultants. Dispose of or store items as requested by Consultants.
8. The Contractor shall coordinate the voltages, over-current protection devices (fuses or circuit breakers), minimum circuit amperes, etc, and installation requirements of all equipment requiring electrical connection.

B. Installation Only Items

1. Where this contractor is required to install items which it does not purchase, it shall coordinate delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to time of installation. This trade shall be responsible for:
2. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt to Consultant's and structural conditions.
3. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

4. This contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted this contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

C. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

D. Use of premises: Use of premises shall be restricted as directed by the Consultant and as required below:

1. Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove equipment and unused material. Put building and premises in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of the Consultant.
2. Store materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets of racks and covered with tarpaulins.
3. Do not interfere with function of existing sewers and water and gas mains, electrical or mechanical systems and services. Extreme care shall be observed to prevent debris from entering pipe, ductwork and equipment. Confer with the Consultant as to the disruption of services or other utilities due to testing, connection of new work to existing. Interruption of services shall be performed at time of day or night deemed by Owner to provide minimal interference with normal operation. Obtain Owner's approval of the method proposed for minimizing service interruption.

E. Surveys and Measurements:

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct laying out of work.
2. In event of discrepancy between actual measurements and those indicated, notify the Consultant in writing and do not proceed with work until written instructions have been issued by the Consultant.

F. Fireproofing:

1. Clip, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible prior to start of spray fiber work.
2. Conduit and other items which would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.

3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this section shall be shall be performed by installer of fireproofing and paid for by the trade responsible for damage and shall not constitute grounds for an extra to Owner.

G. Temporary Utilities:

1. Refer to Division 1 regarding requirements.
2. Furnish temporary equipment, and wiring, as needed during the construction phase. Remove temporary items after use.

1.35 MATERIAL AND WORKMANSHIP

A. Work shall be neat and rectilinear. Conduit shall run concealed except in mechanical rooms and areas where no hung ceiling exists. Install material and equipment to comply with manufacturers. Recommended Requirements. Rough Work will be rejected. Work shall be properly and effectively protected, and conduit openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents.

C. Finish of materials, components and equipment shall be as approved by the Consultant and shall be resistant to corrosion and weather as necessary.

D. Owner will not be responsible for material and equipment before testing, commissioning, and acceptance.

1.36 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner's approval.

B. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at such times of day and work so that they have minimal impact to Owner's operations.

D. Subcontractor shall coordinate any shutdowns of existing systems as follows:

1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days are required.
2. Minimize shutdowns of any system.

3. Provide temporary services where required and perform shutdown and tie-ins at a time convenient to Owner.
4. Subcontractor shall be responsible for completing and filing Owner's shutdown notice questionnaire.
5. Perform required survey and inspection work required by the notice for shutdown.

E. Include premium time work associated with interruption of services and/or shutdown as necessary to avoid disruption to Owner's operations.

1.37 ANCHORS AND INSERTS:

A. Inserts shall be iron or steel of type to receive machine bolt head or nut after installation. Insert shall permit adjustment of bolt in one horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

B. Provide anchors as necessary for attachment of equipment support and hangers.

1.38 CORE DRILLING

A. Core drilling is to be avoided.

B. Set sleeves prior to installation of structure for passage of conduits, etc.

C. Where core drilling is unavoidable, or required by renovation projects, locate all required openings prior to coring and submit to the Consultant for review.

D. Coordinate openings with General Contractor/Construction Manager and all other trades.

E. Core drilling is to be provided by the Contractor for General Construction and not by the M/E subcontractors.

F. Do not disturb existing systems.

G. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.

1.39 CUTTING AND PATCHING:

A. Complete cutting and patching in accordance with Division 1, Cutting and Patching Article, and as follows.

B. Provide all sleeves, core drilling, carpentry, cutting and patching required for proper installation of material and equipment specified in this Division.

C. Do not cut or drill structural members without written approval of Owner's Representative and structural engineer.

D. No cutting or patching should be done without first receiving the Consultant's and Structural Engineer's written approval.

E. Any damage caused by cutting and patching shall be restored to the original condition as required by the Consultant.

1.40 WATERPROOF CONSTRUCTION:

A. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashing at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls and floors. Provide membrane clamps at penetrations of waterproof membranes.

B. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rainwater. This requirement applies to damper operators and bearing, damper motors, controls, and instruments. See other paragraphs in this Division for application of this requirement to panels, motors, and devices.

1.41 RESTORATION OF DAMAGE:

A. Repair or replace, as directed by the Consultant and/or Owner's Representative, materials and parts of premises which become damaged as result of installation of Work of this Division. Remove replaced parts from premises.

1.42 ROOF OPENINGS AND CURBS

A. Roof openings where required shall be coordinated with the other affected trades and all flashing and patching shall be as per details indicated on the Consultant's plans.

1.43 TOOLS AND EQUIPMENT

A. Furnish all tools and equipment necessary for the proper installation, protection and upkeep of the Work.

1.44 ADJUSTMENTS

A. Preliminary Operation:

1. Operate any portion of installation for Owner's convenience if so requested by Construction Manager. Such operation does not constitute acceptance of Work as complete. Cost of utilities, such as gas and electrical power, will be borne by Owner if Owner requests operation.

B. Start-up Service:

1. Prior to startup, ensure that systems are ready for their intended use.

C. Start and operate all systems. Provide services of factory trained technicians for start up of major equipment and systems.

D. Adjusting:

1. Adjust all equipment and system components as shown or as otherwise required to result in intended system operation.
2. Thereafter, as a result of system operation or as directed by Owner's Representative, make readjustments as necessary to refine performance and to effect complete system "tune-up".
3. After completion of testing and adjustment, operate the different systems and equipment under normal working conditions for 72 hours continuously and show specified performance.
4. If, in the opinion of the Consultant, performance of equipment or systems is not in accordance with specifications or submitted data, alter or replace equipment at no increase in Contract Sum. The Contractor, at his option, may order tests from an independent approved laboratory to prove compliance. All such tests shall be at no increase in Contract Sum. Repeat process as often as required. If the reason for unsatisfactory operation is design errors all additional cost for corrective measures will be reimbursed to the contractor.
5. At completion of Work, provide written certification that all systems are functioning properly without defects.

E. Noise:

1. Cooperate in reducing any objectionable noise or vibration caused by electrical systems to the extent of adjustments to specified and installed equipment and appurtenances.
2. Cooperate in adjustment of mechanical systems and terminal devices, as directed by Owner's Representative, to obtain specified acoustic properties.
3. Completely correct noise problems caused by failure to make installation in accordance with Contract Documents, including labor and materials required as a result of such failure, at no increase in Contract Sum. Includes refinish walls, floors etc.

1.45 INSTALLATION OF EQUIPMENT

A. Use printed descriptions, specifications and recommendations of manufacturers as a guide for installation of Work.

B. Assemble equipment required to be field assembled under the direct supervision of the manufacturers' agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.

C. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to the satisfaction of the Consultant and in accordance with code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

D. Install equipment so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof mounted equipment shall be installed and supported on structural steel provided under other Sections.

E. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall of ceiling mounting of equipment as required.

F. Provide steel supports and hardware for proper installation of hangers, anchors, guides, etc.

G. Provide cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installations.

H. Structural steel and hardware shall conform to Standard specifications of ASTM; use of steel and hardware shall conform to requirements of Section V of Code of Practice of American Institute of Steel Construction.

I. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly, which will void warranty. Report in writing to the Consultant, prior to purchase or shipment of equipment involved, on conditions which may prevent proper installation.

1.46 PAINTING

A. Equipment installed shall have shop coat of non-lead paint. Hangers and supports shall have one coat of non-lead primer. Finish painting, including painting of various conduit or wire way systems, shall be done under other Sections.

B. Paint all outside exposed equipment and equipment supports with two coats of weather resistant enamel.

C. Properly prepare Work under this Division to be finish painted under Division 9.

D. Refer to standard paint colors for all Electrical equipment inside the Building.

1.47 SELECTIVE DEMOLITION

A. Refer to all drawings for general description of areas requiring demolition.

B. Refer to General Contractor's/Construction Manager's Instructions for all existing equipment and materials that shall remain the property of the Owner.

C. Items of value which are not directed to be returned to the Owner shall become the property of the Contractor. Storage or sale of items on the project site is prohibited.

D. Protection: Ensure the safe passage of persons in and around building during demolition. Prevent injury to persons and damage to property. Provide adequate shoring and bracing to prevent collapse. Immediately repair damaged property to the condition before being damaged. Take effective measures to prevent windblown dust.

E. Utilities: Maintain all utilities except those requiring removal or relocation. Keep utilities in service and protect from damage. Do not interrupt utilities serving used areas without first obtaining permission from the utility company and the Owner. Provide temporary services as required.

1.48 JOBSITE SAFETY

A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employees and sub-consultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insured's under the Contractor's general liability insurance policy.

1.49 FINAL JOBSITE OBSERVATION

A. As the work nears completion, the Contractor is to review the requirements of the Contract Documents, inspect the work and inform all parties involved of the work to be corrected or completed before the project can be deemed substantially complete.

B. When the Project is substantially complete, In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation. Notify the Owner's Representative in writing of this fact, listing any items of Work remaining incomplete, the reason therefore, and the anticipated date that all remaining work will be completed. The Contractor shall inform the certification that the project is complete and ready for a final punch, the Contractor shall sign the attached certification and return it to the Engineer so that the final observation can be scheduled.

C. It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineers additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

D. The Contractor shall carry out their own final inspection and satisfy the Work.

E. The Owner's Representative reserves the right to cancel and reschedule the inspection in the event considerable more work remains to be completed or corrected than indicated in the written request for inspection.

F. All items not completed or found not complying with drawings or specifications by the Owner's Representative will be identified in their inspection report.

G. Correct all items on inspection report. Make the correction and initial and date each item on the report after corrections have been completed.

H. Include the fee for all local inspections.

1.50 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care,and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Owner has the option to video tape all instructions. Coordinate schedule of instructions to facilitate this recording.

D. The instructions shall include:

a. Maintenance of equipment.

b. Start-up procedures for all major equipment.

c. Description of emergency system operation.

1.51 PROJECT CLOSE-OUT PROCEDURE

A. General

1. The requirements of this section are in addition to and supplement the requirements outlined in Division 1.

2. It shall be each contractor's responsibility to personally hand-deliver all of the required project close-out checklist items and to obtain Owner's authorized representative(s) signed receipt on all items requiring Owner sign-off.

B. Project Close-Out Checklist

1. Review requirements of each section of the specifications and submit for approval to Consultants the sign-off forms which shall become the project close-out checklist. The Consultants and/or Owner may incorporate additional specific items to the following checklist which shall become part of project requirements.

END OF SECTION

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 REFERENCES

A. Uniform Construction Code including all relevant amendments:

1. International Building Code, 2015
2. National Electrical Code, 2014
3. International Fire Code, 2015
4. International Plumbing Code, 2014
5. International Mechanical Code, 2014

B. NFPA 72 as amended by the Pennsylvania Code of Regulations. All other applicable Health and Safety requirements, codes and regulations.

C. NFPA 90A Ó Air Conditioning Systems

D. NFPA 110 Ó Standard for Emergency and Standby Power Systems

1.2 SUMMARY

A. This Section supplements all Sections of this Division and shall apply to all Work specified, indicated in the Drawings, and as required to provide a complete installation of electrical systems for the Project. Review all Sections of the Specifications for related work and coordinate the work of this Section with all other Sections.

B. Provide all labor and services, and provide all materials, tools, equipment, appliances, facilities, and transportation necessary for and incidental to performing the Work complete, as shown on the drawings and specified herein. All electrical systems and equipment shall be in proper operating order upon completion of the work. Work includes the following:

C. Provide all incidental work required to provide a complete properly operating system.

D. Provide the following per the drawings and specifications:

1. All construction power and lighting and all power for testing of equipment and systems through final acceptance tests.
2. A complete system of switchboards, transfer switches, feeders, conduits, pullboxes, panelboards, motor-starters, branch circuit wiring, motor and circuit controls, outlet boxes, disconnect devices, outlet devices and receptacles complete.

3. Outlet, junction and pull boxes, plaster rings, plates, J-hooks, cable tray and conduits with draw-wires for all card readers, signal, telephone and data, television, cameras, access control, security and wireless connection systems.
4. Transient voltage surge suppressors at main switchboards and service entrance.
5. Elevator feeder systems consisting of conduit, junction and pull boxes, feeder connectors and disconnect switches, and circuit breakers. Include service conduit and wiring to controllers, cab lighting and HVAC system, hoist-way and pit lighting and GFCI receptacles inclusive, including final connections, as described in the Elevator Section.
6. A complete design-build (deferred approval) fire alarm system including fire alarm control panels, fire alarm annunciators, remote operators control panels, paging cabinets, smoke and heat detectors, manual pull stations, magnetic door hold-open devices, other alarm and trouble devices as indicated, outlet, junction and pull boxes, plaster rings, conduits and wire, including Permit application and all fees, field devices, programming, testing, commissioning and demonstration complete.
7. All lighting fixtures and lamps, complete with controls (switching, dimmers, dimmer and/or relay panels, occupancy sensors, day-light sensors, photocells, time switches, and low voltage relays), including switch packs, and building lighting control system with interface to building/campus automation system.
8. Outlet, junction and pull boxes, conduits, wiring and connections of all motors and equipment for all heating, ventilating and cooling, plumbing, fire protection, food service, and all other equipment.
9. Complete grounding systems for power system neutrals and the equipment grounding bus system, raceways, conduits and cable tray systems, and power systems equipment per Section 260526 - Grounding And Bonding For Electrical Systems• .
10. Testing and commissioning, adjusting and cleaning of the completed work.
11. All line-voltage (120V) control system conduit and wiring, and all low-voltage control conduit with draw-wires, required for the automatic temperature control systems.
12. Demolition and removal of existing electrical systems, including conduits, wiring, equipment, wiring devices, disconnects and connections, per any demolition notes.
13. Access panels, fire rated as required, in the ceilings and walls where necessary for access to electrical equipment, junction boxes, pull boxes, conduit stubs, etc., located in the walls or furred ceiling spaces. Location shall be as approved by the Owner's Representative.
14. Cutting, core-drilling patching, and painting of the building structure, and finishes as required by Contractor in the performance of the work.
15. All sleeves, hangers, supports, inserts, anchors, bolts, etc., required for the installation of this work, including design of supports.
16. All concrete required for this Division of the work including patching and repair at core-drill locations, concrete pads for floor mounted electrical equipment.
17. Shop drawings and technical data; operation and maintenance (O&M) manuals.
18. "As-built" drawings:

a. At the completion of the project provide the as-built drawings, in accordance with Division 01 and provide 2 copies of the drawings on digital CD (compact disc) in the 2018 version of Revit and in Adobe PDF.
b. Include Owner's final room numbers on these Drawings and panelboard directories, and accurately indicate and dimension all conduit runs (including those discovered during construction), and conduit stub-outs and all pullboxes from building walls on all As-built Drawings.

19. Contractor shall be responsible to coordinate with the Owner's Representative regarding the protection of Owner's installed telecommunications and security cabling/wiring, including replacement of these items damaged by Contractor, but not limited to submittals, lead times, procurement, delivery and installation.
20. Provide training to the Owner's personnel, as scheduled by the Owner's Representative, for the operation of the following as applicable:
    a. Power distribution equipment eight (8) hours.
    b. Lighting controls, and occupancy sensors eight (8) hours.
21. Fire Alarm system as indicated in Section 283111 Digital, Addressable Fire-Alarm System.
22. Other training as required by other Sections of these Specifications.
23. Coordinate all training with the Owner's Representative.
24. Provide temporary equipment, and wiring, as needed during the construction phase. Remove temporary items after use.
25. Schedule all outages with the Owner's Representative.
26. Guarantee: Refer to General Conditions for information regarding the 1-year Guarantee to Repair Period. For items requiring longer guarantee periods, refer to individual Sections of the Specifications.
27. On completion of the installation, provide operation and maintenance (O&M) manuals, a minimum of three (3) copies. O&M manuals shall include complete instructions from manufacturer for operation and maintenance of equipment and devices, and shall be provided for lighting sensors, lighting fixtures, lighting controls, power distribution equipment, fire alarm system, emergency lighting system, and other items in this Division. Each manual shall include installation and operations instructions, all reports, calculations, settings, as-built shop drawings, and product data, wiring diagrams, guarantees, calculations, settings for each device, all tabulated with device designations, locations and settings available, and selected for each device. Comply with paragraph 26 below.
28. Operation and Maintenance manual shall include instructions, all respective reports, and all its contents in electronic PDF (Printable Document File) files on compact disk (CD-Rom), in each binder. Include names, addresses, telephone number of contractor (and sub-contractors) the respective data. Submit organized manuals on each system in separate piano-hinged binders. Contents of O&M manual shall be as approved by the Owner¢s Representative.
29. Electrical power system shall be a fully rated system. Each protecting device shall have AIC rating of 110% of calculated value. Series connected breaker ratings are not acceptable.

1.3 MATERIAL STANDARDS

A. All materials and equipment shall be new. All power distribution equipment shall be approved for seismic zone and requirements.

B. All Work shall comply with Applicable Codes Requirements. Refer to 01060 • Regulatory Requirements• including:

1. NEMA.
2. ANSI.
3. IEEE.
4. ICEA.
5. NEC
6. UL.

C. Items for similar application shall be of the same manufacturer.

D. The label of listing by UL shall appear on all materials and equipment for which standards have been established by the agency.

E. Where Codes listed in Division 01 establish label or approval requirements, provide all materials and equipment with either the required labels affixed or the necessary written approval.

F. Provide the type and quantity of electrical materials and equipment necessary to complete Work and all systems in operation, tested and ready for use.

G. Provide all incidental items that belong to the Work described and which are required for complete systems.

1.4 ABBREVIATIONS

A. The Following Abbreviations Apply to All Sections of Division 26:

B. AC: Alternating Current.

C. AIC: Ampere Interrupting Capacity.

D. ADA: Americans with Disabilities Act.

E. AISI: American Iron and Steel Institute.

F. ANSI: American National Standards Institute.

G. ASTM: American Society for Testing and Materials.

H. AWG: American Wire Gauge.

I. UCC: Uniform Construction Code

J. CBM: Certified Ballast Manufacturers.

K. NEC: National Electrical Code.

L. DC: Direct Current.

M. ETL: Electrical Testing Laboratory.

N. FS: Federal Specification.

O. HID: High Intensity Discharge.

P. HP: Horsepower.

Q. ICEA: Insulated Cable Engineers Association

R. IEEE: Institute of Electrical and Electronic Engineers.

S. NEMA: National Electrical Manufacturers' Association.

T. NETA: National Electrical Testing Association, Inc.

U. NFPA: National Fire Protection Association.

V. OSHA: Occupational Safety and Health Act.

W. PVC: Polyvinyl chloride.

X. UBC: Uniform Building Code.

Y. UL: Underwriters' Laboratories, Inc.

Z. SFM: State Fire Marshal.

AA. IBC: International Building Code.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Rated Construction:

1. Maintain integrity of fire-rated construction where penetrated by electrical work.

1.6 QUALITY ASSURANCE

A. General Requirements:

1. Work performed under this Division shall be installed by craftsmen skilled in the trade involved, and apprentices as indicated in the General Conditions.
2. Provide all control equipment for electrically operated equipment except when equipment is provided with control equipment.
3. Provide all electrical Work required for the service and connection of electrically operated and controlled equipment specified in other Divisions of the Specification.
4. All electrical power, signal, alarm and communication systems shall be complete, tested, and ready for use.

B. Requirements of Regulatory Agencies:

1. Codes and Ordinances: In addition to the requirements of Division 01, all materials shall bear the UL label.

C. Factory Tests:

1. See Division 01 for the required factory tests and their procedures.
2. Test Reports Shall Include the Following:

a. Description of equipment tested.
b. Description of tests.
c. Test results.

3. Owner's Representative shall be notified fourteen (14) days in advance of when tests shall be performed. Owner's Representative shall witness tests.
4. Submit factory test reports, a minimum of fourteen (14) days prior to shipping equipment to project site.

D. Electrical Acceptance Tests:

1. General Scope:

a. Contractor shall engage the services of a qualified testing laboratory for the purpose of performing inspections and tests of installed Work as herein specified and specified in other Sections of Division 26 of these Specifications.
b. The testing laboratory shall provide all material, equipment, labor and technical supervision to perform such tests and inspections.
c. All tests shall be performed in compliance with the recommendations and requirements of the NETA, per Applicable Code Requirements.

d. Upon completion of the tests and inspections noted in these specifications, a label shall be attached to all serviced devices. These labels shall indicate date serviced and the service company responsible.
e. The tests and inspections shall determine suitability for continued reliable operation.
f. All tests shall be conducted in the presence of Owner's Representative and Owner's Electrical Inspector.

2. Qualifications of Testing Agency:

a. The testing laboratory shall meet the Federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907.
b. Contractor shall submit proof of the above qualifications.
c. All instruments used to evaluate electrical performance shall meet NETA's Specifications for Test Instruments.
d. Test Reports Shall Include the Following:
e. Description of equipment tested.
f. Description of test, and applicable test standards used.
g. Test results.
h. Conclusions and recommendations, including corrective measures performed.
i. Appendix, including appropriate test forms, and related NETA Specifications.
j. List of test equipment used and calibration date.

3. A copy of all test reports shall be included in the Operation and Maintenance binder submittal.
4. All tests to be performed and test reports submitted for review by the Owner's Representative, minimum of ten (10) working days prior to energization of equipment.

1.7 SUBMITTALS

A. Shop Drawings and Product Data:

1. Refer to Division 01 for procedures.
2. The review period by the design team shall be up to 15 working days. Schedule submittals in such a way that no due dates fall on the same day and such that no more than 4 submittals shall be due in any one week.
3. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment.
4. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or Drawing and Detail number, identify deviations, if any.
5. Organize submittals in same sequence as they appear in Specification Sections, articles or paragraphs.

6. Shop Drawings shall show physical arrangement, construction details and finishes:
7. Drawings shall be drawn to scale and dimensioned where applicable.
8. Catalog cuts and published material shall be included to supplement scale drawings.
9. Internal wiring diagrams of equipment shall show wiring as actually provided for this project, with all optional items clearly identified as included or excluded. Clearly identify external wiring connections. Identify and obliterate superfluous material.
10. Submittal literature, drawings and wiring diagrams shall be specifically applicable to this Project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item. Submittals shall include, but not be limited to those items listed in individual Sections:
11. Include all physical and performance data, including materials, manufacturer's names, model numbers, weights, sizes, capacities, performance curves, finishes, colors, accessories, installation instructions, and all other data required to completely describe equipment and to indicate complete compliance with Specifications and Drawings.
12. Include with complete submittals above, complete, large scale, dimensioned Shop Drawings, certified by manufacturer, of all major equipment and other equipment as directed by the Owner¢s Representative.
13. In addition to the requirements of Division 01 the following are required:

    a. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of all materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.
    b. Submittals shall be reviewed for general compliance with Specifications only. The Contractor shall be responsible for deviations from the Drawings or Specifications and for errors or omissions of any sort in submittals.
    c. Submit for review to the Owner's Representative, within forty-five (45) days of Notice to Proceed date, a complete list of material and equipment proposed for the project, including manufacturers' names and catalog numbers. Submission on all materials and equipment shall be made, even if they are as specified or shown on the Drawings.
    d. The Contractor shall add and sign the following paragraph on all equipment and materials submitted for review.

        1) "It is hereby certified that the equipment, material shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and Specifications and can be installed in the allocated spaces."
        2) Failure to add the above written statement for compliance shall result in return of submittals to be reviewed.

e. The Contractor shall verify dimensions of equipment and be satisfied per Applicable Code Requirements for fit prior to submitting Shop Drawings for approval.
f. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
g. For any material specified to meet Underwriters' Laboratories, Inc. (UL) or trade standards, provide the manufacturer's or vendor's certification that the material provided for the work does in fact equal or exceed such Specifications.
h. Submit on all materials and equipment even if they are as specified or shown on the Drawings.
i. Equipment Floor Plans: After approval of material is secured, prepare a floor plan of each electrical equipment closet enclosures and room drawn to, scale of 1/2 inch equals 1 foot, and submit for approval in the same manner as for Shop Drawings. The layout drawings shall be to exact scale, and indicate location of all electrical equipment.

    1) Resubmittals shall include written response to each item in review of previous submittal.

14. Special Submissions:

    a. Test reports for the following:

        1) Ground fault devices, including ground fault interrupter (GFI) receptacles.
        2) Megger Readings: Ground system, motors, feeders and switchgear.
        3) Voltage Readings: Distribution, service and motors.
        4) Emergency lighting systems.
        5) Fire Alarm system.
        6) Acceptance testing per NETA Specifications for all power system equipment. Include manufacturer's testing standards used to verify the test results.
        7) Field inspection reports by manufacturer's engineer confirming that the respective equipment is installed correctly, and it meets the manufacturer¢s requirements.

    b. Test reports required by the Owner's Representative.

15. Report indicating compliance with Contractor provided 260572 Overcurrent Protective Device Short-Circuit Study.
16. Report indicating compliance with Contractor provided 260573 Overcurrent Protective Device Coordination Study.
17. 1/2" scale equipment layout for each electrical, elevator, and mechanical equipment room, indicating all working clearances.

18. Items required in other Sections.
19. Submit, within forty-five (45) days of Notice to Proceed date, list of manufacturers of all equipment proposed to be used for project construction.

B. Substitutions

1. In addition to the requirements of Division 01 should the Contractor submit a manufacturer under the Óor Equal• provisions of these specifications, the following information shall be included in the submittal:
2. A complete statement addressing the systems compliance with each requirement noted in each paragraph of this section, and each paragraph of specification section for respective equipment.
3. For equipment other than that specified, the Contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance and quality of the specified equipment; include the technical data of the specified equipment and that of the substitute equipment, as well as a tabular comparison between the two equipment. The submittal acceptance shall not relieve the Contractor of obligation to provide the specified equipment or equal.

C. Should the substituted equipment be determined not to be in compliance with this specification at any time during the course of the project, it will be the Contractor's responsibility to remove non-compliant substitute products and provide the specified products at Contractor's expense, with no additional compensation by the Owner.

1.8 COORDINATION DRAWINGS

A. Submit in line with agreed schedule, in Revit Release 2018, a set of the coordination drawings, for each floor level, showing electrical, mechanical, plumbing, structural and architectural for the Project, indicating coordination of electrical equipment and installation, with all trades. Refer to Division 01. Schedule the submittal of the Coordination Drawings, to provide adequate review time, and not impact project construction schedule.

B. Provide the following information on, but not limited to scale drawings in plan, sections with minimum ½"• scale or ¼" scale as appropriate:

1. Vertical and horizontal conduit type, route and size (for interior and exterior installation).
2. Cabinet type, locations and size.
3. Junction box type, location and size.
4. Electrical equipment type, location and size.
5. Pullbox type, locations and size (both internal and external).
6. Lighting fixture type, location and size, and connection details.
7. Fire alarm system, including conduit layouts.
8. Telecommunication, telephone, data and access control systems¢ device and conduit layouts.
9. Submit in time so as not to impact project schedule.

C. Shop drawing production

1. Electronic Electrical CAD and REVIT files shall be provided at the discretion of the design team. If provided these are for general information only, and shall not be used for shop drawing production.

D. Coordination and Short-Circuit Study Report

1. Protective Device Testing, Calibration and Adjustment: Have equipment manufacturer provide the services of a qualified field engineer employed by switchgear manufacturer, and necessary tools and equipment to test, calibrate and adjust the protective relays and circuit breaker trip devices as recommended in the Contractor provided Overcurrent Protective Device and Short-Circuit Coordination studies.

E. Contractor shall submit the Coordination Study and Short-Circuit Study within four (4) weeks of power equipment submittal approvals. All reports shall be provided in 3-ring binders and each binder shall contain a Compact Disk (CD) containing PDF electronic files of the reports. Submit six (6) copies for review.

F. Site records:

1. Mark changes as work progresses on shop drawings and as changes occur. Include changes to existing electrical systems, fire alarm systems and low voltage control wiring.
2. Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
3. Use different color for each service.
4. Make available for reference purposes and inspection.

G. As-built drawings:

1. Prior to start of final electrical certification testing, finalize production of as-built drawings.
2. Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
3. Submit to Owner's Representative for approval and make corrections as directed.
4. Perform final certification testing, adjusting and commissioning using as-built drawings.
5. Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
6. Submit copies of as-built drawings for inclusion in final TAB report.

1.9 LOCATION AND ROUTING

A. The Drawings indicate diagrammatically the desired location or arrangement of conduit runs, outlets, equipment, etc., and shall be followed as closely as possible. Execute the Work so as to secure the best possible installation in the available space and overcome local difficulties due to space limitations or interference with structural conditions.

B. Verify dimensions and the correct location of equipment before proceeding with the roughing-in of connections.

C. Lighting fixtures in mechanical spaces are shown in their approximate locations only. Do not install light outlets or fixtures until mechanical piping and ductwork are installed; then lighting fixtures shall be installed in locations best suited for equipment arrangement and as approved by the Owner's Representative. Verify locations of fixtures with elevator installer in elevator machine rooms and hoistways before installation.

D. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any Work, check and verify all dimensions, sizes, etc., with the Drawings to see that the equipment being installed shall fit into the spaces provided.

E. Locations of Openings: Locate all chases, shafts and openings required for the installation of the electrical Work during framing of the structure. Do any cutting and patching required due to incorrectly located or omitted openings as approved and at no additional cost to the Owner. Cutting or drilling in any structural member is prohibited without prior written approval of Owner's Representative.

F. Access to Equipment. Locate starters, switches, receptacles, and pull boxes to provide easy access for operation, repair, and maintenance and, if concealed, provide access doors.

G. Rough-in locations for all electrical equipment shall be determined from approved shop drawings or from the equipment itself, and shall be coordinated with work specified in other sections.

1.10 COORDINATION

A. Coordinate sequencing, arrangement, required clearances, mounting, and support of electrical equipment with other Divisions of work.

B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

D. Coordinate electrical service connections to components provided by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8.

F. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

G. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

1.11 TESTING

A. Upon completion of the Work and adjustment of all equipment, conduct an operating test for each system approval. Conduct the test in the presence of Owner's Representative and Owner's Electrical Inspector. Demonstrate all systems and equipment to operate in accordance with all requirements of the Contract Documents and to be free from all electrical and mechanical defects. Provide all systems free from short circuits and incorrect grounds and show an insulation resistance between phase conductors and ground not less than 250,000 ohms. Test all circuits and terminations for correct neutral connection, as well as phase connections.

B. Conduct resistance to ground tests by journeymen electricians and the required number of apprentices to measure resistance to ground at all grounding electrodes. If the resistances exceed values specified in Section 260526 Grounding And Bonding For Electrical Systems• perform all corrective measures as approved and at no additional cost to the Owner.

C. Prior to energizing any motors, measure the service voltage for phase balance and report immediately to the Owner's Representative if unbalance exceeds 1% from mean.

D. Measure the three-phase voltage at no load and at maximum load conditions.

E. Complete all tests prior to final field observation of Project, including corrective Work based on the results of the tests.

1.12 SETTING OF PROTECTIVE DEVICES

A. Perform the settings of all protective devices (new and existing) in accordance with the coordination and short circuit studies, prior to final inspection by the Owner's Inspectors.

B. Inspection and subsequent corrections shall be completed between six (6) months, and nine (9) months after project completion.

C. Contractor to reduce the Arc Flash category to Category 2 or lower by doing either, or a combination of the following:

1. Adjust circuit breaker trip settings.
2. Provide special instantaneous protection function, such as optical trip units (optical device).
3. Change the overcurrent protection to a faster tripping time with an arc flash reduction maintenance switch retrofit.

1.13 TRAINING

A. Provide a period of sixteen (16) hours for the necessary training programs and instructions to the Owner's personnel, unless indicated otherwise in individual specification sections.

1.14 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than five days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.

PART 2 - PRODUCTS

2.1 GENERAL

A. Whenever possible, all materials and equipment used in the installation of the work shall be of the same brand or manufacturer for each class of material or equipment, and be U.L. Listed.

2.2 CONCRETE BASES

A. Concrete Forms and Reinforcement Materials: As specified in Division 03.

B. Concrete: 3000-psi, 28-day compressive strength as specified in Division 03.

2.3 Touchup paint

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Be responsible for and install electrical equipment as specified in individual specification sections, and in accordance with manufacturers' recommendations, and per Applicable Code Requirements, for safe installation.

B. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

C. Comply with NECA 1.

D. Coordinate connection of branch circuits and feeders to equipment provided under other Divisions.

E. Measure indicated mounting heights to bottom of unit for suspended items and wall-mounted items, unless noted otherwise.

F. 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.

G. Sequence for efficient flow of installation and positioning prior to building closing-in. Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations, maintaining adequate clear working access per NEC. Provide for ease of disconnecting of equipment with minimum interference to other installations.

H. Arrange raceways, cables, wireways, and cable trays to be clear of obstructions and of the working and access space of other equipment.

I. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

J. Give right of way to piping systems installed at a required slope.

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

L. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Comply with Division 07.

M. Comply with project specification for restoration of surfaces disturbed by electrical installation.

N. Paint finished surfaces damaged during electrical installation, matching color and type of paint. Follow manufacturer's written instructions for surface preparation and application. Apply successive coats required to restore finish equal to the unblemished areas.

3.2 EXCAVATION AND BACKFILL

A. General:

1. Do all excavation and backfill required to install the work in this Division.
2. Perform all excavation and backfill outside of building perimeter in accordance with requirements specified in Division 31

B. Excavation: Bury conduits outside the building to a depth of not less than 2'-6" below finish grade unless noted otherwise.

C. Backfilling: Do not backfill until final inspection and approval for the conduit installation by the Owner's Representative. Backfill material shall be as specified in Division 31

3.3 RACEWAY AND CABLE INSTALLATION

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

B. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

C. Use temporary raceway caps to prevent foreign matter from entering.

D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
4. Transition from nonmetallic tubing to PVC coated rigid steel conduit before rising above floor.
5. Make bends in exposed 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 exposed parallel raceways.

G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

H. Install telephone and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.

I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

J. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.4 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.

C. Connect outlet and component connections to wiring systems and to ground. 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.

3.5 Electrical supporting device application

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.6 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.

    a. Field Welding: Comply with AWS D1.1.

7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.

9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.7 Identification materials and devices

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Identify raceways and cables with color banding as follows

1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
3. Colors: As follows

    a. Fire Alarm System: Red.
    b. Security System: Blue and yellow.
    c. Telecommunication System: Green and yellow.
4. Refer to electrical plans for identification of raceways (in public spaces only) to be painted. Fire Alarm, Security, and Telecommunication raceways to be painted the colors indicated above.

E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.

G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.

4. Neutral: White
5. Ground: Green

H. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows

1. Phase A: Yellow.
2. Phase B: Brown.
3. Phase C: Orange.
4. Neutral: White or Gray
5. Ground: Green

I. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed 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.

J. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.8 Firestopping

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 07.

3.9 Concrete Bases

A. Equipment Mounting: Install floor mounted equipment on a concrete base, 4-inch nominal thickness extending 3 inches beyond footprint, in all directions, of supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

B. Comply with requirements for concrete base specified in Division 03.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions provided with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

3.10 DEMOLITION

A. General:

1. Coordinate with the Owner's Representative regarding specific items that are to be demolished or removed and retained, otherwise, all demolished or Contractor removed materials become the property of the Contractor, unless otherwise indicated. Contractor shall be responsible for removing such materials from the job site. Refer to Division 01.
2. Contractor shall restore or maintain continuity of circuits to outlets or devices that are to remain.
3. Where existing panelboards are to be replaced, the Contractor shall reconnect existing branch circuit homeruns (that are to remain) to the new replacement panelboard.
4. Where existing panelboards are to be relocated, the Contractor shall extend all existing circuits that are to remain to the new panelboard location.
5. Contractor to dispose of hazardous waste, including ballasts and lamps, per Applicable Code Requirements.
6. Provide temporary equipment and wiring as required.
7. Existing materials and construction that are not to be demolished shall be protected. Any such materials that are damaged shall be replaced with new to match existing.
8. Survey existing electrical equipment, devices and raceways whether or not shown on the drawings, which may interfere with the work, to determine the source of power and the load it serves. Disconnect and either remove completely or relocate and reconnect these equipment, devices and raceways as directed.
9. Maintain circuit continuity for all existing equipment to remain in service.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

E. Equipment: All the existing equipment to be removed shall be disassembled or cut into pieces to allow removal through available existing openings.

F. Conduits (Feeder and Branch): Conduit shall be capped for all abandoned installations, and indicated on As-Built drawings.

3.11 SERVICE CONTINUITY

A. Refer to Division 01 for "shut-down" information.

3.12 PROTECTION AND CLEANING

A. Protection: Fully protect all finished parts of the materials and equipment against physical damage from whatever cause during the progress of this work and until completion.

B. During construction, cap all conduits so as to prevent the entrance of sand and dirt.

C. Cleaning: After installation has been completed, the Contractor shall clean all systems as follows:

1. Equipment with factory finish: Clean exterior thoroughly to remove grease, oil, plaster, cement and dirt, and leave surfaces clean and polished.
2. Equipment to be painted: Clean exterior of piping and equipment exposed in completed structure, removing rust, plaster, cement and dirt by wire brushing. Remove grease, oil and similar materials by wiping with clean rags and solvents.

3.13 REFINISHING AND TOUCH UP PAINT

A. Painting is specified in Division 09.

B. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.14 CUTTING AND PATCHING

A. Include all cutting, patching, painting, removal of existing construction, and reconstruction of same, for completing the electrical installation. Coordinate with electrical and other trades' drawings for scope of demolition. Adjust conduits within these areas so they are concealed, or surface-mounted and painted to match existing wall where concealment is not possible

B. Sleeves and Inserts: Provide all sleeves, inserts, and openings necessary for the installation of the electrical work. Sleeves shall be as approved by the Owner¢s Representative.

C. Openings for All Electrical Equipment Shall be Field Verified:

1. Special forming, recesses, chases, and curbs, as necessary for the correct reception and installation of the electrical equipment, as shown on the Drawings, are specified in other Divisions.
2. The Contractor shall examine all Drawings to ascertain that correct provisions have been made for the work. If such provisions are not made in time, the Contractor shall bear all extra costs incurred in later cutting and patching to accommodate this work.

3.15 VIBRATION ISOLATION

A. Provide vibration isolators for all electrical equipment that emits noise and vibration.

3.16 Cleaning and protection

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 260519-LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260526 - Grounding and Bonding for Electrical Systems
4. Section 260529 - Hangers and Supports for Electrical Systems
5. Section 260533 - Raceways and Boxes for Electrical Systems
6. Section 260544 - Sleeves and Sleeve Seals for Electrical Raceways and Cabling
7. Section 260553 - Identification for Electrical Systems

1.2 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Comply with NEC (NFPA 70).

B. Comply with NEMA WC 70/ICEA S-95-658.

C. Comply with UL 1277, UL 1685 for Type TC-ER cable.

D. Wire and cable boxes and reels shall bear the date of manufacture. The date of manufacture shall not precede contract date by more than one year.

E. Conductor sizes indicated are based on copper conductors. Do not provide conductors smaller than those indicated, unless noted otherwise.

F. Coordination: Set sleeves in cast-in place concrete, masonry walls and other structural components as they are constructed

1.4 DELIVERY, STORAGE, AND HANDLING

A. All conductors shall be delivered to job site in unbroken packages.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Provide the following. For requirements regarding Substitutions for Cause see Division 01
   1. Southwire Company.
   2. AFC Cable Systems, Inc.

B. Single Conductors 600V and below:

   1. Provide copper conductors.
   2. Provide stranded or solid conductors as specified in this section.
   3. Provide conductors with Type THHN/THWN, 90°C insulation for indoor applications.
   4. Provide conductors with Type THWN-2, 90°C insulation for exterior, wet or damp locations.
   5. Provide conductors with Type RHW-2, 90°C insulation for areas subjected to temperatures exceeding 60°C (140°F).
   6. Comply with NEMA WC 70.
   7. Aluminum conductors not permitted.

2.2 CONNECTORS, SPLICES, AND TERMINATIONS

A. Provide the following. For requirements regarding Substitutions for Cause see Division 01.

   1. AFC Cable Systems, Inc.
   2. ABB, Inc. Steel City Commercial Fittings.
   3. Hubbell Power Systems, Inc.

B. Component Characteristics:

   1. Provide UL Listed, factory-fabricated connectors, splices and terminals of size, ampacity rating, material, type and class for application and service indicated.
   2. Connections to Fixtures: Make circuit wiring connections to fixture wire with insulated electrical spring connectors. Threaded-type wire nuts, porcelain or Bakelite are not acceptable.
   3. Wire Joints:

a. No. 6 AWG and larger: Burndy Type QPR, Penn Union.
b. No. 8 AWG and smaller: Pigtail splices, or made with insulated electrical spring connectors.

C. Terminations:

1. Provide compression set, bolted, or screw type lug, or direct to bolted or screw type terminal.
2. Connections to Circuit Breakers and Switches:

a. No. 12 AWG wire: formed around binding post or screw.
b. No. 10 AWG and No. 8 wire AWG: *Buchanon Termend*, locking tongue lug or equivalent.
c. No. 6 AWG wire and larger: Burndy *Qiklug* Type QDA, Penn Union, round flange solderless lug or equivalent.

3. Sleeves for Cables:

a. Steel Pipe Sleeves: Type E, Grade B, Schedule 40, galvanized steel, plain ends.
b. Cast-Iron Pipe Sleeves: Cast or fabricated wall pipe, equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
c. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
d. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

4. Plastic Cable Ties:

a. Nylon or approved, locking type.
b. Metallic ties not permitted.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Insulated wire conductors for circuit voltage, 600 volts or less, shall be solid copper conductors for No. 10 AWG and smaller, stranded copper for #8 AWG and larger. Minimum wire size shall be #12 AWG.

B. Conductors shall have UL approved 600 volt insulation of type specified below or elsewhere in the Specifications.

C. Feeders: Copper, Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper, Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 FEEDER WIRING METHODS

A. Service Entrance: Type THHN-THWN-2, single conductors in raceway,

B. Feeders: Type THHN-THWN-2, single conductors in raceway.

3.3 BRANCH CIRCUIT WIRING METHODS

A. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway

B. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

C. AC Drive Output Circuits: Type TC-ER with oversized cross-linked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

D. Minimum branch circuit wire sizes, 208/120V: Increase wire size of all conductors per the following table. Increase conduit size as required. Contractor to field verify lengths.

1. Up to 90 feet at 120V use #12 AWG minimum.
2. Lengths exceeding 90 feet use # 10 AWG minimum.
3. Lengths exceeding 150 feet use # 8 AWG minimum.
4. Lengths exceeding 230 feet use # 6 AWG minimum.
5. External wiring use # 10 AWG minimum.

E. Minimum branch circuit wire sizes, 480/277V: Increase wire size of all conductors per the following table. Increase conduit size as required. Contractor to field verify lengths.

1. Up to 300 feet use #12 AWG minimum.
2. Lengths exceeding 300 feet use # 10 AWG minimum.
3. Lengths exceeding 450 feet use # 8 AWG minimum.
4. External wiring use # 10 AWG minimum.

3.4 Cord Drops and Portable Appliance Connections:

A. Type SO, hard service cord with stainless-steel, wire-mesh and strain relief device at terminations to suit application.

3.5 INSTALLATION OF CONDUCTORS AND CABLES

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

B. Complete raceway installation between conductor and cable termination points according to Section 260533 prior to pulling conductors and cables.

1. Thoroughly clean out all conduit and raceway systems prior to installation of conductors and cables.

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

D. Pull conductors into raceway at same time. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables above accessible ceiling using plastic cable ties to support cables from structure. Do not rest cable on ceiling panels. Support cables according to Section 260529

G. Identify and color-code conductors and cables according to Section 260553.

H. Not more than three lighting or convenience outlet circuits in one conduit unless otherwise indicated. Limit conduit fill to a maximum of 9 current-carrying conductors. No more than three branch circuits plus associated neutral and ground conductor will be allowed.

I. Pull no thermoplastic wires at temperatures lower than 32° F.

J. All conductors shall be new and shall have been manufactured within 12 months of the date of delivery to the Project site and continuously stored where protected from the heat or weather.

K. For conductors installed in areas subjected to temperatures exceeding 140ºF, including terminating in incandescent lighting fixtures and installed through or into housing containing ballasts, furnish type THHN.

L. Unless specifically indicated, separate raceways for conductors of 120/208 and 277/480 volt systems, except where 480 volt motor branch circuit wiring and related 120V control wiring. Separate raceways for emergency system conductors.

M. For conductors installed in exposed conduit outside of buildings and conduit within or just under roofing material, furnish type THHN.

N. Control Circuits for Mechanical Equipment: Use 600 volt UL Type THWN conductors except where subject to abnormally high temperatures such as on or near boilers. Under these conditions, use UL Type THHN.

O. For control wiring, conform to the wiring diagrams shown on the mechanical Drawings and the manufacturer's wiring diagrams to control the equipment in the manner specified in Division 22 and Division 23. Color code all control wiring.

P. Where conductors in conduit pass through exterior walls, a sealing compound of moisture-resistant material shall be applied in the ends of the conduits to seal around the conductors. Sealant shall be Dow-Corning No. 795, or equal.

Q. Tag all conductors of power circuits and the various signal and sound systems. Conductors shall be tagged in each junction box, pull box, wireways or auxiliary gutter and at each device, motor outlet, panelboard, switchboard or other conductor termination. Tag shall show feeder number, size, phase and origin.

R. Megger tests shall be taken on all feeder conductors and on all conductors for motors over 15 HP. Tests shall be made prior to connection of equipment. Conductors testing below manufacturer's standard shall be replaced at Contractor's expense.

S. Arrange wiring in cabinets, switchgear and electrical equipment neatly cut to proper length, grouped and tied together, remove surplus wire and bridle and secure in an acceptable manner

T. Pigtails shall be extended from branch wiring in outlet boxes for attachment to devices. Loops in through wiring shall not be acceptable.

U. Conductors in outlet boxes shall have a minimum of 8 inches of extra conductors.

V. Tag all conductors in pull boxes, junction boxes, pull boxes, and wireways, indicating panel board and circuit number.

W. Tag all feeder conductors with designation (power source and circuit number) in each equipment enclosure.

X. Where single conductors and cables in handholes, cable trays and other indicated locations are not wrapped together by some means such as arc and fireproofing tapes, bundle throughout their exposed length all conductors entering from each conduit with nylon self-locking releasable cable ties placed at intervals not exceeding 18 inches on center

Y. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible. Protect exposed cables from damage.

Z. Wiring at Outlets: Install conductor at each outlet, with at least 12inches of slack.

AA. Install stranded conductors where conductors terminate in crimp type lugs. Do not place bare stranded conductors directly under screws.

BB. Cap spare conductors and conductors not terminated with UL listed end caps.

CC. For conductors that will be connected by others, provide at least 6 feet spare conductors in freestanding panels and at least 2 feet spare in other assemblies. Provide more spare conductors in any particular assembly where it is obvious that more conductors will be needed to reach the termination point.

DD. Install conductors only after:

1. Building interior is enclosed and weather tight
2. Mechanical work likely to damage conductors has been completed
3. Raceway installation is complete and supported

EE. Provide conductor sizes indicated on Drawings.

FF. All wiring shall be installed in conduit unless noted otherwise.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07..

B. Wrap together as a single cable all conductors entering from each conduit.

C. Follow tape manufacturer's installation instructions. Secure the arc and fireproofing tape at frequent intervals with bands of the specified glass cloth electrical tape

3.7 CONNECTIONS, SPLICES, AND TERMINATIONS

A. Connectors:

1. Except where equipment is furnished with bolted or screw type lug, use compression set pressure connectors with insulating covers. Use compression tools and die compatible with the connectors being installed.

2. Use bolt or compression-set type with application of insulating tape, pre-stretched or heat-shrinkable insulating tubing for splices and taps of No. 8 AWG conductors and larger. Install with hydraulic compression tool.
3. Use pre-insulated twist-on connectors with integral spring for splices and taps of No. 10 AWG conductors an smaller.
4. Tighten electrical connectors according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 466A-486B.
5. Motor connections shall be one-hole compression lugs and bolts of the proper size and length.

B. Splices:

1. Splice wires and cable only in one accessible location, such as within junction boxes.
2. Make splices to carry full capacity of conductors with no perceptible temperature rise.
3. Use electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half-lapped layers of plastic electrical tape, for joints, taps and splices of No. 1 AWG conductors and larger.
4. Plastic snap-on splice insulators are not allowed.
5. No WAGO type splice connectors permitted.

C. Terminals:

1. Torque screw termination per manufacturer's recommended values. If manufacturer's torque values are not indicated, use those specified in UL 466A-486B.
2. Insulate ends of spare conductors with electrical tape and identify spare circuit number where appropriate.
3. Eye type crimped terminal for removable screw type terminal. Forked torque terminal when screw terminal cannot be removed.
4. Train wires to eliminate fanning of strands, crimp with proper tool and die.

D. Cable Ties:

1. Neatly bundle conductors and cables together for support. Size cable ties sufficiently to accommodate the multiple cables being supported.

E. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

F. All joints shall be insulated and taped.

3.8 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553.

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

C. Smaller than No. 6 AWG: Provide all single conductors with integral insulation pigmentation of the designated colors.

D. No. 6 AWG and larger: Conductors may be provided with color coding by wrapping the conductor at each end and all accessible locations with vinyl tape. Wrap at least six (6) full overlapping turns of tape around the conductor covering an area of 1 ½ to 2 inches wide at a visible location.

E. Phase Rotation: Phase A, B and C implies the direction of positive phase rotation.

3.9 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544.

3.10 FIELD QUALITY CONTROL

A. List of items or systems requiring testing, evaluation, verification, or commissioning: Low Voltage Cables.

B. Documentation required:

1. Test reports: The contractor will engage a qualified Independent testing and inspecting agency to perform field tests/inspections and provide reports for service entrance and feeder conductors for compliance with requirements.

    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Required testing protocols:

1. The independent testing agency shall perform the following field tests and inspections and prepare test reports:

a. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements
b. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.3. Certify compliance with test parameters.
c. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

    1) Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    2) Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    3) Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

d. Perform insulation resistance testing of all power and control circuits below 600 volts with a 500-volt megger, applied for 1 minute.

2. Corrective measures:

    a. Cables will be considered defective if they do not pass tests and inspections.
    b. Remove and replace malfunctioning circuits/feeders and retest as specified above.

END OF SECTION

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. RS-485 cabling.
3. Low-voltage control cabling.
4. Control-circuit conductors.
5. Identification products.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260519 - Low-Voltage Electrical Power Conductors and Cables
4. Section 260526 - Grounding and Bonding for Electrical Systems
5. Section 260533 - Raceways and Boxes for Electrical Systems
6. Section 260544 - Sleeves and Sleeve Seals for Electrical Raceways and Cabling
7. Section 260553 - Identification for Electrical Systems

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: Circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. RCDD: Registered Communications Distribution Designer.

D. UTP: Unshielded twisted pair.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Comply with NEC (NFPA 70).

B. Comply with NFPA 262 and UL 1665 for plenum rated cables.

C. Comply with UL 1666 for riser cables.

D. Comply with TIA/EIA-568-C.1, TIA/EIA-568-C.2, NEMA WC 66, and UL 444 for UTP cables.

E. Comply with UL 83 for control circuit conductors.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Division 06.

B. Painting: Paint plywood on all sides and edges with flat black latex paint. Comply with requirements in Division 06.

2.2 UTP CABLE

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. ADC.
2. Belden Inc.
3. CommScope, Inc.
4. Draka Cableteq USA.

B. Description: 100-ohm, four-pair UTP, Category 6.

1. Communications, Plenum Rated: Type CMP complying with UL 1685 in accessible non-exposed areas and Type CMP in listed plenum communications raceway elsewhere.
2. Communications, Riser Rated: Type CMR in listed plenum or riser communications raceway.

2.3 UTP CABLE HARDWARE

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. ADC.
2. Belden Inc.
3. Hubbell Incorporated.
4. Panduit Corp.

B. General Requirements for Cable Connecting Hardware: IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Jacks and Jack Assemblies: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular.

D. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.4 TWIN-AXIAL DATA HIGHWAY CABLE

A. Plenum-Rated Cable: Type CMP.

1. Paired, two pairs, No. 20 AWG, stranded (7x30) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.

2.5 RS-485 CABLE

A. Plenum-Rated Cable: Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.

4. Fluorinated ethylene propylene jacket.

2.6 LOW-VOLTAGE CONTROL CABLE

A. Plenum-Rated, Paired Cable: Type CMP.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.

2.7 CONTROL-CIRCUIT CONDUCTORS

A. Comply with requirements in Section 260519.

B. Class 1 Control Circuits: Stranded copper, Type THHN-THWN-2, in raceway **(or MC cable).**

C. Class 2 Control Circuits: Stranded copper, Type THHN-THWN-2, in raceway **(or MC cable).**

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN-THWN-2, in raceway **(or MC cable).**

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Secure conduits to backboard if entering the room from overhead.
3. Extend conduits 3 inches above finished floor.
4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems".
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets and terminals.
4. Cables may not be spliced.
5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems". Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems". Monitor cable pull tensions.
9. Support: Do not allow cables to lay on removable ceiling tiles.
10. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
11. Plenum rated control cabling may be installed without conduit in accessible non-exposed areas. Control cabling shall be installed in listed plenum communications raceways elsewhere.

B. UTP Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271500 unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

C. Installation of Control-Circuit Conductors:

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings on J-hooks cable supports not more than 30 inches Insert dimension apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
4. Cables shall be Plenum rated and listed.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For low-voltage control wiring and cabling, comply with requirements in Section 260526.

3.7 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553.

B. Identify data and communications system components, wiring, and cabling according to TIA-606-A.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, and labeling of all components.
3. Test UTP cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Grounding systems and equipment.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260529 - Hangers and Supports for Electrical Systems
4. Section 260533 - Raceways and Boxes for Electrical Systems
5. Section 260544 - Sleeves and Sleeve Seals for Electrical Raceways and Cabling
6. Section 260553 - Identification for Electrical Systems

1.2 ACTION SUBMITTALS

A. Product Data: For grounding busbars.

1.3 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Grounding arrangements and connections for separately derived systems.
4. Grounding for sensitive electronic equipment.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NFPA 70B .

a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
b. Include recommended testing intervals.

1.5 QUALITY ASSURANCE

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

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide the following. For requirements regarding Substitutions for Cause see Division 01.
1. Eritech.

2.2 GROUNDING AND BONDING CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Grounding and bonding conductors shall be soft-drawn stranded copper conductors.

C. Buried or concealed joints shall be made by exothermic welding.

D. System grounding conductors shall be a minimum of #4/0 AWG unless otherwise indicated, and shall be continuous without joints or splices.

E. Bonding conductors shall be in accordance with the NEC, # 4 AWG minimum.

F. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS AND ACCESSORIES

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Compression and Pressure Connectors: Copper or copper alloy, plated type.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Busbar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, bolt connection.

1. Electric Room Ground Busbar Connection: Single bolt.
2. Telecommunication Grounding Busbar Connection: Two-bolt.

E. Ground connection plates shall be 4-hole, Burndy Type YGF29-4N, O.Z.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch diameter by 120 inches.

B. Ground rod clamps shall be of cast bronze body providing high pressure contact between rod and ground wire.

2.5 GROUNDING BUSBARS

A. Grounding Bus: Predrilled rectangular bars of annealed copper, ¼ by 2 inches in cross section, drilled and tapped with 3/8" coarse thread (2 rows at 2" centers), with standoff insulators for mounting.

1. Main Electrical Room Grounding Busbar: 4 inches wide by 1/4 inches thick, length as required, 7/16-inch holes, pattern AA.
2. Electrical Closet Grounding Busbar: 2 inches wide by 1/4 inches thick, length as required, 7/16-inch holes, pattern EE.
3. Telecommunications Main Grounding Busbar (TMGB): Rectangular bar of annealed copper with insulated spacers, 2 inches wide by ¼ inch thick, length as required.
4. Telecommunications Grounding Busbar (TGB): Rectangular bar of annealed copper with insulated spacers, 2 inches wide by 1/4 inches thick, length as required, with 6 pairs of 5/16-inch holes, and 3 pairs of 7/16-inch holes, arranged in accordance with BICSI recommendations.

B. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Sized and selected to comply with requirements of the NEC (NFPA70). Where the sizes and types specified exceed the NEC, the more stringent requirements and larger sizes are to be used.

B. Underground Grounding Conductors: Install bare copper conductor, # 4/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. No equipment grounding conductors may be shared between circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than # 6 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. Transformers, generator and other isolated neutrals shall be grounded from the neutral bushing or connector to main ground electrode bus, cold water pipe, building steel.

G. All conduit stub-ups shall be grounded and where multiple stub-ups are made within an equipment enclosure, such as a switchboard, they shall be equipped with grounding bushings and bonded together and to the enclosure and the enclosure ground bus, and connect to cold water ground.

H. Flexible conduit shall not be used as a ground path. Include NEC sized green conductor in all flex conduit.

I. Furnish NEC approved bonding devices, fittings or jumpers at expansion fitting, isolation sections or wherever continuity of ground is broken.

J. Install grounding and bonding conductors with sufficient slack to prevent breaking due to settlement and movement of conductors at attached points.

K. Install a ground bus in electrical rooms, telephone equipment rooms, pump rooms and laboratories, as shown on drawings. Install ground bus 6-inch from wall on 1-inch minimum insulated spacers, 18-inches above finished floor, unless otherwise noted on drawings.

3.5 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 compatible, and free of galvanic action.

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. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Compression 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.

C. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use compression type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

E. Moisture Protection: Where insulated grounding conductors are connected to grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

F. Conductor Connections:

1. Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Ground Rods at Test Wells: Bolted connectors.

G. Structural Steel: Exothermic weld.

3.6 LABELING

A. Comply with requirements in Section 260553 for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without 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.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Resistance to ground for electrical systems shall not exceed 5 ohms measurement and additional grounding shall be furnished to attain this value or less.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance. Provide additional grounding as required until ground resistance meets specified value, or is lower.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260526 - Grounding and Bonding for Electrical Systems

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Delegated Design: Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NEC (NFPA 70).

C. Comply with Metal Framing Manufacturers Association MFMA-4.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. Thomas & Betts Corporation.

2. Metallic Coatings: Pre-galvanized or hot-dip galvanized.
3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
2. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

a. Cooper B-Line, Inc.; a division of Cooper Industries.
b. Empire Tool and Manufacturing Co., Inc.
c. Hilti Inc.

d. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05. for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, and RMC as scheduled in NECA 1, where it's Table 1 lists maximum spacings less than stated in NEC (NFPA 70). Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

E. The use of metal cable ties as supports is not permitted.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches high and 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.

C. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, dowels, and placement requirements are specified in Division 03.

D. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install epoxy-coated anchor bolts to elevations required for proper attachment to supported equipment, according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260526 - Grounding and Bonding for Electrical Systems
4. Section 260529 - Hangers and Supports for Electrical Systems
5. Section 260544 - Sleeves and Sleeve Seals for Electrical Raceways and Cabling
6. Section 260553 - Identification for Electrical Systems
7. Section 280513 - Conductors and Cables for Electronic Safety Systems

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. GRC: Galvanized rigid steel conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. MC: Metal-clad cabling

F. RNC: Rigid nonmetallic conduit.

1.3 ACTION SUBMITTALS

A. Product Data: For wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. Comply with NEC (NFPA 70).

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6. Standard weight steel that is hot-dipped galvanized both inside and out with threaded steel connectors and couplings.

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

a. Allied Tube & Conduit; a Tyco International Ltd. Co.

B. PVC-Coated Steel Conduit: Comply with NEMA RN 1.

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

a. Robroy Industries - PLASTI-Bond Red•
b. OCA Corporation - Ocal-Blue•

2. Provide PVC coated rigid steel conduits and fittings with a half lap, 40 mil extruded PVC jacket. The jacket shall have high tensile strength, shall be highly resistant to corrosion and shall not oxidize or deteriorate or shrink when exposed to sunlight and weather. The jacket shall be flame retardant and shall not support combustion.
3. The interior of conduit and fittings shall be coated with urethane coating (two mil thickness) for protection against corrosion.
4. Fittings and accessories shall be provided by the same manufacturer and installed in accordance with the manufacturer's specifications.

C. EMT: Comply with ANSI C80.3 and UL 797.

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

    a. Allied Tube & Conduit; a Tyco International Ltd. Co.

2. Provide tubing of high grade steel electrically welded with exterior protective coating of hot galvanized zinc, applied by the electro galvanized process.
3. Tubing shall be dipped in a chromic acid bath to chemically form a corrosion-resistant protective coating of zinc chromate over galvanized surface.
4. Interior surface shall be coated with aluminum lacquer or enamel.
5. Fitting shall be steel, watertight, gland ring compression type, wrench tightened connectors and couplings. Manufactured by Appleton, O-Z Gedney, Cooper/Crouse-Hinds.
6. Provide compression fittings
7. Set screw, die cast and indenter type fittings not permitted.

D. FMC: Comply with UL 1.

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

    a. AFC Cable Systems, Inc.

2. Provide conduit manufactured from single strip, standard weight steel hot-dipped galvanized on all four sides prior to conduit fabrication.
3. Provide die cast fittings of the type that screw into the inside of the conduit with threaded edges at 90 degrees to the fitting body to insure a force fit. Fittings shall be manufactured by AFC, O-Z Gedney, T&B and Steel City.
4. General: flexible conduit and fittings shall provide positive ground continuity. Include a separate green grounding conductor in each run.
5. Aluminum and light-weight steel conduits & binding screw type fittings not permitted.

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

    a. Sealtite Flexible type - UA•
    b. Flex-Seal type - XL•

2. Provide conduit manufactured from single strip standard weight steel, hot dipped galvanized on all four sides prior to conduit fabrication and shall be provided with an extruded polyvinyl chloride cover.

3. Provide malleable iron, zinc plated fittings with locknut and O-ring seal and slim diameter with small turning radius. Manufactured by O-Z Gedney-4Q series, T&B- 5200 series or Appleton Flexible Fittings-ST series.
4. General: Liquidtight conduit and fittings shall provide positive ground continuity. Include a separate green grounding conductor in each run.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

G. Joint Compound for GRC or ARC: Compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. Wiremold, Legrand
2. Cooper B-Line, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NEC (NFPA 70).

C. Fittings and Accessories: Include covers, 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.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Provide metal wireway where indicated on drawings or as required.

F. Minimum Size: 6" x 6"• unless otherwise noted.

G. Finish: Rust inhibiting primer coating with grey enamel finish.

H. Outdoor units shall be raintight with screw covers and furnished with full gaskets.

I. Provide with divider for power and data where required.

2.3 CONDUIT HANGERS:

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Section 012500.

1. B-Line, Cooper Industries
2. Caddy, ERICO International Co.
3. Thomas & Betts Co.

B. Conduit shall be strapped using either conduit strap, conduit clips or conduit hangers as outlined below.

C. Two hole stainless steel conduit strap mounted on strut is preferred.

D. Conduit clip mounted on strut may also be accepted.

E. Conduit hangers, stainless steel, may also be accepted.

F. Cable ties, twist ties, wire ties and any other tying devices are not permitted.

G. One hole conduit straps are not permitted

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. Appleton, Emerson Electric Co.
2. Crouse-Hinds, Cooper Industries
3. Steel City Ó Thomas and Betts Co.
4. Raco, Hubbell Inc.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Device Box Dimensions:

1. Device and Outlet Boxes: 4 inches square by 2-1/8 inches deep minimum, with adequate space for devices, wires, and 30 percent spare fill capacity.
2. Telephone, Data, and Intercom Outlet Boxes: 4-11/16 inches square by 2-1/8 inches deep.
3. Fire Alarm Device Boxes: 4 inches square with plaster ring to suit type of device. Special boxes shall be as specified in Division 28.

F. Modular gangable boxes are prohibited, use non-gangable boxes only for ganged devices.

G. Pull and Junction Boxes:

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

   a. O.Z. Gedney Ó EMERSON Industrial Automation
   b. Alhambra Foundry Co.

2. Sheet Metal Pull and Junction Box: Comply with NEMA OS 1 and UL 514A. Provide standard outlet or concrete ring boxes wherever possible; otherwise use minimum 16 gauge galvanized sheet metal, NEMA 1 boxes, sized to Code requirements with covers secured by cadmium plated machine screws located 6 inches on centers.
3. Cast Metal Pull and Junction Box: Comply with NEMA FB 1 and UL 1773. Provide standard cast malleable iron outlet or device boxes wherever possible; otherwise use cadmium plated, cast malleable iron boxes with bolt-on, interchangeable conduit hub plates with neoprene gaskets.
4. Flush mounted pullboxes and junction boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

H. Poke-Through Boxes:

1. See Section 262726 - Wiring Devices.

I. Floor Boxes:

1. See Section 262726 - Wiring Devices.

J. Conduit Outlet Body:

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

   a. Appleton, type "LBD" or "LBDN" series
   b. Crouse-Hinds, Cooper Industries
   c. Torpaz electrical fittings

2. Provide Cadmium plated cast iron alloy, oblong conduit outlet bodies with threaded conduit hubs and neoprene gasket, cast iron covers where required. Condulets shall be cast iron with threaded hubs and gasket.

K. Conduit Seals:

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

    a. Appleton, type "ESUF" or "ESUM" series
    b. Crouse-Hinds, type "EYS" or "EZS" series

2. Provide cast iron alloy for both body and closure. The seals shall have large openings with threaded closures to provide easy access to conduit hubs.

L. Wall Penetration Seals:

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.
2. Provide modular water tight seals for all conduits penetrating exterior walls to prevent entrance of water inside the building.

M. Expansion Couplings:

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

    a. O-Z/Gedney, Type "AX" or "DX series
    b. Crouse-Hinds, Type "XD" or "XJD" series

2. Provide expansion couplings in areas that two sections of conduit are subject to longitudinal movement due to thermal expansion, buckling and where crossing the structural joints.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NEC (NFPA 70), by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Rigid steel conduit shall be used for the following:

1. Where required by Code.
2. Where exposed to weather, damp and wet locations
3. Where exposed to physical damage
4. In corrosive areas, in slabs and in concrete **- Schedule 40 PVC may be substituted for branch circuiting as permitted by owner.**
5. Generator enclosure

C. EMT conduit shall be used for the following:

1. EMT conduit shall be used for all sizes up to 4" in dry locations as in stud partitions and furred ceiling space.
2. EMT conduit may be used up to 4" for Telecommunication and Voice/Data System.
3. EMT conduit may be used up to 4" for Fire Alarm System wiring where conduit is concealed and where it is not main run and riser.
4. EMT conduit shall not be used for underground, exterior, where it is prohibited and where rigid steel conduit is required.

D. Flexible steel conduit shall be used for the following:

1. Where required by Code.
2. In dry locations.
3. Where structural condition prevents the use of other type of conduit and for a maximum length of 24".
4. For final connection to motors, transformers and vibrating equipment. Lengths shall be limited to within maximum of 6'.
5. For final connection from junction box to light fixture (whip). Lengths shall be limited to within maximum of 6'.

E. Liquidtight Flexible conduit shall be used for the following:

1. Where required by Code.
2. In plenum areas.
3. Where exposed to weather, in damp or wet locations.
4. For connections to equipment containing water (i.e. water heaters)
5. Any connections made below sinks.
6. Provide polyvinyl covers listed for the application of area of use.
7. Minimum length of flexible liquidtight conduit shall be 3' for connection to motors and vibrating equipment. The lengths shall be limited to a maximum of 6' unless otherwise noted.

F. PVC coated steel conduits shall be used in lieu of rigid nonmetallic conduit **(except where Schedule 40 PVC conduits are installed)** for the following conditions or locations:

1. Use for all conduit stub-ups through the floor slab, including the elbows.
2. For all bends in conduits 2" and larger, use large radius factory made bends or field fabricate with a power bender.
3. All conduits and fittings that have a damaged PVC coating shall be replaced promptly.

G. Minimum Raceway Size:

1. The size of the raceways for the various circuits shall be as indicated on the Drawings and not less than required by National Electrical Code (Chapter 9, Annex, Table C1, based on "THW" insulation type) for the size and number of conductors to be pulled therein. NEC requirements shall prevail where fill is not shown on drawings.
2. Above Ground: 3/4-inch trade size.
3. Raceway size shall be increased to the next larger size where it shall be installed in slab or underground.

H. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

I. Install aluminum conduit for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

J. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NEC (NFPA 70) limitations for types of raceways allowed in specific occupancies and number of floors.

B. Install work in accordance with State and local standards and codes.

C. Identify raceway and boxes in accordance with Section 260553 Identification for Electrical Systems• .

D. Ground and bond raceway and boxes in accordance with Section 260526 Grounding & Bonding for Electrical Systems• .

E. Installation of raceways shall be coordinated with building structure and other trades and shall be complete with bends, fittings, junction and pull boxes to meet all codes and make complete operating system.

F. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

G. Complete raceway installation before starting conductor installation.

H. Upon completing the installation of any run of conduit, the runs shall be tested to see that they are free from all obstructions and have a smooth interior. Each end of each conduit run shall be plugged with "pennies" and bushings and left plugged until ready to pull circuit wires.

I. Comply with requirements in Section 260529 for hangers and supports.

J. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

K. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

L. Support conduit within 12 inches of enclosures to which attached.

M. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG. Install junction box with drain fitting at low points in conduit system.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on conduits.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Install raceway sealing fittings at accessible locations according to NEC (NFPA 70) and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NEC (NFPA 70).

W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where an underground service raceway enters a building or structure.
2. Where otherwise required by NEC (NFPA 70).

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. LFMC: Maximum length of 36 inches.
2. FMC: Maximum length of 72 inches.

Y. Mount boxes at 18 inches above finished floor or at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten raceway, junction and pull boxes to or support from building structure and finishes in accordance with this Section. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. A separate raceway shall be installed for each homerun indicated on the drawings

FF. Holes for conduits through existing concrete walls, or floors shall be made by the "core-drill" method. The size and location shall be approved by the Owner/Landlord.

3.3 Raceway Routing:

A. Raceway routing is shown in approximate locations unless dimensioned.

B. Route raceways parallel and perpendicular to walls and ceilings for all exposed and concealed locations, no jogging or zigzagging allowed.

C. Route raceways in furred spaces to clear access openings.

D. Maintain minimum of 6 inch or larger clearance as required between raceway and piping for maintenance purposes.

E. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104°F such as hot water and steam pipes, flues, heating appliances and etc.

F. Supports:

1. Raceway supports shall be dedicated to support the raceways only and shall not support any other item.
2. Support raceways from structure above suspended ceilings; maintain minimum 8 inch or larger clearance above drop ceiling to allow removal of ceiling tiles. Maintain minimum 3 inch or larger clearance above recessed light fixtures.
3. Do not attach raceway to ceiling support wires or other piping systems.
4. Provide plated or galvanized hangers, rods, channels and metallic support and fastening material. Do not use perforated metal strap or wood as support material.
5. Hangers and racks shall be attached to concrete with insets, set at the time the concrete is poured and to steel members with beam clamps or machine bolts.
6. Conduit clamps and hanger rods attached to concrete structures shall be secured by machine bolts or rods screwed into anchors. Anchors not cast into the concrete shall be of the expansion shield type.
7. Where single conduits 3/4 inch and larger are suspended from ceiling, use pipe hangers suspended from rods.
8. Where two or more conduits 1-1/2 inch and larger are suspended from ceiling, use trapeze type hanger suspended from rods.
9. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints. Where Raceways cross the joints, provide approved expansion or deflection fittings, or combinations of fittings and liquidtight flex conduits to allow deflection in all directions as required.
10. Raceways shall be continuous from outlet to outlet, from outlet to cabinet, junction box, pull box and shall enter and be secured to all boxes, etc., in such a manner that each system will be mechanically and electrically continuous from service to all outlets.
11. Supports shall be installed for 3/4 to 1-1/4 inch conduits; within 18 inch of each junction box inclusive and on either side of couplings and fittings and at a spacing not to exceed 8 feet.
12. Supports shall be installed for 1-1/2 inch and larger conduits; within 36 inch of each junction or pullbox and terminal cabinet and at a spacing not to exceed 8 feet.
13. When conduits are supported from trapezes, the supports shall be spaced not more than 8 feet apart.
14. Secure exposed conduit runs on concrete, plaster or other construction in place with cast conduit clamps affixed with metallic expansion anchors or toggle bolts and cadmium plated machine or lag screws.
15. Surface Raceway: Install flat-head screws, clips and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
16. Support raceways adjacent to walls with preformed channels.
17. Do not strap or fasten rigid conduit to mechanical equipment, or to equipment subject to vibration or mounted on shock absorbing bases.

G. Conduit Hangers:

1. Conduit straps, clips or hangers shall be used to mount conduit.
2. Where conduit clips are used, preference is to mount on strut, rather than on wall.

H. Bends:

1. Keep bends and offsets in raceway runs to an absolute minimum. There are no zigzagging or small jogging permitted.
2. Install no more than equivalent of four 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams.
3. Conduit bends will not be permitted around the corners of beams, walls or equipment. Provide condulets as required with accessible covers.
4. For bends and offsets in conduit 1 inch and larger, use larger radius factory fittings or a hydraulic bender. Replace flattened, deformed or kinked conduit.
5. For the serving utilities the bending radius of raceways shall meet their requirements.

I. Cuts and Joints:

1. Cut conduit square using saw or pipe cutter; de-burr cut ends.
2. Cut conduit squarely and ream ends to remove burrs. Close open ends of conduits, unless in a closed box or cabinet, with approved conduit caps or closures as soon as installed and keep closed until ready to pull in conductors.
3. Ream the ends of all conduits and clean conduits before pulling conductors.
4. For rigid steel conduit use conduit unions to connect two rigidly held conduits. Running thread will not be accepted.
5. Cut threads on rigid conduit to standard taper and to length such that bare metal exposed by the threading operation will be completely covered by the couplings or fittings used.
6. Use pipe joint compound (pipe dope) and oil applied to the male threads only and tighten joints securely.
7. For exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing "Galvabar".
8. Right and left hand couplings shall not be used.

J. Terminations:

1. Secure conduits to panels, pull boxes, wireways and enclosures with locknuts, inside and out and provide high impact plastic or insulated throat steel bushings at terminations in pull boxes, wireways, signal cabinets, boxes and enclosures.
2. For rigid steel conduit, provide steel insulating bushings with plastic liner.
3. For EMT provide insulated throat connectors secured with locknut on interior of box or enclosure.
4. For flex conduit, provide insulated throat steel twist-in connectors secured with locknut on interior of the box or enclosure, or steel twist-in connectors with plastic bushing and locknut.

5. At panelboards, switchboards and gear specified with ground bus terminate conduits with ground bushing bonded to ground bus with code size conductor.
6. Conduit connections to panel cabinets and pull boxes shall have grounding wedge lugs between the bushing and the box or locknuts designed to bite into the metal.
7. Use approved couplings or unions; running thread, thread less coupling, or split coupling connections are not permitted.
8. Use insulated bushings and locknuts on all conduits where entering pullboxes, junction boxes, outlet boxes, cabinets and similar enclosures and for all signal and telephone conduit terminated in cabinets or backboards. For 1-inch or larger bushings, shall be with grounding lugs, O-Z/Gedney Type BLG or equal. Bushings shall be installed before any wire is pulled.
9. For all PVC jacketed steel conduits wrap all joints with two layers of 10 mil PVC tape.

K. Sleeves:

1. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.
2. Wherever conduits pass through concrete walls, suspended slabs or metal deck floors furnish and install sleeves of ample size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations with the Owner's Representative.
3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
4. Use rectangular sleeve (minimum of 0.052-inch thick steel) for openings that the perimeter is less than 50 inches and all sides are less than 16 inches.
5. Use rectangular sleeve (minimum of 0.138-inch thick steel) for openings that the perimeter is equal or greater than 50 inches and one or more sides are equal or greater than 16 inches.
6. Cut sleeves to length for mounting flush with both wall surfaces.
7. Extend sleeves installed in floors 2 inches above finished floor level.
8. Finish around Sleeves: Rough edges shall be finished smooth.
9. Space between conduit and sleeves where conduit passes through exterior walls shall be sealed to permit movement of conduit, but prevent entrance of water.
10. Space between conduit and sleeves where conduit passes through fire rated interior walls and slabs shall be sealed with approved materials to provide a fire barrier conforming to the requirement of Codes as listed in General Requirements.
11. Sleeve shall be 1 inch To 2 inch bigger than conduit size.

L. Empty Raceways:

1. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

2. Provide nylon or polypropylene pull ropes in all conduits more than 60 inch in length that are left empty for future use. Minimum of 60 inch of rope shall be provided at each end of the conduit.
3. For 1-1/2 inch and smaller conduits, provide 1/8 inch outside diameter rope.
4. For 2 inch and larger conduits, provide 3/8 inch outside diameter rope.
5. Tag all empty conduits at each accessible end with a permanent tag identifying the purpose of the conduit and the location of the other end.
6. All open ends of conduits for communications cabling shall be furnished with plastic bushing.

M. Seals:

1. Conduits terminating where termination is subject to moisture or where conduit penetrates exterior wall shall be sealed.
2. Seal all conduits from exterior outlets at first interior junction to prevent moisture from entering the building through the conduit. Slope exterior conduits away from the building.
3. Provide conduit seal for all conduits that pass through Classified (hazardous) areas, sump pump and sewage ejector pits, refrigerated areas, temperature controlled rooms such as cold room or warm rooms.
4. Seal all fire rated wall or ceiling penetrations. Sealant material and method shall be UL listed.

3.4 Installation of Boxes:

A. Provide the type of boxes permitted in these Specifications or required for each location or condition per applicable codes and jurisdictions whichever is more stringent.

B. Install boxes in accordance with manufacturer's written instructions, as shown on drawings and as specified herein.

C. Provide pull boxes inside the building to facilitate pulling of conductors and cables for long and excessive runs of raceways. The spacing of pullboxes shall not exceed 200 feet of raceway runs for electrical system and 100 feet for telecommunications system. These pullboxes are not necessarily indicated on drawings. (Coordinate telecommunication requirements with Division 27.)

D. All boxes shall be of NEC size for the number of wires or conduits passing through or terminating therein, but in no case shall any box be less than 4" square by 2-1/8" deep, unless specifically noted as smaller on the Drawings.

E. Locate electrical boxes as shown on Drawings and in other locations as required for splices, taps, wire pulling, equipment connections, Code compliance and other building elements.

F. Prior to coring existing slab for poke-thru devices, coordinate with structural engineer and Owner's Representative for approval.

G. Install outlet boxes at the locations and elevations shown on the Drawings or specified elsewhere. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.

H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only such as electrical rooms, mechanical rooms and utility areas.

I. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

J. Do not install flush mounting boxes back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic and fire rated walls.

K. For boxes not specified or indicated, use boxes and mounting height as required by equipment and recommended by equipment manufacturer.

L. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

M. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

N. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.

O. Use extension rings with blank covers for making exposed conduit connections to flush wall or ceiling boxes.

P. Locate outlet boxes to allow light fixtures positioned as indicated on Drawings.

Q. Locate switch outlet boxes on the latch side of doorways unless otherwise indicated.

R. Install gang box where more than one device is to be mounted together. Do not use sectional box.

S. Install gang box with plaster ring for single device outlets.

T. Supports:

1. Support boxes independently of conduit system:
2. Install stamped steel bridges/brackets to fasten flush mounting outlet box between studs.
3. Install adjustable steel channel fasteners for hung ceiling outlet box.
4. Do not fasten boxes to ceiling support wires or other piping systems.

5. Support boxes, installed in suspended ceilings supporting acoustical tiles or panels, directly from the structure above wherever pendant mounted lighting fixtures are to be installed from the box.
6. Mount boxes, installed in suspended ceilings of gypsum board or lath and plaster construction, to 16 gauge metal channel bars attached to main ceiling runners.

U. Boxes for different systems:

1. Where both emergency and normal circuits feed a single light fixture, provide an outlet box for each system.
2. Provide separate pull boxes and J-Box for different voltage conductors. Also provide separate boxes for general loads, communications, fire alarm, lighting, signal and miscellaneous systems.
3. Multiple gang boxes containing 277volt switches shall have a barrier between each switch.
4. Paint the outside and inside of all boxes containing fire alarm devices with red paint.

V. Covers:

1. Covers for flush outlets shall finish flush with plaster or other finished surface.
2. Install raised covers (plaster rings) on all outlet boxes in stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
3. For outlets flush in exterior walls, use weatherproof joints and connections all around. Outlets shall have cast covers and be fitted with gaskets.
4. Label the cover of each accessible junction box with panel and circuit designation and function per Section 260553 Identification for Electrical Systems.
5. Install galvanized steel coverplates on boxes in unfinished areas, above accessible ceilings and on surface mounted outlets.
6. Provide cast metal boxes with gasketed cast metal cover plates where boxes are exposed in damp or wet locations.

    a. Use conduit outlet bodies to facilitate pulling of conductors or to make changes in conduit direction only. Do not make splices in conduit outlet bodies.
    b. Leave no unused openings in any box. Install close-up plugs as required to seal openings.

W. J-Boxes shall not be installed on any vibrating equipment (I.e. pumps, fans, etc.) unless used for power or control of the same equipment. No J-Box shall be installed on air ducts or pipes.

X. J-Boxes shall not be installed in visible finished areas. Place boxes that might be exposed to public view in a location approved by the Owner's Representative. Provide covers or plates to match adjacent surfaces as approved by the Owner's Representative.

3.5 Miscellaneous Items:

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Division 07.

B. Provide fire-proofing pad add additional sheet rock as necessary to maintain original fire rating of walls where boxes are installed on rated walls.

C. Provide acoustic pad or membrane around all outlet boxes and switches located in party walls of offices, meeting rooms and all quiet areas.

D. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.

E. Wherever conduit extends through roof, furnish and install galvanized sheet metal flashing. Flashing shall extend six inches above roof.

3.6 Adjustments:

A. Align adjacent wall mounted outlet boxes for switches, thermostats and similar devices. Refer to wiring device mounting detail on electrical drawings.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height to agree with required location for equipment served.

D. In concrete or drywall construction, set recessed boxes so that the front of the plaster ring or front of the box for those without plaster rings is not more than 1/4" behind the final finished surface.

E. Set all recessed boxes in other types of construction so that the fronts are flush with the finished surface. Where these settings are not achieved, provide a 24-gauge or heavier galvanized steel liner flush with finished surface.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544.

3.8 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260544-SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Note: Submittals for IEQ Credit 4 are to be provided to GC to review and ensure compliance with State requirements and LEED criteria, Buro Happold will not review these submittals, if provided they should be for record only.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.
a. Metraflex Company (The).

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07.
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable.
4. Install sleeves for wall penetrations. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

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

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 262726 - Wiring Devices

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NEC (NFPA 70).

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with UL969 for adhesive-attached labeling materials

F. Furnish products listed and classified by Underwriters Laboratories, Inc. or by a testing agency acceptable to Authorities Having Jurisdiction as suitable for purpose specified and indicated.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. Markers:

a. Thomas & Betts.
b. Brady.
c. Seton Safety Labelling.

2. Tapes:

a. Kroy.
b. Merlin.
c. 3M Scotch.

2.2 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Tag feeders at panels, switchboards, pull boxes, and other accessible enclosures, indicating source, voltage, circuit number, and conductor ampere rating. Tags to be readily readable after installation.

B. Tag exposed ends of conduit stubs indicating system, name of panel, switchboard, etc., of origin and conduit size.

C. Identify all branch circuit system conductors with pre-marked self-adhesive, wrap around cloth wire markers, indicating circuit number and name of panel, cabinet, etc, or origin, at panel boards, motor control centers, switchboards, isolated power panels, terminal cabinets, wireways, junction boxes and at all outlet boxes containing more than one neutral wire.

D. Identification Format Example:

1. Switchboard Feeder œ DBHN1-1 480/277V 225A
2. Transformer Subfeeder - T1A 208/120V 380A
3. Transfer Switch Subfeeder - EAH1 480V 800A
4. Panel Branch Circuit - LN1A-10

E. Paint Fire Alarm System J-boxes and pullboxes red and provide label: "Fire Alarm System".

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.5 FLOOR MARKING TAPE

A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 WARNING LABELS AND SIGNS

A. Comply with NEC (NFPA 70) and 29 CFR 1910.145.

B. Warning Signs:

1. Weather-resistant, nonfading, preprinted, No. 18 AWG steel, white porcelain enameled signs with 1 inch high black letters
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. Rooms or areas containing equipment rated over 600V and on front of such enclosures: "DANGER! œ HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY!•
4. Electrical and Signal Rooms: ELECTRICAL (or SIGNAL) ROOM œ NO STORAGE PERMITTED

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated on the drawings. Provide numbering, lettering, and colors as approved in submittals and as required by Code.

B. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

C. Nameplates - General:

1. Provide laminated, engraved plastic nameplates with ⅜ inch high letters for all switchgear, switchboards, motor control centers, transfer switches, panelboards, signal system equipment cabinets, and terminal cabinets. Provide similar nameplates with ⅜ inch high letters for transformers, time switches, individually mounted breakers, switches and controls, switchboards, and motor center branch devices. Attach nameplates to gear with sheet metal screws. Adhesive mounted nameplates are not acceptable. Refer to single line diagrams and schedules for actual designations and circuit numbers that apply to this project.
2. Include nameplate schedule on shop drawing submittals.
3. Indicate on Gear Nameplates:

a. Line 1: Equipment designation
b. Line 2: Primary voltage, phase, number of wires. (In addition, include kVA
c. rating of transformers, kW rating generators, Amperes for switchgear, Automatic Transfer Switches, and panelboards).
d. Line 3: Source equipment ÓFed From• (For Automatic Transfer Switch, indicate normal and emergency source equipment and for equipment fed from a transformer, indicate source with transformer in parenthesis).
e. Line 4: (where applicable, For Automatic Transfer Switch, indicate priority number.)
f. Example #1:

Distribution Board DBHN1
480/277V, 3P, 4W, 2000A

g. Example #2:

ATS E-AH1
480/277V, 3P, 4W, 600A
NORMAL SOURCE: DBHN1, EMERGENCY SOURCE: E-DBHN1
PRIORITY 1

h. Example #3

PANEL LN1A

120/208V, 3P, 4W, 150A
FED FROM DBHN1 (VIA T1A)

4. Indicate equipment and/or equipment controlled and designation on component nameplates. Examples:

    a. Switchboard Breaker: CKT 3 - PANEL LN1A
    b. Motor Switch: TOILET EXHAUST FAN EC-3
    c. Submeter: KWHR SUBMETER AIR CONDITIONING
    d. Time-Switch: TSA - PARKING LIGHTS (served from Panel A)
    e. Fire Alarm Terminal Cabinet: FIRE ALARM SYSTEM 24V DC

5. Install panelboard nameplates behind panel door in public areas and on panel face in equipment rooms.

D. Nameplate Color Schedule:

1. Over 600V: Brown letters on white label.
2. 277 through 600V: Orange letters on white label.
3. 120 through 240V: Black letters on white label.
4. Emergency System: White letters on red label.
5. Devices Connected ahead of Service Mains and Substation Secondary Mains: Letter color as per switchboard voltage on Yellow label.
6. Fire Alarm System: Black letters on red label.
7. Communication or Signal Systems: White letters on black label. Identify system and voltage.
8. Building Control System: White letters on green label.

E. Stenciled Designations: Provide readily visible block letter stenciled designations for the following with ⅜ inch high minimum letters on background of contrasting colors as outlined under Nameplate Color Schedule (above). Fabricate stencils of brass and deliver to Owner on completion of work. Obtain receipt and include in maintenance manual.

1. Junction and pull boxes of signal and communication systems identifying system and voltage.
2. Lighting Outlet and Junction Boxes: Identify voltage and circuits contained within box.
3. 480V Outlet and Junction Boxes: 480V. Identify circuit(s).
4. Each 10 foot length of medium voltage conduit, exposed or in accessible ceiling space and associated junction and pull boxes: DANGER HIGH VOLTAGE
5. Feeder conduit runs on 25 foot centers and on both sides of wall and floor penetrations, where visible from floor and above demountable ceilings. Indicate circuit designation and number on all feeders. Indicate system on all signal and communications system conduit sized 1½ inch and larger.

F. Labels:

1. Provide label, in addition to UL label, for each switchgear, switchboard, panelboard, transfer switch, and motor control center indicating the short circuit rating of the gear as constructed and the minimum rating of devices allowable. Submit with shop drawings.
2. At all 120V outlet locations, provide labels with panel and circuit information using a P-touch or similar label maker with minimum ½" tape. For normal power, label shall be black letters on white tape. For emergency power, label shall be white letters on red tape.
3. At all dedicated outlet locations, in addition to label as indicated in "b)" above, provide the name of the device to be connected at the dedicated outlet on the label. Example "L1A-13", Freezer•
4. At all fusible devices, either individually mounted or part of gear, provide a label (as supplied by fuse manufacturer) or nameplate inside each switch cover, indicating specific type of fuse required for replacement.

G. Devices: Engrave on each device plate with 3/16 inch high block letters with black enamel where noted and as follows:

1. Lock switch and switch with pilot light œ device controlled.
2. Switch for fan, motor unit heater œ equipment controlled.
3. Switch where lights or equipment are out of sight œ identify area or equipment controlled.
4. Switches in gangs of three or more œ identify areas or equipment switched.
5. Receptacles over 150V to ground and/or 30A and higher rating œ voltage and ampere rating.
6. Isolated Ground Receptacles œ Isolated Ground.
7. Where wording is not indicated, allow for ten letters per device and use wording as directed.
8. For switch cabinets engrave each device or provide engraved nameplate.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.10 panel schedules

A. Provide typewritten panel schedules on inside of panel doors behind clear plastic. Indicate as-built quantity and type of outlets served as well as general location of outlets or fixtures and/or item of equipment served.

B. Electronic copies of all panel schedules shall be provided as part of close out documentation. Electronic panel schedules may be provided in Microsoft Excel or AutoCAD formats only. Scanned or other non-editable electronic files are not acceptable.

2.11 DIAGRAMS AND POSTED SIGNS

A. For switchboards with bus rating 1000A or greater, and for substations, provide a bus diagram framed and mounted behind clear plastic indicating bus configuration and rating, devices, ground fault detectors, standby generator connection, and switchboard components. Submit diagram for review with shop drawings.

B. For signal and communication systems, provide block wiring and location diagram mounted behind clear plastic and posted at system control location or as directed. Submit diagram for review with shop drawings.

C. For all main electrical rooms, and/or as directed by Owner, provide a single line diagram framed and mounted behind clear plastic indicating as-built system configuration and distribution.

2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power per article 700 of the NEC.

a. Paint junction box covers and covers of multi-outlet assemblies red.

b. Use visibly red receptacles and devices. Alternately, engrave plates "EMERGENCY SYSTEM" and fill in with red enamel.

2. Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in panels, switchboards, vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors. Use conductors with color factory-applied the entire length of the conductors except as follows:

a. Color shall be factory applied or field applied for sizes larger than No. 10 AWG, if authorities having jurisdiction permit.

1) Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or tape are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1 inch wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
2) In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.
3) Color coded conductors of cables used in communication and signal systems and control conductors in line and low voltage control panels, motor control centers, and supervisory panels. Use white for grounded conductors and green for equipment ground, exclusively.

2. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be painted with colors indicated below. Make each color band 2 inch wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 10 foot maximum intervals in straight runs. Apply the following colors:

a. Fire Alarm Systems: Red.
b. Fire Suppression Supervisory and control System: Red and Yellow
c. Mechanical and Electrical Supervisory System: Green and White
d. Telephone System: Green and Yellow

3. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Neutral: White
    e. Ground: Green

4. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Neutral: Gray
    e. Ground: Green

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NEC (NFPA 70) and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.
c. Uninterruptible power supplies.

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Stenciled legend 4 inches high.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchboards.
e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
f. Generators.
g. Emergency system boxes and enclosures.
h. Enclosed switches.
i. Enclosed circuit breakers.
j. Enclosed controllers.
k. Variable-speed controllers.
l. Push-button stations.
m. Power transfer equipment.
n. Contactors.
o. Lighting control panels.
p. Remote-controlled switches, dimmer modules, and control devices.
q. Monitoring and control equipment.

END OF SECTION

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1. Coordination of series-rated devices is not permitted.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 262200 - Low Voltage Transformers
4. Section 262413 - Switchboards
5. Section 262416 - Panelboards
6. Section 263600 - Transfer Switches

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and 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.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developer: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:

1. ABM Electrical Power Solutions.
2. EPS Engineering and Design.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.

3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.
   1. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
   2. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

   1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
   4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
   7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   9. Motor horsepower and NEMA MG 1 code letter designation.
   10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on the Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Control panels.
7. Standby generators and automatic transfer switches.
8. Branch circuit panelboards.
9. Disconnect switches.
10. Fire pump controller transfer switch.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following. For requirements regarding Substitutions for Cause see Division 01.

1. ABM Electrical power Solutions.

2. EPS Engineering and Design
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.

6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
2. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260526 - Grounding and Bonding for Electrical Systems
4. Section 260533 - Raceways and Boxes for Electrical Systems
5. Section 260553 - Identification for Electrical Systems
6. Section 260573 - Overcurrent Protective Device Coordination Study
7. Section 264313 - Surge Protection for Low-Voltage Electrical Power

1.2 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards; include selectable ranges for each type of overcurrent protective device.
8. Thickness, gauges, and finish of materials.
9. Types of materials and bus bracing.
10. Sheet metal enclosure construction and sizes, and UL approval.
11. Compliance with Contractor furnished Overcurrent Protective Device Coordination Study.

1.3 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Comply with NEMA PB 1.

D. Comply with NEC (NFPA 70).

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weather tight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide the following, or approved equal. For requirements regarding Substitutions for Cause see Division 01.
1. General Electric Company.

B. All panelboards shall be of same manufacturer as the Switchboards. Refer to Section 262413.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets, minimum size 20 inches wide by 5-3/4 inches deep.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

a. For doors more than 36 inches high, provide two latches.
b. Door-in-door hinges and covers.

3. Hinged Front Cover: Door-in-door, with entire front trim hinged to box and with standard door within hinged trim cover.
4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Finishes:

a. Panels, Trim & Back Boxes: ANSI 61 Gray, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

6. Directory Card: Provide 6-inch by 8-inch minimum size circuit directory frame and card, inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: Top or bottom as required.

C. Phase, Neutral, and Ground Buses:

1. Material: Provided with flush locks, hard-drawn copper, and 98 percent conductivity. Aluminum not permitted.
2. Minimum Rating:

a. Lighting Panels: 100 amperes, or higher as required by ratings as indicated.
b. Power Panels: 225 amperes, or higher as required by ratings as indicated.

3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box, required as indicated.
5. Neutral Bus: 100% rated minimum, as standard.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads served by a K-rated transformer, required as indicated.

D. Conductor Connectors:

1. Material: Hard-drawn copper, 98 percent conductivity, suitable for use with conductor material and sizes.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.
4. Feed-Through Lugs: Not permitted.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. All panelboards shall be furnished with minimum of 25% spare circuit breakers
2. Provide 42-circuit panelboards for 120/208V system and 277/480V system, unless otherwise noted on drawings.
3. Provide isolated ground bus for all 120/208V panelboards serving non-linear loads

F. Panelboard Short-Circuit Current Rating: Panelboard, overcurrent protective devices, and accessories shall be fully rated to interrupt symmetrical short circuit faults. Series rating is not permitted.

2.3 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Front Cover: Door-in-door, with entire front trim hinged to box and with standard door within hinged trim cover.

D. Mains: As indicated in Panel Schedules or on Single Line Diagram. Shall be installed vertically on the top or the bottom of panel. Installing the main breaker at branch circuit location is not acceptable.

E. Branch Overcurrent Protective Devices: Bolt-on, molded-case or electronic static trip circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type. Load Centers not permitted.

B. Front Cover: Door-in-door, with entire front trim hinged to box and with standard door within hinged trim cover.

C. Mains: As indicated in Panel Schedules or on Single Line Diagram. Shall be installed vertically on the top or the bottom of panel. Installing the main breaker at branch circuit location is not acceptable.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Standard frame sizes, trip ratings, and number of poles.
2. Mechanical lugs suitable for number, size, trip ratings, and conductor materials.
3. Type SWD for switching fluorescent lighting loads.
4. Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
5. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
6. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 200 A and larger.
7. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
8. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
9. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    c. Ground-Fault Protection: Integrally mounted, self-powered type with mechanical ground fault indicator, relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory and shunt trip unit, and three phase, zero sequence current transformer/sensor.
    d. Shunt Trip: Trip coil energized from separate circuit, with coil clearing contact.

10. Circuit breakers feeding "Fire Alarm Control Panel(s)" shall be in red in color and shall have handle locks.

2.6 METERING

A. Sub Metering: A separate metering compartment and section for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks. Meters shall have BacNET output for remote data collection by BAS.

2.7 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Refer to Section 264313.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1 and per manufacturer¢s written instructions. Furnish and install all construction channel bolts, angles, etc., required to mount the equipment furnished under this section.

B. Mounting height shall be 6'-0" to top of panelboard or 6'-6" to the centerline of highest mounted breaker handle.

C. Installation of adjacent panelboards shall be such that top trims are level and at the same height, unless specifically noted otherwise. Protection device heights shall be a maximum of 6¢-6• to the handle of the device for panelboards over 29" in height, and 5'- 6" in panelboards 29" high or less, except where adjacent to taller panelboards where they shall align.

D. All lighting and power panelboards shall be rigidly supported independently of conduit with minimum two rows of steel channels.

E. Panelboards located in mechanical areas shall have weatherproof gaskets on trims and doors.

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

G. Comply with mounting and anchoring requirements specified in Section 260548.

H. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

J. Arrange overcurrent protective devices as indicated on Drawings.

K. Install filler plates in unused spaces.

L. Stub two 3/4-inch and two 1-inch empty conduits, capped from flush-mounted panelboards into accessible ceiling space or space designated to be ceiling space in the future.

M. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

N. Panelboards installed in damp locations, on exterior walls of basements or areas exposed to moisture shall be mounted with a minimum 1" of gap between back of the cabinet and the wall or other supports.

O. "Train" interior wiring; bundle and clamp, using specified plastic wire wraps specified under Section 260519 - Low Voltage Electrical Power Conductors & Cables.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553.

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553.

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. The contractor will engage a qualified Independent testing and inspecting agency to perform field tests/inspections and provide reports for all connections/terminations, bussing and protective devices.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

E. Test insulation resistance for each panelboard bus, component, connecting supply, feeder and control circuit.

F. Molded Case Circuit Breakers (Frame Size Larger than 100 Amps)

1. Visual and Mechanical Inspection:

a. Check circuit breaker for proper mounting and physical damage.
b. Check mechanical operation.
c. Check tightness of electrical cable connections.
d. Check settings against coordination study.

2. Electrical Tests:

a. Measure contact resistance.
b. Measure long-term delay by primary current injection at three (3) times long-time pickup current.
c. Measure instantaneous pickup current by primary current injection.
d. Check trip unit reset operation.
e. Perform insulation resistance test phase-to-ground, phase-to-phase and across open contacts.
f. Test continuity of each circuit

G. Test each panel for proper grounding.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.

C. Check and tighten all bolts and connections with a torque wrench using manufacturer's recommended values.

3.6 CLEANING

A. After completing equipment installation and before energizing, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Vacuum interiors of panelboards.

END OF SECTION

SECTION 262713-ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes equipment for electricity metering by Owner.

B. Related Requirements

1. Section 260010 – Electrical General Conditions
2. Section 260500 – Common Work Results for Electrical
3. Section 260526 – Grounding and Bonding for Electrical Systems
4. Section 260519 – Low Voltage Electrical Power Conductors
5. Section 260523 – Control-Voltage Electric Power Cables
6. Section 260553 – Identification for Electrical Systems

1.2 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

B. PC: Personal computer.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Division 01, include the following:

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC (NFPA 70), by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.8 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. Square D.
2. Shark Meters/Electro Industries.
3. Schweitzer Engineering Laboratories.
4. E-MON.

B. General Requirements for Meters:

1. Comply with UL 1244.
2. Meters used for billing shall have an accuracy of 0.2 percent of reading, complying with requirements in ANSI C12.20.
3. Meters shall be certified local AHJ and shall comply with all affiliated regulations.
4. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
5. Identification: Comply with requirements in Section 260553.
6. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
7. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
8. Type: Split core.
9. Communication Protocol: Utilize Ethernet TCP/IP
10. Building Automation System (BAS) Interface:

    a. One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.

C. Kilowatt-hour Meter: Electronic single- and three-phase meters, measuring electricity used.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.

D. Kilowatt-hour/Demand Meter: Electronic single- and three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.

E. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 260523.

F. Software: PC based, a product of meter manufacturer, suitable for calculation of utility cost allocation and billing.

1. Utility Cost Allocation: Automatically import energy-usage records to allocate energy costs for the following:

a. At least 10 tenants.

2. Tenant or Activity Billing Software: Automatically import energy-usage records to automatically compute and prepare tenant bills based on metering of energy use and peak demand. Maintain separate directory for each tenant's historical billing information. Prepare summary reports in user-defined formats and time intervals.
3. The system shall communicate with the Building Automation System and provide dashboard display on remote panels. Refer to Division 27 for further information and coordination with BAS system and provided software as necessary.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553.

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 262726-WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles.
2. Switches.
3. Device wall plates.
4. Floor service outlets.
5. Poke-through assemblies.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260526 - Grounding and Bonding for Electrical Systems
4. Section 260519 - Low Voltage Electrical Power Conductors
5. Section 260523 - Control-Voltage Electric Power Cables
6. Section 260533 - Raceways and Boxes for Electrical Systems
7. Section 260553 - Identification for Electrical Systems

1.2 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

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

C. Comply with NEC (NFPA 70).

D. Comply with NEMA WD 1.

E. Comply with NEMA WD 6 and UL 498 for receptacles.

F. Comply with UL 943 for GFCI receptacles.

G. Comply with UL 20 for switches.

H. Comply with UL 514A for floor service assemblies.

1.7 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

C. Coordinate final location of furniture and floor service fittings and poke-through assemblies with Engineer.

1.8 MANUFACTURERS

A. Manufacturers: Provide the following to match existing, or Equal. For requirements regarding Substitutions for Cause see Division 01.

1. Hubbell.
2. Leviton.

1.9 SPECIFICATION GRADE DEVICES

A. Receptacles: Heavy-duty, specification grade, 125 V, 20 A, grounding type, NEMA 5-20R back and side wired, with types as indicated on Drawings..

1. Single Receptacles:

a. Hubbell; HBL5361.
b. Leviton; 5361.

2. Duplex Receptacles:

a. Hubbell; HBL5362.
b. Leviton; 5362.

3. GFCI Duplex Receptacles: Integral GFCI for personnel protection, non-feed-through type, with indicator light for protection status.

a. Hubbell; GFR5362_TR.
b. Leviton; 7899.

4. Weather-Resistant GFCI Duplex Receptacles: Integral GFCI for personnel protection, non-feed-through type, with indicator light for protection status, and additional protection against accelerated aging, cold impact, corrosion, and ultraviolet light exposure.

a. Hubbell; GFR5362__TR.
b. Leviton; W7899.

5. Twist-Locking Single Receptacles: Heavy-duty, industrial-grade, grounding type, with voltage ratings, amperage ratings, and NEMA configuration as indicated on Drawings.

B. Switches: Fully enclosed, flush, 120/277 V, 20 A, heavy-duty, quiet-type, specification-grade, grounding type, back and side wired, with types as indicated on Drawings.

1. Toggle Switches:

a. Single Pole:

1) Hubbell; HBL1221.
2) Leviton; 1221-2.

b. Three Way:

1) Hubbell; HBL1223.

2) Leviton; 1223-2.

1.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Finish of wall plates for switches, receptacles and tele/data devices shall be as follows:

a. Public / Front of House Areas œ color to match existing devices.
b. Administration / Offices œ White Stainless steel
c. Back of House / technical œ Galvanized steel

3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
4. For receptacles with other than 120 volt, inscribe voltage available.
5. For receptacles served by emergency circuit, inscribe Emergency.•

B. Wet-Location, Weatherproof In-Use Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

1.11 FLOOR SERVICE FITTINGS

A. Manufacturers: Provide the following, or Equal. For requirements regarding Substitutions for Cause see Division 01.

1. Legrand - Evolution.
2. Hubbell - System One.

B. Type: Modular, flush-type, dual-service units suitable for wiring method used.

C. Compartments: Barrier separates power from voice and data communication cabling.

D. Service Plate: Rectangular

E. Power Receptacle: NEMA 5-20R, unless otherwise indicated.

F. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

G. Description:

1. Recessed Floor Boxes: Provide recessed gang able floor box with quantity and configuration of gangs as indicated on contract documents. Provide Die-cast aluminum flip lid cover assembly for use in tile or carpet installation in black finish or as directed by Owner. Refer to Sheet E0.01 for product number.

2. Flush Floor Boxes: Provide flush multi-gang floor box for power, communication and other signaling systems as indicated on contract documents. Provide Brushed aluminum cover assembly for use in tile/carpet installation or as directed by Owner. Refer to Sheet E0.01 for product number.
3. Boxes shall be complete with device plates, covers, devices, receptacles, etc. and any other accessories as required.
4. All boxes shall have handle or means to easily open the box.

1.12 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Provide the following, or Equal. For requirements regarding Substitutions for Cause see Division 01.

1. Legrand - Evolution.
2. Hubbell - System One.

B. Description:

1. Provide recessed style multi-service, 2-hour fire rated, poke-thru devices with fully recessed device outlets that allow all plug-in devices and jacks to be fully contained within the compartment with cover closed and only cables visible.
2. Provide poke thru devices complete with assembly, insert, activation cover, receptacles, communication modules mounting accessories, etc. and any additional accessories to facilitate the installation shown on drawings.
3. Integral gasket shall be provided as part of the cover assembly to maintain scrub water tightness by preventing water, dirt and debris from entering the power and communication compartments.
4. Provide Die-cast aluminum cover assembly in black finish or as directed by Owner.
5. Furniture Feeds: Cat. # 6ATCFF-xx series with surface style cover.
6. Misc. Devices: Cat. # 6STCP series with associated surface style cover Cat. # 6CTC-xx
7. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
8. Comply with UL 514 scrub water exclusion requirements.
9. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks.
10. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
11. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
12. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
13. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables.

1.13 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: See 2.3.A.2.
2. Wiring Devices Connected to Emergency Power System: Red.
3. Floor Service Fittings: As selected by the Owner.
4. Poke-Through Coverplate Finish: As selected by the Owner.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length. Feed-through installation is not permitted, except for devices fed downstream of GFCI protected receptacles.
5. Do not circuit more than 5 receptacles on one circuit.
6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
7. Use a torque screwdriver when a torque is recommended or required by manufacturer.
8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
9. Tighten unused terminal screws on the device.
10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right .

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

1. Ganged switches on 277 volt circuits shall have a barrier between each switch.

H. Adjust locations of floor service outlets and poke-through assemblies to suit arrangement of partitions and furnishings. Coordinate final location with equipment.

2.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles.

B. IDENTIFICATION

C. Comply with Section 260553.

D. Identify each receptacle with panelboard identification and circuit number. Use engraved machine printing on face of plate, and durable wire markers or tags inside outlet boxes

1. Receptacles: Indicate panel name and circuit.
2. Multi-ganged Switches: Indicate switchleg.
3. Special Purpose Switches: Identify controlled load for projection screens, shades, exhaust fans, and other non-lighting loads.

2.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 262816-ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260553 - Identification for Electrical Systems

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Comply with NEC (NFPA 70).

D. Comply with Federal Specification W-S-865.

E. Comply with UL 98 and NEMA KS1 for fusible and nonfusible switches.

F. Comply with UL 489, NEMA AB1, and NEMA AB3, for enclosed molded-case circuit breakers.

G. Comply with ASME A17.1 for shunt trip switches.

H. Comply with Federal Specification W-S-865.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Square D; Schneider Electric.

2.2 MATERIALS

A. All disconnect switches shall be the "Heavy Duty" type and shall meet the latest edition of FS W-S-865.

B. Type HD heavy duty single throw 600V AC 30A unless otherwise indicated, horsepower rated, lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

C. Furnish all disconnect switches with devices enabling the switch to be locked in the open and closed positions.

D. Manual motor starters shall be motor rated tumbler switches rated 3 HP 208 or 480 volts, three-phase with overload heaters as specified or shown to protect equipment served.

E. Externally operable safety switches shall have quick-make, quick-break mechanism, capable of switching 10 times the switch rating, and with cover interlocks with defeat mechanism for maintenance.

F. Furnish switches with number of poles, ampere, voltage and HP rating, types of enclosures and fusible or nonfusible as indicated and as required for the particular application.

G. Furnish NEMA 1 enclosures for interior locations and NEMA 3R enclosures for exterior or wet locations unless otherwise indicated. Switches having a dual rating when used with dual element fuses shall have rating so indicated on the metal plate. Fuses, where required, shall be UL listed current limiting type RK5.

H. For disconnect between variable speed starters and the motor served, furnish auxiliary contact in switch, wired to disconnect the starter coil in OFF position. Auxiliary contact to open before disconnect.

I. Fuses, where indicated to be used, shall be current-limiting type, with rejection type fuse holders. And fuse adaptors as needed.

J. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted, insulated, capable of being grounded and bonded, labeled for copper neutral conductors.
3. Auxiliary Contact Kit: Two normally open/normally closed Form C auxiliary contacts arranged to activate before switch blades open.
4. Lugs: Mechanical type suitable for number and size of copper conductors indicated.

2.3 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switches: Type HD, heavy-duty, 600 V, quick-make, quick-break mechanism, capable of switching ten times the switch rating, horsepower rated, with clips or bolt pads to accommodate specified fuses, compression type lugs suitable for conductors indicated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position, with the following configurations as indicated:

1. Single Throw.

B. Nonfusible Switches: Type HD, heavy-duty, 600 V, horsepower rated, compression type lugs suitable for conductors indicated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position, with the following configurations as indicated:

1. Single Throw.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: Type 1.
2. Outdoor Locations: Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548.

C. Install fuses in fusible devices.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges in accordance with Contractor furnished Overcurrent Protective Device Coordination Study.

END OF SECTION

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.
3. Reduced-voltage magnetic.
4. Reduced-voltage solid state.
5. Multispeed.

B. Related Requirements

1. Section 260010 - Electrical General Conditions
2. Section 260500 - Common Work Results for Electrical
3. Section 260526 - Grounding and Bonding for Electrical Systems
4. Section 260529 - Hangers and Supports for Electrical Systems
5. Section 260548 - Vibration Controls for Electrical Systems
6. Section 260553 - Identification for Electrical Systems
7. Section 260573 - Overcurrent Protective Device Coordination Study
8. Section 262923 - Variable Frequency Motor Controllers
9. Section 264313 - Surge Protection for Low-Voltage Electrical Power

1.2 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.
e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manuals: Operation and maintenance manuals: Include all approved submittals, product data, shop drawings, all test reports, installation and maintenance installations for all items.

1.6 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Indicating Lights: Two of each type and color installed.
3. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.

4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand vibrations defined in Section 260548.

1.8 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.

1.9 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide the following. For requirements regarding Substitutions for Cause see Division 01.

1. Square D Powerlogic
2. Allen Bradley
3. Eaton Electrical Inc.; Cutler-Hammer Products
4. General Electric

2.2 MATERIALS

A. Motor starters shall be of the size and type and rated for the short circuit current available and the service to be performed and conform to all applicable NEMA and NEC requirements. All starters shall be complete with the accessories necessary for operation as specified and as called for on the Drawings. All starters shall be horsepower rated, with interchangeable thermal overloads in each phase leg. Furnish overload devices in the field to match motor nameplate rating. The overload relay assembly shall be of the thermal bimetallic type. Overload relays shall be reset from outside the enclosure by means of an insulated button.

B. MANUAL motor starters, both single and three-phase shall be capable of opening all ungrounded conductors simultaneously. Single phase starters shall be of the tumbler switch type, clearly indicating the "On," "Off," and "Tripped" positions. Three-phase starters shall be push button operated with "Start" and "Stop-Reset" buttons on the enclosure.

C. Each MAGNETIC motor starter shall be equipped with a "hand-off-auto" heavy duty selector switch in the cover unless Drawings specifically indicated a different control device and a 120 volt operating coil power from its individual control power transformer. Furnish starter with a minimum of four auxiliary contacts (2-N.O, 2-N.C., or more if required by mechanical control diagrams) and with pilot lights with push-to-test feature. Three pilot lights shall be furnished for each starter: pilot lights shall be low-voltage transformer type; unless Drawings specifically indicate otherwise, green shall indicate that starter is in the closed position; white shall indicate that power is available; red shall indicate that the starter is in the open position. Include all accessories as required to meet requirements of mechanical control diagrams.

D. COMBINATION motor starters shall conform to all of the requirements for magnetic starters, plus have a circuit breaker circuit protective disconnect in the same enclosure conforming to NEC requirements for the motor operation. Disconnect shall be sized as shown on the Drawings and as specified in Section 262416, PANELBOARDS, for available fault current. The disconnect shall be interlocked with the cover door to prevent opening door unless disconnect is in open position. A maintenance means to defeat the door interlock shall be included.

E. The COMBINATION starter unit disconnect shall be of the high speed instantaneous magnetic trip motor circuit protector type, designed to suit motor characteristics.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.4 ADDITIONAL ACCESSORIES

A. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

B. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

C. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

D. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

E. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. For wall mounted units at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall.

B. For wall mounted units not at walls, provide free-standing racks complying with Section 260529.

C. Install free-standing units on concrete bases.

D. Bundle train and support wiring in enclosures.

E. Connect hand-off-automatic switch and other automatic control devices where applicable.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices, where applicable.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner Representative before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner Representative before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

E. Set field-adjustable circuit-breaker trip ranges in accordance with Contractor furnished Overcurrent Protective Device Coordination Study.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION

SECTION 269500 - ACCEPTANCE TESTING OF ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the testing of the electrical equipment provided by or modified by this Project to ensure that all equipment is operational, within industry and manufacturer tolerances and is installed in accordance with design specifications.

B. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, procedures, coordination and performance of all portions of the Work as specified in the General Conditions.

C. All work within this section shall be coordinated with the Owner's Commissioning Authority (CA).

D. Refer to individual Division 26 sections for additional testing not specifically covered in this section.

1.2 QUALITY ASSURANCE

A. All inspections and tests shall be in accordance with all Applicable Code Requirements including the following:

1. National Electrical Manufacturer's Association - NEMA
2. Institute of Electrical and Electronic Engineers - IEEE
3. International Electrical Testing Association - NETA
4. American National Standards Institute ANSI: C2 - 1984
5. National Electrical Safety Code: Z244-1
6. American National Standard for Personnel Protection
7. Insulated Cable Engineers Association - ICEA
8. Association of Edison Illuminating Companies - AEIC
9. Occupational Safety and Health Administration: Part 1910
10. Subpart S, 1910.308: Part 1926
11. Subpart V, 1926.950 through 1926.960
12. ANSI/NFPA 70B Electrical Equipment Maintenance
13. NFPA 70 E - Electrical Safety Requirements for Employee Workplaces
14. ANSI/NFPA 70 - National Electrical Code
15. ANSI/NFPA 780 - Lightning Protection Code
16. ANSI/NFPA 101 - Life Safety Code

B. All inspections and tests shall utilize the following references:

1. Project Design Specifications
2. Project Design Drawings
3. Manufacturer's instruction manuals applicable to each particular apparatus

1.3 RESPONSIBILITIES

A. The Contractor shall notify the Owner¢s Representative and the CA two (2) weeks prior to the commencement of any testing.

B. The Contractor shall coordinate the scheduling of all phases of the project.

C. Acceptance Testing shall be completed thirty (30) days prior to occupancy of the facility to allow for correction of defective systems, materials or workmanship.

D. Any system, material or workmanship which is found defective on the basis of acceptance tests shall be reported to the Owner¢s Representative and the CA within twenty-four (24) hours.

1.4 TESTERS AND INSPECTORS

A. Subject to compliance with requirements, available testers and inspectors that may be used for the Work include, but are not limited to, the following:

1. ABM Electrical power Solutions.
2. EPS Engineering and Design.

1.5 TEST EQUIPMENT

A. Contractor shall furnish all test equipment.

B. Test Instrument Calibration.

1. The Contractor shall ensure that the Electrical Testing Agency has a calibration program which assure that all applicable test instruments are maintained with rated accuracy.
2. The accuracy shall be directly traceable to the National Bureau of Standards.
3. Instruments shall be calibrated in accordance with the following frequency schedule:

a. Field instruments:

1) Analog: 6 months maximum
2) Digital: 12 months maximum

b. Laboratory instruments: 12 months
c. Leased specialty equipment: 12 months
d. (Where accuracy is guaranteed by lessor)
e. Dated calibration labels shall be visible on all test equipment.

4. Records shall be kept up to date which show date and results of instruments calibrated or tested.
5. An up-to-date instrument calibration instruction and procedure shall be maintained for each test instrument.
6. The calibrating standard shall be of higher accuracy than that of the instrument tested.

1.6 SUBMITTALS

A. The following information shall be submitted for review and approval.

1. Electrical Testing Agency qualifications shall be submitted for review and approval.
2. Test Report (including, but not limited to, the following):

a. Summary of Project
b. Description of equipment or device tested
c. Description of test including date, time and duration of test
d. Test results
e. Conclusions and recommendations
f. Appendix, including appropriate test forms
g. Identification of test equipment used
h. Signature of responsible test organization authority
i. Name and signature of testing personnel performing the test

B. Furnish seven (7) copies of the complete report to the Owner's Representative no later than thirty (30) days after completion of Project unless approved otherwise by Owner's Representative.

C. Furnish and fasten a label in most visible area of the following components which identifies the 'DATE OF TEST', the 'COMPANY NAME' of the electrical testing agency and the name of the 'TECHNICIAN' performing the test.

D. Written certification shall be furnished that the metering equipment is performing within ANSI standards and that the meters are registering and have the correct multipliers.

1.7 SAFETY AND PRECAUTIONS

A. Safety practices shall include, but not be limited to, the following requirements:

1. State of Pennsylvania
2. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4.
3. Applicable State and Local safety operating procedures.
4. NETA Safety/Accident Prevention Program.
5. Owner's safety practices.
6. National Fire Protection Association - NFPA 70E.
7. American National Standards for Personnel Protection - ANSI Z244.1.

B. All tests shall be performed with apparatus de-energized, except where otherwise specifically required.

C. The Contractor shall ensure that the Electrical Testing Agency has a designated Safety Representative on the Project to supervise operations with respect to safety.

1.8 GENERAL SCOPE OF EQUIPMENT TO BE TESTED

A. Testing shall include, but not be limited to, the following items:

1. Cables - Low Voltage (600 Volts and Less)
2. Cable Terminators
3. Surge Arrestors
4. Generator
5. Low Voltage Power Transformers
6. Switchboards
7. Low Voltage Power and Insulated Case Circuit Breakers
8. Control Power Transformers
9. Disconnect Switches
10. Grounding Systems
11. Panelboards
12. Molded Cases Circuit Breakers
13. Fuses
14. Motor Starters, Motor Controllers and Variable Frequency Drives
15. Lighting Control Systems.
16. Transfer Switches
17. Vibration Isolation Systems.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTANCE TESTING - EQUIPMENT VERIFICATIONS, TESTS AND CALIBRATIONS

A. Cables - Low Voltage (600 volts and less)

1. Visual and Mechanical Inspection

a. Inspect Cables for physical damage and proper connection.
b. Torque test cable connection. Tighten connections in accordance with industry standards

2. Electrical Tests

a. Perform insulation resistance test of each cable with respect to ground and adjacent cables.

B. Low Voltage Power and Insulated Case Circuit Breakers

1. Visual and Mechanical Inspection:

a. Check circuit breaker for proper mounting and physical damage.
b. Check mechanical operation.
c. Check tightness of electrical cable connections.
d. Check settings against coordination study.

2. Electrical Tests

a. Measure contact resistance.
b. Measure long-term delay by primary current injection at three (3) times long-time pickup current.
c. Measure instantaneous pickup current by primary current injection.
d. Check trip unit reset operation.
e. Perform insulation resistance test phase-to-ground, phase-to-phase and across open contacts.

C. Metering and Instrumentation

1. Meters: Contractor shall employ and pay for the services of a meter tester having the necessary equipment to test and calibrate the meters. These tests shall be performed in accordance with ANSI standards after installation and energizing of the switchboard on which the meters are mounted, and before the final acceptance of the Contract. Tests shall be done in the presence of Owner's Representative.
2. Written certification shall be furnished that the metering equipment is performing within ANSI standards and that the meters are registering and have the correct multipliers.
3. Meter Test Report: Contractor shall submit to Owner's Representative a certified, written test report which shall show for each watt-hour meter the following:

    a. That the meter has been calibrated by comparison with an accurate rotating standard watt-hour meter.
    b. The watt-hour constant (Kh).*
    c. The dial constant (Kr).*
    d. The register ratio (R/r).*
    e. The shaft gear reduction (G/r).*
    f. The gear ratio (R/g).*
    g. The current transformer ratio (CTR).*
    h. The potential transformer ratio (PTR).*
    i. The percentage of regulation.
    j. *These items shall be shown on the meter.

D. Control Power Transformers

1. Visual and Mechanical Inspection

    a. Inspect for physical damage, proper installation, anchorage and grounding.
    b. Clean interior and all bushing and insulator surfaces.
    c. Verify proper auxiliary device operation such as fans and indicators.
    d. Check tightness of accessible bolted electrical joints. Tighten connections in accordance with industry standards.

2. Electrical Tests

    a. Perform insulation resistance tests winding to winding and winding to ground. Apply appropriate guard circuit over all bushings.
    b. Perform dialectic absorption test winding to winding and winding to ground for ten (10) minutes. Compute the polarization index.
    c. Perform turns ratio test between windings for tap positions.
    d. Perform insulation power factor tests on all high and low voltage windings.
    e. Check output voltages.
    f. Verify point-to-point connection of all wiring and polarity.

E. Generator

1. Perform tests described in Section 263213, ENGINE GENERATORS.

F. Disconnect Switches

1. Perform tests described in Section 262816, SWITCHES, DISCONNECT AND SAFETY.

G. Grounding Systems

1. Perform tests described in Section 260526, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. Panelboards

1. Perform tests described in Section 262416, PANELBOARDS.

I. Molded Case Circuit Breakers (Frame Size Larger Than 100 Ampere)

1. Perform tests described in Section 262416, PANELBOARDS.

J. Fuses

1. Visual and Mechanical Inspection

a. Inspect for physical damage.
b. Check cleanliness of contact surfaces.
c. Clean all creepage surfaces.

2. Electrical Tests

a. Perform a resistance test to verify fuse element is not broken.

K. Motor Controllers and Variable Frequency Drives

1. Perform tests described in Section 262913, ENCLOSED CONTROLLERS.

L. Transfer Switches

1. Perform tests described in Section 263600, TRANSFER SWITCHES.

M. Vibration Isolation Devices.

1. Perform tests described in Section 260548, VIBRATION CONTROL FOR ELECTRICAL SYSTEMS.

END OF SECTION

ABBREVIATIONS

AD	AREA DRAIN
BFP	BACKFLOW PREVENTOR
BT	BATHTUB
BV	BALL VALVE
CI	CAST IRON
CL	CENTER LINE
CLG	CEILING
CO	CLEANOUT
CODP	CLEANOUT DECK PLATE
COWP	CLEANOUT WALL PLATE
COL	COLUMN
CP	CONTROL PANEL
CW	COLD WATER
DCV	DOUBLE CHECK VALVE
DCDA	DOUBLE CHECK DECTOR ASSEMBLY
DF	DRINKING FOUNTAIN
DFU	DRAINAGE FIXTURE UNIT
DIA	DIAMETER
DN	PIPE DOWN THROUGH FLOOR
DR	DRAIN
DW	DISHWASHER
DWG	DRAWING
EL	ELEVATION
ELEC	ELECTRIC
ETBR	EXISTING TO BE REMOVED
ETR	EXISTING TO REMAIN
EWC	ELECTRIC WATER COOLER
EWH	ELECTRIC WATER HEATER
EX	EXISTING
F	FIRE SERVICE
FAI	FRESH AIR INTAKE
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FFD	FUNNEL FLOOR DRAIN
FL	FLOOR
FU	FIXTURE UNIT
FS	FLOOR SINK
G	GAS
GAL	GALLON
GC	GENERAL CONTRACTOR
GI	GREASE INTERCEPTOR
GM	GAS METER
GV	GATE VALVE
GW	GRAY WATER
HB	HOSE BIBB
HC	HANDICAPPED
HVAC	HEATING, VENTILATION & AIR CONDITIONING
HW	HOT WATER
HWR	HOT WATER RETURN
IG	IRRIGATION PIPING
IE	INVERT ELEVATION
IW	INDIRECT WASTE
JS	JANITOR SINK

KS	KITCHEN SINK
L	LEADER
LAV	LAVATORY
LP	LOW PRESSURE
MAX	MAXIMUM
MIN	MINIMUM
MGCV	MASTER GAS CONTRAL VALVE
MICV	METER INLET CONTROL VALVE
MS	MOP SINK
NFWH	NON-FREEZE WALL HYDRANT
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
OD	OVERFLOW DRAIN
OS&Y	OUTSIDE SCREW & YOKE
PG	PRESSURE GAUGE
PLBG	PLUMBING
PO	PLUGGED OUTLET
POE	POINT OF ENTRY
PS	PANTRY SINK
RD	ROOF DRAIN
REF	REFRIGERATOR
RPZ	REDUCED PRESSURE ZONE
RM	ROOM
S	SOIL
SA	SHOCK OBSORBER
SAN	SANITARY
ST	STORM DRAIN
SE	SEWAGE EJECTOR
SP	SUMP PUMP
SH	SHOWER
SPEC	SPECIFICATIONS
SQ. FT.	SQUARE FEET
TD	TRENCH DRAIN
TMV	THERMOSTATIC MIXING VALVE
TP	TRAP PRIMER
TYP	TYPICAL
UR	URINAL
V	VENT
VTR	VENT THROUGH ROOF
VB	VACUUM BREAKER
W	WASTE
WC	WATER CLOSET
WH	WALL HUNG
WHA	WATER HAMMER ARRESTER
WSFU	WATER SUPPLY FIXTURE UNIT

PLUMBING SYMBOLS

SYMBOL	DESCRIPTION
SAN	SANITARY WASTE (S OR W)
ST SD	STORM DRAINAGE (ST)
OD	OVERFLOW STORM DRAINAGE
V	VENT
CW	DOMESTIC COLD WATER
HW	DOMESTIC HOT WATER
HWR	DOMESTIC HOT WATER RETURN
G	NATURAL GAS
RW	RAINWATER REUSE
SED	SEWAGE EJECTOR DISCHARGE
PD	PUMP DISCHARGE PIPING
STED	STORM EJECTOR DISCHARGE
GRW	GRAY WATER (LA ONLY)
GW	GREASE WASTE
SCW	SOFTENED WATER
PW	PURIFIED WATER
CA	COMPRESSED AIR
OX	OXYGEN
N	NITROGEN
LVM	LAB VACUUM
LA	LAB AIR
LG	LAB GAS
LW	LAB WASTE
LV	LAB VENT
TW	TEPID WATER
	REMOVE EXISTING PIPING
	PIPING WITH ELECTRIC TRACE HEATING
	PIPING INTERRUPTED OR TO BE CONTINUED
	CAP OR END OF PIPE
P400 XXX	SECTION SHEET No. SECTION NUMBER
P #	SYSTEM DESCRIPTION RISER NUMBER — PLUMBING RISER
ST #	SYSTEM DESCRIPTION RISER NUMBER — STORM RISER
G #	SYSTEM DESCRIPTION RISER NUMBER — GAS RISER
P #	EQUIPMENT DESCRIPTION EQUIPMENT NUMBER — EQUIPMENT REFERENCE
	POINT OF DISCONNECT
	CONNECT NEW TO EXISTING
	HOT WATER BALANCING ASSEMBLY
	SUSPENDED/ WALL CLEANOUT
	FLOOR CLEANOUT
	OVERFLOW DRAIN
	ROOF DRAIN / ROOF RECEPTOR
2	ROUND DRAIN / SQUARE DRAIN
	HOUSE TRAP
	P-TRAP
	WATER HAMMER ARRESTOR
TP	TRAP PRIMER
	ARROW INDICATES DIRECTION OF FLOW
	ELBOW UP OR RISE
	ELBOW DN OR DROP
	PIPE DROP OR RISE

PLUMBING SYMBOLS

SYMBOL	DESCRIPTION
	BOTTOM CONNECTION
	TOP CONNECTION
	UNION SCREWED
	WATERPROOF PIPE SLEEVE
	NON FREEZE WALL HYDRANT
	VALVE ON RISER
	BACK FLOW PREVENTER
	DOMESTIC WATER BALANCING ASSEMBLY
	CHECK VALVE
	GATE VALVE
	BALL VALVE
	GAS VALVE
	GLOBE VALVE
	PRESSURE REDUCING VALVE
	TEMPERATURE & PRESSURE RELIEF VALVE
	PRESSURE REGULATING VALVE
	THERMOSTATIC MIXING VALVE
	VALVED CAPPED OUTLET
	CURB VALVE
S	SOLENOID VALVE
	OUTSIDE STEM AND YOKE VALVE
	OUTSIDE STEM AND YOKE VALVE W/ TAMPER SWITCH
	STRAINER
	PRESSURE GAUGE
	HOSE BIB
	VACUUM BREAKER
T	THERMOMETER
	PUMP
	SCHEMATIC PUMP
	FLOOR SINK
	VENT THRU ROOF
M	METER
F	FILTER
	FAI
	VENT INCREASER
	EXPANSION JOINT
	POST HYDRANT

PLUMBING LEGEND

HATCHING INDICATES AREA IS NOT IN PROJECT SCOPE.

PLUMBING NOTES:

1. CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND JOB CONDITIONS AND SHALL REPORT TO ENGINEER ANY DISCREPANCIES OR OMISSIONS THAT WOULD INTERFERE WITH SATISFACTORY COMPLETION OF THE WORK.
2. CONTRACTOR SHALL VISIT THE JOB SITE AND THOROUGHLY FAMILIARIZE THEMSELVES WITH ALL EXISTING CONDITIONS PRIOR TO THE BEGINNING OF CONSTRUCTION.
3. ALL WORK SHALL BE PERFORMED BY A LICENSED PLUMBING CONTRACTOR IN A FIRST CLASS COMPETENT MANNER. THE COMPLETED SYSTEM SHALL BE FULLY OPERATIVE AND FUNCTIONAL.
4. NOTIFY BUILDING MANAGER AT LEAST 48 HOURS BEFORE NEW WORK OR BEFORE SHUT DOWN OF EXISTING SERVICES. RISER SHUT DOWNS SHALL BE PERFORMED AT TENANT'S COST, AT DESIGNATED TIMES UNDER BUILDING MANAGER'S SUPERVISION AND ONLY WITH THEIR APPROVAL.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR ARRANGING WITH BUILDING MANAGEMENT FOR HANDLING MATERIALS, AS WELL AS FOR ALLOWABLE WORKING HOURS AND DELIVERIES.
6. PLUMBING CONTRACTOR SHALL COORDINATE ALL WORK WITH RESPECT TO ALL OTHER TRADES, INCLUDING STRUCTURE AND CEILING HEIGHTS.
7. DRAWINGS ARE NOT TO BE SCALED.
8. CONTRACTOR SHALL COMPLY WITH ALL CITY BUILDING CODES, REGULATORY AGENCIES AND CODE REQUIREMENTS. BE RESPONSIBLE FOR SECURING ALL NECESSARY PERMITS AND APPROVALS OF ALL TRADES.
9. CONTRACTOR SHALL CARRY AND DOCUMENT LIABILITY, ACCIDENT AND PROPERTY DAMAGE INSURANCE AS REQUIRED BY COOPERATIVE CORPORATION AND OBSERVE THEIR PERMITTED HOURS FOR WORK.
10. CONTRACTOR SHALL EXERCISE EXTREME CARE IN PROTECTING AREAS ADJACENT TO CONSTRUCTION AREAS, SHALL FULLY PROTECT THEM FROM ANY DAMAGE RESULTING FROM CONTRACTOR'S TEAM, SUBCONTRACTORS OR AGENTS, AND SHALL BE RESPONSIBLE FOR REPAIRING, CLEANING OR REPLACING ANY SUCH DAMAGE.
11. UNLESS STATED OTHERWISE, CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS, APPURTENANCES, EQUIPMENT AND SERVICES TO COMPLETE ALL WORK AS INDICATED ON DRAWINGS AND/OR SPECIFIED ON NOTES.
12. UNLESS STATED OTHERWISE, CONTRACTOR SHALL FOLLOW MANUFACTURERS' DIRECTIONS WITH APPLICABLE CODES, INSTRUCTIONS AND RECOMMENDATIONS FOR ALL MATERIALS AND PROCESSES USED IN THIS CONTRACT. CONTRACTOR SHALL PROVIDE ALL FITTINGS, TRANSITIONS, VALVES, AND OTHER DEVICES REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.
13. UPON COMPLETION OF THE WORK, CONTRACTOR SHALL COMPLETELY CLEAN THE CONSTRUCTION AREA TO MAKE SUITABLE FOR THE OWNERS USE. THIS INCLUDES REMOVING ALL LABELS (AFTER ARCHITECTS INSPECTION) AND CLEANING ALL EQUIPMENT, CONSTRUCTION WORK, WINDOWS AND ANY OTHER NEW OR OLD WORKING IN THAT CONSTRUCTION AREA.
14. APPROVED BUILDING DEPARTMENT PLANS SHALL BE TURNED OVER TO OWNER AT THE COMPLETION OF THE JOB.
15. AT THE FINAL COMPLETION OF THE JOB, CONTRACTOR SHALL SUBMIT TO THE OWNER AND TO ENGINEER A NOTARIZED AFFIDAVIT STATING COMPLIANCE WITH ALL PROVISIONS OF THIS CONTRACT, INCLUDING ALL NOTES, EXCEPT FOR THOSE CHANGES SPECIFICALLY APPROVED IN WRITING BY THE ARCHITECT.
16. CONTRACTOR SHALL GUARANTEE ALL WORK PERFORMED UNDER THIS CONTRACT FOR ONE YEAR, STARTING FROM DATE OF FINAL COMPLETION OF ALL WORK.
17. THE CONTRACTOR MUST MAKE ALLOWANCE FOR NECESSARY MODIFICATIONS TO EXISTING CONDITIONS TO PERFORM WORK.
18. ANY AND ALL EXISTING SYSTEMS SHALL BE LEFT IN PERFECT WORKING ORDER UPON COMPLETION OF ALL NEW WORK.
19. CONTRACTOR TO VERIFY SYSTEM WORKING PRESSURE AND PROVIDE PRESSURE REDUCING VALVES WHERE APPLICABLE.

RECORD DRAWINGS

1. PREPARE AND FURNISH TO OWNER "AS BUILT" PLANS FOR ALL WORK INSTALLED. PROVIDE CAD DRAWINGS AND CAD FILES COMPLETED IN THE LATEST VERSION OF AUTOCAD. ALL DRAWINGS SHALL BE IN A STYLE COMMENSURATE WITH THE ENGINEERING DESIGN. THE ENGINEERING DESIGN CAD DRAWINGS OR BACKGROUNDS WILL BE FURNISHED FOR USE TO THIS CONTRACTOR FOR THE PURPOSE OF THIS SUBMISSION (SUBMIT A CAD INDEMNIFICATION AGREEMENT).

2. DURING CONSTRUCTION, KEEP AN ACCURATE RECORD OF ALL DEVIATIONS BETWEEN THE WORK AS SHOWN ON DRAWINGS AND THAT WHICH IS ACTUALLY INSTALLED. THIS RECORD SET OF PRINTS SHALL BE KEPT AT JOB SITE FOR INSPECTION.

3. UPON COMPLETION OF THE INSTALLATION. SUBMIT ONE SET OF BLACK AND WHITE PRINTS OF THESE "AS-BUILT" RECORD DRAWINGS TO THE ARCHITECT/ENGINEER FOR REVIEW. AFTER REVIEW BY THE ARCHITECT/ENGINEER, MAKE NECESSARY CHANGES TO THESE DRAWINGS AND DELIVER TO THE OWNER FOR RECORD. FINAL PAYMENT WILL BE WITHHELD UNTIL COMPLETION OF "AS-BUILT" DRAWINGS.

DEMOLITION NOTES

1. EACH BIDDER SHALL VISIT THE SITE AND BECOME INFORMED AS TO THE CONDITION OF THE PREMISES AND THE EXTENT AND CHARACTER OF WORK REQUIRED. NO ADDITIONAL COMPENSATION WILL BE APPROVED DUE TO FIELD CONDITIONS.
2. DRAWINGS ARE DIAGRAMMATIC AND INDICATE GENERAL ARRANGEMENT.
3. VERIFY ALL GOVERNING DIMENSIONS, PIPE SIZES AND LOCATION OF THE PIPING AND EQUIPMENT TO BE REMOVED.
4. NOTIFY BUILDING MANAGER AT LEAST 48 HOURS BEFORE DEMOLITION WORK OR BEFORE SHUT DOWN OF EXISTING SERVICES. RISER SHUT DOWNS SHALL BE PERFORMED AT TENANT'S COST, AT DESIGNATED TIMES UNDER BUILDING MANAGER'S SUPERVISION AND ONLY WITH THEIR APPROVAL.
5. ALL FIXTURES, EQUIPMENT, PIPING, ETC. TO BE REMOVED, SHALL BE DISPOSED OF, RELOCATED, TURNED OVER TO THE TENANT OR SALVAGED AS DIRECTED BY CCAC.
6. UPON COMPLETION OF ALL NEW WORK NO ABANDONED PIPING SHALL REMAIN.
7. THE EXISTING SYSTEMS SHALL BE LEFT IN PERFECT WORKING ORDER UPON COMPLETION OF ALL NEW WORK.
8. LOCATIONS AND SIZES OF EXISTING PIPING ARE APPROXIMATE. EXACT SIZES AND LOCATIONS OF ALL EXISTING PIPING SHALL BE VERIFIED AT THE SITE.
9. NO REMOVED EXISTING PIPING FITTINGS, VALVES, FIXTURES, ETC. SHALL BE REUSED UNLESS OTHERWISE APPROVED BY THE ENGINEER.
10. UNDER NO CIRCUMSTANCES WILL THIS CONTRACTOR OR THEIR TEAM BE PERMITTED TO USE ANY PART OF THE BUILDING AS A SHOP, EXCEPT PARTS DESIGNATED BY THE OWNER FOR SUCH PURPOSES.
11. THIS CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL FROM THE PREMISES ALL DEBRIS RESULTING FROM PLUMBING WORK. UNNECESSARY NOISE SHALL BE AVOIDED AT ALL TIMES AND NECESSARY NOISE SHALL BE REDUCED TO A MINIMUM.
12. WHERE THE WORK MAKES TEMPORARY SHUTDOWNS OF SERVICES UNAVOIDABLE, THEY SHALL BE MADE AT NIGHT OR AT TIMES AS WILL CAUSE THE LEAST INTERFERENCE WITH THE ESTABLISHED OPERATING ROUTINE OF THE BUILDING.
13. THIS CONTRACTOR SHALL ARRANGE THE WORK CONTINUOUSLY, INCLUDING APPROVED BY ARCHITECT OVERTIME OF REQUIRED, TO ASSURE THAT SERVICES WILL BE SHUTDOWN AND CUT-INS ONLY DURING THE TIME ACTUALLY REQUIRED TO MAKE THE NECESSARY CONNECTIONS TO EXISTING WORK.
14. ANY AND ALL REQUIRED DEMOLITION WORK TO BE PERFORMED ABOVE EXISTING SUSPENDED CEILINGS AND FURRED OUT WALLS SHALL BE DONE AT THE TIME WHEN THE EXISTING CEILINGS AND FURRED OUT WALLS ARE REMOVED BY THE GENERAL CONTRACTOR.
15. ALL EQUIPMENT AND INSTALLATIONS MUST BE EQUAL TO THE STANDARDS OF THE BASE BUILDING. ANY DEVIATION FROM BUILDING STANDARDS WILL BE PERMITTED ONLY IF INDICATED OR SPECIFIED ON THESE PLANS AND SPECIFICATIONS, AND APPROVED.
16. TO INSURE CONTINUOUS OPERATIONS, MAKE ALL NECESSARY TEMPORARY CONNECTIONS BETWEEN NEW AND EXISTING WORK. ALL COSTS RESULTING FROM TEMPORARY SHUTDOWNS SHALL BE BORNE BY THE CONTRACTOR.

Notes

Rev	Description	Date	Drn	Ch'd

COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL — JEREMY SNYDER — ENGINEER — PE064480

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FOR CONSTRUCTION

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Project	CCAC CEIT - ROOM 202, 220, 222 ELECTRICAL AND COMPRESSED AIR REVISIONS
Address	807 Ridge Ave, Pittsburgh, PA 15212
Drg Title	SYMBOLS AND ABBREVIATIONS
Scale	12" = 1'-0"
Drawn By	Author
Checked By	Checker
Date	11/15/2024
Job No.	P064636
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Notes

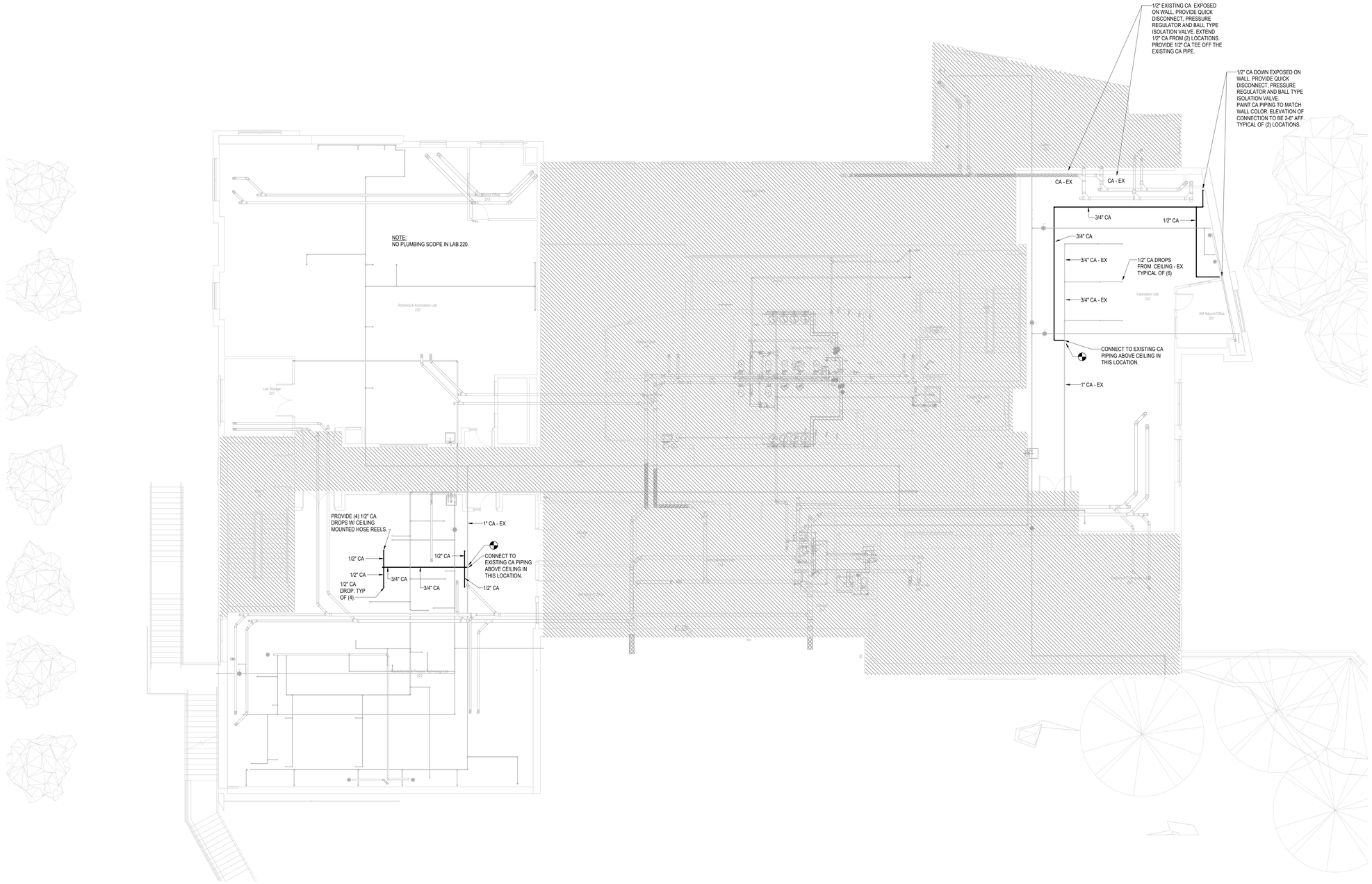
1. CONTRACTOR SHALL TEMPORARILY REMOVE PORTIONS OF EXISTING CEILING FOR ABOVE CEILING WORK AND REPLACE CEILING WHEN COMPLETE. CONTRACTOR SHALL REPLACE ANY DAMAGED TILES, CEILING GRID OR CEILING ELEMENTS.

2. CONTRACTOR SHALL COORDINATE INWALL CONSTRUCTION AND SHALL PATCH BACK WALL TO NEW FINISH AND PAINT TO MATCH EXISTING.

3. CONTRACTOR SHALL ROUTE PIPING PARALLEL AND PERPENDICULAR TO EXISTING STRUCTURE AND EXISTING PIPING INSTALLATIONS.

4. CONTRACTOR SHALL COORDINATE HANGER INSTALLATIONS.

5. WHERE PIPING IS PAINTED, CONTRACTOR SHALL MATCH AND PAINT NEW PIPING INSTALLATIONS.



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Address	807 Ridge Ave, Pittsburgh, PA 15212
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Scale	As indicated
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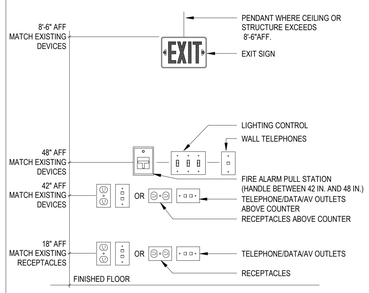
WIRING DEVICES

SYMBOL	DESCRIPTION
	5-20R, SIMPLEX RECEPTACLE OUTLET, 5-15R, TAMPER PROOF, FOR RESIDENTIAL APPLICATIONS, UNO.
	5-20R, DUPLEX RECEPTACLE OUTLET, 5-15R, TAMPER PROOF, FOR RESIDENTIAL APPLICATIONS, UNO.
	5-20R, DUPLEX CONTROLLED RECEPTACLE OUTLET, 5-15R, TAMPER PROOF, FOR RESIDENTIAL APPLICATIONS, UNO.
	5-20R, QUADRUPLEX RECEPTACLE OUTLET
	SPECIAL RECEPTACLE, NEMA CONFIGURATION PER PLAN
	RECEPTACLE OUTLET MOUNTED ABOVE COUNTER TOP, 5-20R, GFCI FOR RESIDENTIAL KITCHEN COUNTER APPLIANCE CCTS
	MULTIOUTLET ASSEMBLY - SPACING AND QUANTITY AS NOTED ON DRAWINGS
	CEILING MOUNTED RECEPTACLE OUTLET
FB#	FLOORBOX / POKETRHOUGH FB# - INDICATES BOX TYPE, REFER BELOW [TO SCHEDULE AND DETAILS] FOR TYPE FB0 - PROVIDE POWER [AND DATA] [FLOORBOX] WITH [#] DUPLEX RECEPTACLE(S) AND [#] GANG DATA WITH 3/4" C. FOR POWER, AND MIN. 1-1/4" C. FOR DATA FB1 - PROVIDE [#]INCH POWER [AND DATA] [POKETHROUGH] WITH [#] DUPLEX RECEPTACLE(S) AND [#] GANG DATA WITH 3/4" C. FOR POWER, AND MIN. 1-1/4" C. FOR DATA

RECPTACLE ABBREVIATIONS	DESCRIPTION (CCT AS INDICATED UNO ON PLANS)
AV	DEDICATED RECEPTACLE FOR AUDIO VISUAL EQUIPMENT. COORDINATE DATA/AV REQUIREMENT WITH IT/AV DESIGNER.
DR	14-30R RECEPTACLE FOR ELECTRIC CLOTHES DRYER WITH FOUR WIRE, #10 BRANCH CIRCUIT AND 30A, 2P OCP
DW	DEDICATED 20A CCT FOR DISHWASHER
EM	RECEPTACLE ON EMERGENCY CIRCUIT
GD	DEDICATED 20A CCT AND SWITCH ABOVE COUNTER FOR FOOD WASTE DISPOSER
GFCI	GROUND-FAULT CIRCUIT INTERRUPTER
GI	5-15R RECEPTACLE FOR GAS COOKTOP, RANGE OR OVEN
GIU	OUTDOOR DAMP LOCATION GFCI WITH IN-USE COVER
IG	ISOLATED GROUND
MW	DEDICATED 20A CCT AND RECPTACLE FOR MICROWAVE OVEN
OV	RECEPTACLE FOR ELECTRIC OVEN WITH FOUR WIRE BRANCH CIRCUIT, OCP AND BRANCH WIRING PER OVEN MANUFACTURER REQUIREMENTS
OS	OCCUPANCY SENSOR CONTROLLED 20 MINUTE AUTO SHUT-OFF VIA A 20A RELAY.
REF	DEDICATED RECPTACLE FOR REFRIGERATOR
TV	RECESSED RECEPTACLE FOR WALL MOUNTED TV OR MONITOR. COORDINATE RECEPTACLE HEIGHT WITH ARCHITECT. COORDINATE DATA/AV REQUIREMENT WITH IT/AV DESIGNER.
USB	UNIVERSAL SERIAL BUS CHARGING RECEPTACLE
W	DEDICATED 20A CCT AND RECEPTACLE FOR WASHING MACHINE
WD	DEDICATED 20A CCT AND RECEPTACLE FOR WARMING DRAWER
WP	WEATHER RESISTANT GFCI WITH WHILE-IN-USE CAST COVER
$	DUPLEX RECEPTACLE CONTROLLED BY LOCAL LIGHT SWITCH

TYPICAL WIRING DEVICE MOUNTING HEIGHT DETAIL



WIRING DEVICE ELEVATION NOTES:

1. WIRING DEVICE MOUNTING HEIGHTS SHALL MATCH MOUNTING HEIGHTS OF EXISTING ADJACENT WIRING DEVICES OF SIMILAR TYPES.

2. MOUNTING HEIGHTS SHALL BE MEASURED FROM FINISHED FLOOR TO CENTERLINE OF DEVICE EXCEPT EXIT SIGNS AND FIRE ALARM VISUAL DEVICES.

3. INSTALL WIRING DEVICES ON A COMMON VERTICAL CENTERLINE.

CABLE AND CONDUIT SYSTEMS

SYMBOL	DESCRIPTION
	HEAVY LINES INDICATE NEW WORK
	LIGHT LINES INDICATE EXISTING WORK TO REMAIN
	CONDUIT TURNED UP
	CONDUIT TURNED DOWN
	CONDUIT STUB WITH WIRE PULL AND CAP
	UNDERGROUND CONDUIT OR DUCT BANK
	SINGLE CHANNEL RACEWAY
	DUAL CHANNEL RACEWAY

ONE LINE AND RISER DIAGRAM

SYMBOL	DESCRIPTION
	NORMAL POWER PANEL
	LIFE-SAFETY POWER PANEL (NEC BRANCH 700)
	LEGALLY REQUIRED STANDBY POWER PANEL (NEC BRANCH 701)
	OPTIONAL STANDBY POWER PANEL (NEC BRANCH 702)
	GROUNDED/UNGROUNDED DELTA CONNECTION
	GROUNDED/UNGROUNDED WYE CONNECTION
	CONNECTION TO GROUNDING SYSTEM
G G	GENERATOR (ONE-LINE / RISER SYMBOL)
	TRANSFORMER
	BATTERY
NO NC	CONTROL OR POWER CONTACT NORMALLY OPEN / NORMALLY CLOSED
	MEDIUM VOLTAGE DRAW-OUT CIRCUIT BREAKER
	LOW VOLTAGE DRAW-OUT CIRCUIT BREAKER
	FUSED SWITCH
	CIRCUIT BREAKER
N E	AUTOMATIC OR MANUAL TRANSFER SWITCH
VFD	VARIABLE FREQUENCY DRIVE
VFD	VFD WITH BYPASS
	COMBINATION MOTOR STARTER
EC	ELEVATOR CONTROLLER (BY DIV. 14)
	MOTOR
	LIGHTNING OR SURGE ARRESTOR
	POTENTIAL TRANSFORMER
	CURRENT TRANSFORMER
M M	WATTHOUR METER
EPO	EMERGENCY POWER OFF (EPO)
G	GREEN INDICATING LAMP (DE-ENERGIZED)
R	RED INDICATING LAMP (ENERGIZED)
A	AMBER INDICATING LAMP (ABNORMAL)
W	WHITE INDICATING LAMP (CONTROL POWER)
CS	CONTROL SWITCH
K	KEY INTERLOCK
AF	ARC FLASH MAINTENANCE SWITCH
SPD	SURGE PROTECTIVE DEVICE
FSD	FIRE SMOKE DAMPER
F F	FEEDER BUSWAY
B B	PLUG-IN BUSWAY
XXXXX	FEEDER ID TAG

POWER

SYMBOL	DESCRIPTION
	PANELBOARD - DASHED OUTLINE DENOTES WORKING SPACE CLEARANCES.
	DRY TYPE TRANSFORMER PRIMARY FUSED DISCONNECT OR CB WHEN SOURCE CB IS NOT WITHIN SIGHT CONCRETE HOUSEKEEPING PAD FOR FLOOR MOUNTED APPLICATIONS
FSD J VAV	JUNCTION BOX 'FSD' DENOTES FIRE SMOKE DAMPER 'VAV' DENOTES VARIABLE AIR VOLUME DEVICE
	HARD-WIRED CONNECTION
	MOTOR
	FUSED DISCONNECT SWITCH
	NON-FUSED DISCONNECT SWITCH USE ONLY IN APPLICATIONS WHERE AVAILABLE FAULT CURRENT IS LESS THAN 10 KA
	ENCLOSED CIRCUIT BREAKER
	COMBINATION MOTOR STARTER
	MOTOR STARTER
M	THERMAL OVERLOAD SWITCH
	CIRCUIT HOMERUN - SHORT TICK MARKS INDICATES NUMBER OF HOT WIRES, LONG TICK MARK INDICATES NEUTRAL WIRE AND THE DOT INDICATES THE GROUND WIRE.

EQUIPMENT NAMING CONVENTION

E - PP- W - 1 - 3

SEQUENCE
1, 2, 3, ...

LOCATION
"#" - FLOOR LEVEL

BUILDING/AREA
E - EAST AREA
W - WEST AREA
A - BUILDING A

PANEL TYPE
ATS - AUTOMATIC TRANSFER SWITCH
DP - DISTRIBUTION PANEL
DS - DISCONNECT SWITCH
FP - FIRE PUMP
G - GENERATOR
IT - INFORMATION TECHNOLOGY PANEL
LB - LOAD BANK
LP - LIGHTING PANEL
MP - MECHANICAL PANEL
PG - PARALLELLING GEAR
PP - POWER PANEL
SB - SWITCHBOARD
SG - SWITCHGEAR
SS - SUBSTATION
TA - TWEATRE AUDIO/VISUAL
TE - THEATRE ENGINEERING
TL - THEATRE LIGHTING
TX - TRANSFORMER

POWER TYPE
(BLANK) - NORMAL POWER
E - LIFE SAFETY POWER (NEC BRANCH 700)
S - LEGALLY REQUIRED STANDBY POWER (NEC BRANCH 701)
O - OPTIONAL STANDBY POWER (NEC BRANCH 702)

ELECTRICAL ABBREVIATIONS

ABBREVIATION	DEFINITION
A	AMPERE
AA/FA	AMBIENT AIR/FORCED AIR TRANSFORMER RATING
AC	ALTERNATING CURRENT OR AIR COMPRESSOR
AF	AMPERE FRAME
AFCI	ARC FAULT CIRCUIT INTERRUPTER
AFF	ABOVE FINISHED FLOOR
AHJ	AUTHORITY HAVING JURISTICTION
AHU	AIR HANDLING UNIT
AIC	AMPERE INTERRUPTING CAPACITY
AS	AMPERE SWITCH
AT	AMPERE TRIP
ATS	AUTOMATIC TRANSFER SWITCH
BAS OR BMS	BUILDING AUTOMATION / MANAGEMENT SYSTEM
BIL	BASIC INSULATION LEVEL
BPS	BOLTED PRESSURE SWITCH
C	CONDUIT
CB	CIRCUIT BREAKER
CCT	CORRELATED COLOR TEMPERURATURE
CKT	CIRCUIT
CPT	CONTROL POWER TRANSFORMER
CT	CURRENT TRANSFORMER
CTB	CABLE TAP BOX (BUSWAY)
DC	DIRECT CURRENT
DIA	DIAMETER
DPDT	DOUBLE POLE DOUBLE THROW SWITCH
DPST	DOUBLE THROW SINGLE THROW SWITCH
DS	DISCONNECT SWITCH
DN	DOWN
DP	DISTRIBUTION PANEL
E OR EM	EMERGENCY
EC	EMPTY CONDUIT
EF	EXHAUST FAN
ELEC	ELECTRICAL
EMT	ELECTRICAL METAL TUBING
EO	ELECTRICALLY OPERATED
EPO	EMERGENCY POWER OFF
EX	EXISTING
ETR	EXISTING TO REMAIN
ETD	EXISTING TO BE DEMOLISHED
FA	FIRE ALARM
FAA	FEDERAL AVIATION ADMINISTRATION
FBO	FURNISHED BY OTHER
FPB	FAN POWERED BOX
FMC	FLEXIBLE METAL CONDUIT
FSD	FIRE SMOKE DAMPER
FT	FEET OR FOOT
FR	FIRE RATED
G	GROUND OR GENERATOR
GEC	GROUNDING ELECTRODE CONDUCTOR
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GFP	GROUND FAULT PROTECTION
GFPI	GROUND FAULT PROTECTION INDICATION ONLY
HP	HORSE POWER
HZ	HERTZ
IDF	INTERMEDIATE DISTRIBUTION FRAME
IMC	INTERMEDIATE METAL CONDUIT
IN	INCH
IG	ISOLATED GROUND
IT	INFORMATION TECHNOLOGY
JB	JUNCTION BOX
KAIC	KILO-AMPS INTERUPTING CAPACITY
KV OR kV	KILOVOLT
KVA	KILOVOLT AMPERE
KW	KILOWATT
L	LINE
LED	LIGHT EMITING DIODE
LFMC	LIQUID-TIGHT FLEXIBLE METAL CONDUIT
LTG	LIGHTING
L,S,I,G	LONG TIME, SHORT TIME, INSTANTANEOUS, GROUND TRIP
LV	LOW VOLTAGE

IEEE STANDARD DEVICE NUMBERS

ABBREVIATION	DEFINITION
25	SYNCHRONIZING OR SYNCHRONISM CHECK DEVICE
27	UNDERVOLTAGE RELAY
50	INSTANTANEOUS OVERCURRENT
51	AC INVERSE TIME OVERCURRENT RELAY
52	AC CIRCUIT BREAKER
59	OVERVOLTAGE RELAY
81	FREQUENCY RELAY
86	LOCKOUT RELAY
87	DIFFERENTIAL PROTECTIVE RELAY
P	PHASE
N	NEUTRAL
G	GROUND

ELECTRICAL ABBREVIATIONS

ABBREVIATION	DEFINITION
M	METER
MCB	MAIN CIRCUIT BREAKER
MCM,KCMIL	THOUSAND CIRCULAR MILS
MD	MOTORIZED DAMPER
MCOV	MAXIMUM CONTINUOUS OPERATING VOLTAGE RATING
MDF	MAIN DISTRIBUTION FRAME
MLO	MAIN LUGS ONLY
MOV	METAL OXIDE VARISTOR
MPOE	MINIMUM POINT OF ENTRY
MTS	MANUAL TRANSFER SWITCH
MV	MEDIUM VOLTAGE
N	NEUTRAL
NC	NORMALLY CLOSED
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NPNP	NON-PROGRAMMED NEUTRAL POSITION
NTS	NOT TO SCALE
OC	ON CENTER
OCP	OVERCURRENT PROTECTIVE DEVICE
PF	POWER FACTOR
PFC	POWER FACTOR CORRECTION
PH	PHASE
PMM	POWER MONITORING METER
PNL	PANEL
PNP	PROGRAMMED NEUTRAL POSITION
PT	POTENTIAL TRANSFORMER
PWR	POWER
RCP	REFLECTED CEILING PLAN
RL	RELOCATED EXISTING DEVICE
REF	REFRIGERATOR
RMC	RIGID METAL CONDUIT
SB	SHORTING BAR TEST SWITCH
SCCR	SHORT CIRCUIT CURRENT RATING
SD	SMOKE DAMPER
SP	SMOKE PURGE
SPD	SURGE PROTECTIVE DEVICE
SPDT	SINGLE POLE DOUBLE THROW SWITCH
SS	SUBSTATION OR STAINLESS STEEL
ST	SHUNT TRIP
SW	SWITCH
T	TRANSFORMER
TGB	TECHNOLOGY GROUND BAR
TMGB	TECHNOLOGY MAIN GROUND BAR
TR	TAMPER RESISTANT
TS	TEST SWITCH
TYP	TYPICAL
U	UNIT
UC	UNDERCOUNTER
UH	UNIT HEATER
UL	UNDERWRITER LABORATORIES
UON	UNLESS OTHERWISE NOTED
UPS	BATTERY BACKED POWER SUPPLY
V	VOLTAGE
VCB	VACUUM CIRCUIT BREAKER
VFD	VARIABLE FREQUENCY DRIVE
VP	VAPOR PROOF
VPI	VACUUM PRESSURE IMPREGNATED
W	WIRE
WH	WATER HEATER
WP	WEATHERPROOF
Z	IMPEDANCE

Notes

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COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
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Address: 807 Ridge Ave, Pittsburgh, PA 15212

Drg Title: SYMBOLS AND ABBREVIATIONS

Scale	12" = 1'-0"	Job No.	P064636
Drawn By	MH	Drawing No.	E-001
Checked By	JG		
Date	11/07/24	Rev	

A. CONTRACT PERFORMANCE

1. THE DRAWINGS SHOW VARIOUS CONDUIT SYSTEMS DIAGRAMMATICALLY. JUNCTION BOXES, PULL BOXES, SUPPORTS AND ACCESSORIES ARE NOT SHOWN BUT REQUIRED TO MEET APPLICABLE CODES, BUILDING STANDARDS AND TO FULFILL CONTRACT DOCUMENTS.

2. ALL WORK SHALL BE DONE IN CONFORMANCE WITH APPLICABLE CODES AND STANDARDS:

A. 2017 NATIONAL ELECTRICAL CODE WITH LOCAL AMENDMENTS
B. INTERNATIONAL BUILDING CODE WITH LOCAL AMENDMENTS
C. 2015 IECC INTERNATIONAL ENERGY CONSERVATION CODE
D. NFPA 101: LIFE SAFETY CODE
E. NFPA 110: STANDARD FOR EMERGENCY AND STANDBY POWER SYSTEMS
F. NFPA 111: STANDARD ON STORED ELECTRICAL ENERGY EMERGENCY AND STANDBY POWER SYSTEMS
G. ADA STANDARDS: AS AMENDED THROUGH SEPTEMBER 2010
H. ACCESSIBILITY GUIDELINES FOR BUILDINGS AND FACILITIES (ADAAG): AS AMENDED THROUGH SEPTEMBER 2004
I. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)
J. UNDERWRITERS' LABORATORIES INC. (UL)
K. AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)
L. ILLUMINATING ENGINEERING SOCIETY (IES)
M. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
N. ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
O. REQUIREMENTS AND STANDARDS OF THE LOCAL ELECTRIC UTILITY
P. ELECTRICAL TESTING LABORATORIES (ETL)
Q. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
R. ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)
S. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
T. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
U. APPLICABLE LOCAL CODES AND ORDINANCES

3. OBTAIN PERMITS AND APPROVAL FROM THE AUTHORITY HAVING JURISTICTION.

4. SCHEDULE WORK TO BE PERFORMED WITH OWNER AND AND INCLUDE ALL NECESSARY PREMIUM TIME REQUIRED FOR SHUTDOWNS, WORK IN OCCUPIED AREAS, ETC.

5. AREAS ASSOCIATED WITH WORK TO BE PERFORMED SHALL BE EXAMINED PRIOR TO BID SUBMISSION. NO ADDITIONAL COMPENSATION SHALL BE MADE FOR CONDITIONS FOUND DURING INSTALLATION.

6. COORDINATE WORK WITH OTHER TRADES TO INSURE INSTALLATION IS MADE IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

B. INSTALLATION

1. COORDINATE WORK SHOWN ON DRAWINGS WITH OTHER TRADES TO ASSURE SYSTEMS ARE COMPLETE AND OPERATIONAL. COORDINATE EQUIPMENT LOCATIONS AND CONDUIT RUNS TO AVOID CONFLICTS OR OBSTRUCTIONS WITH OTHER TRADES. PROVIDE NECESSARY PULL BOXES, VERTICAL SUPPORT BOXES AND CONDUIT OFFSETS REQUIRED WHETHER OR NOT INDICATED ON PLANS.

2. CONDUIT RUNS INDICATED ON PLAN ARE DIAGRAMATIC. EXACT LOCATIONS AND ELEVATION OF CONDUIT TO BE DETERMINED AFTER COORDINATION WITH OTHER TRADES. SUBMIT COORDINATED SHOP DRAWINGS SHOWING EXACT LOCATION OF EQUIPMENT AND CONDUIT INCLUDING LOCATIONS AND MEANS OF SUPPORT AS WELL AS EXPECTED LOAD CONCENTRATION AT POINTS OF ATTACHMENT. SUBMIT LOADING INFORMATION TO THE STRUCTURAL ENGINEER FOR APPROVAL.

3. PROVIDE NECESSARY CABLE SUPPORT BOXES, PULL BOXES AND CONDUIT SUPPORTS, WHERE NOTED AND AS REQUIRED BY APPLICABLE CODES. LABEL PULLBOXES FOR THEIR INTENDED USE. PROVIDE DECALS TO INDICATE VOLTAGE LEVEL. TAG CONDUIT WITH FEEDER OR BRANCH CIRCUIT DESIGNATION AT ALL BOXES. WHERE CONDUIT BENDS ARE REQUIRED IN COMMUNICATIONS RACEWAY SYSTEMS, LIMIT THE RADIUS OF RACEWAY BENDS TO LESS THAN TEN TIMES THE DIAMETER OF THE RACEWAY. LABEL EACH RACEWAY PER TECHNOLOGY SPECIFICATION REQUIREMENTS EVERY 50 FEET HORIZONTALLY AND ON EACH FLOOR VERTICALLY. SUBMIT LABELING SYSTEM FOR REVIEW.

4. PULL WIRES IN CONDUIT ONLY AFTER THE CONDUIT SYSTEM IS COMPLETE. USE APPROVED PULLING COMPOUND WHERE REQUIRED. SPLICE WIRING ONLY WITHIN JUNCTION BOXES.

5. LOCATIONS AND MOUNTING HEIGHTS OF WALL OUTLETS AS NOTED ON ELECTRICAL MOUNTING HEIGHT DETAIL.

6. DO NOT WORK ON ENERGIZED EQUIPMENT.

7. FINAL CONNECTIONS TO EQUIPMENT SHALL BE MADE ACCORDING TO MANUFACTURER APPROVED SHOP DRAWINGS.

8. REASONABLE EFFORTS HAVE BEEN MADE TO COORDINATE OUTLET TYPES WITH EQUIPMENT NEEDS. HOWEVER, CONTRACTOR SHALL VERIFY FINAL OUTLET TYPES WITH THE EXPECTED EQUIPMENT THAT SHALL USE THE OUTLET TYPE TO ENSURE PROPER WIRING AND COMPATIBILITY WITH ATTACHMENT PLUGS OR JUNCTION BOXES THAT MAY BE FURNISHED AS AN INTEGRAL PART OF THE EQUIPMENT.

9. INSTALL RECEPTACLES IN ACCORDANCE WITH MOUNTING HEIGHT AND PLACEMENT INDICATED ON DRAWINGS. ENSURE THAT RECEPTACLES SHALL BE ACCESSIBLE BEHIND EQUIPMENT. COORDINATE EXACT LOCATION OF EQUIPMENT RECEPTACLES WITH EQUIPMENT MANUFACTURER'S REQUIREMENTS.

9. INSTALL RECEPTACLES IN ACCORDANCE WITH MOUNTING HEIGHT AND PLACEMENT INDICATED ON DRAWINGS. ENSURE THAT RECEPTACLES SHALL BE ACCESSIBLE BEHIND EQUIPMENT. COORDINATE EXACT LOCATION OF EQUIPMENT RECEPTACLES WITH EQUIPMENT MANUFACTURER'S REQUIREMENTS.

10. INSTALL GFCI RECEPTACLES SO THE TEST AND RESET BUTTONS ARE ACCESSIBLE.

11. VERIFY PHASE LOAD BALANCING ON POWER PANELS UPON COMPLETION OF THE ELECTRICAL INSTALLATION. INCLUDE RE-DISTRIBUTION OF CIRCUITS WITHIN PANELS TO BALANCE WITHIN A 10% WINDOW (±5%).

12. WHERE MORE THAN ONE CIRCUIT IS ROUTED IN THE SAME CONDUIT, DERATE THE WIRING PER NATIONAL ELECTRICAL CODE REQUIREMENTS.

13. TYPE MC CABLE MAY BE UTILIZED FOR BRANCH RECEPTACLE CIRCUITRY, WHERE PERMITTED BY THE AHJ AND CODE AND PROVIDED THAT:
a. IT IS IN ACCORDANCE WITH THE BUILDING RULES AND REGULATIONS.
b. CONTAINS AN INSULATED GROUND WIRE.
c. CONDUIT IS RUN TO THE FIRST DEVICE DOWN-LINE OF THE PANEL (I.E. RECEPTACLE).

14. CONTRACTOR SHALL INSTALL PENETRATIONS THROUGH IDENTIFIED FIRE RATED WALLS WITH CONTRACTOR'S FIRE STOP PROVIDER.

C. ENGINEER'S REVIEW

1. SUBMIT SHOP DRAWINGS FOR REVIEW PRIOR TO THE START OF WORK. WORK OR EQUIPMENT INSTALLED PRIOR TO REVIEW OF SHOP DRAWINGS AND FOUND TO BE UNACCEPTABLE MUST BE REMOVED AND MODIFIED AT THE CONTRACTOR'S EXPENSE INCLUDING ANY RESULTANT SCHEDULING DELAYS EXPERIENCED.

2. THE ENGINEER WILL REVIEW SHOP DRAWINGS AND SAMPLES FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND THE INFORMATION CONTAINED IN THE CONTRACT DOCUMENTS. THE ENGINEER'S REVIEW OF SHOP DRAWINGS AND SAMPLES IS ONLY FOR THE CONVENIENCE OF THE OWNER IN FOLLOWING THE WORK AND DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR DEVIATIONS FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS. THE ENGINEER'S REVIEW SHALL NOT BE CONSTRUED AS A COMPLETE OR DETAILED CHECK OF THE WORK SUBMITTED, NOR SHALL IT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OF ANY SORT IN THE SHOP DRAWINGS AND SAMPLES, OR FROM THE NECESSITY OF FURNISHING WORK REQUIRED BY THE CONTRACT DOCUMENTS WHICH MAY HAVE BEEN OMITTED FROM SHOP DRAWING SUBMITTALS.

3. THE REVIEW OF A SEPARATE ITEM SHALL NOT INDICATE REVIEW OF THE COMPLETE ASSEMBLY IN WHICH IT FUNCTIONS. NOTHING IN THE ARCHITECT'S AND/OR ENGINEER'S REVIEW OF SHOP DRAWINGS AND SAMPLES SHALL BE CONSIDERED AS AUTHORIZING:
a. A DEPARTURE FROM CONTRACT DOCUMENTS OR SPECIFICATIONS, OR,
b. ADDITIONAL COST TO THE OWNER, OR,
c. INCREASED TIME FOR COMPLETION OF THE WORK.

4. NO PART OF THE WORK SHALL BE STARTED IN THE SHOP OR IN THE FIELD UNTIL THE ENGINEER HAS REVIEWED THE SHOP DRAWINGS AND SAMPLES FOR THAT PORTION OF THE WORK. THEREAFTER, THE WORK SHALL BE EXECUTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND THE INDICATED STATUS OF THE REVIEWED SHOP DRAWING.

5. TWO WEEKS AFTER AWARD OF CONTRACT SUBMIT A SHOP DRAWING LOG FOR REVIEW WITH SUBMITTAL DATES AND SUBMITTAL TYPE.

6. PROVIDE OPERATIONS AND MAINTENANCE MANUALS FOR ALL EQUIPMENT AND MATERIALS.

D. RECORD DRAWINGS

1. PREPARE AND FURNISH TO OWNER "AS BUILT" PLANS FOR ALL WORK INSTALLED. PROVIDE CAD DRAWINGS AND CAD FILES COMPLETED IN THE LATEST VERSION OF AUTOCAD. ALL DRAWINGS SHALL BE IN A STYLE COMMENSURATE WITH THE ENGINEERING DESIGN. THE ENGINEERING DESIGN CAD DRAWINGS OR BACKGROUNDS WILL BE FURNISHED FOR USE TO THIS CONTRACTOR FOR THE PURPOSE OF THIS SUBMISSION (SUBMIT A CAD INDEMNIFICATION AGREEMENT).

2. DURING CONSTRUCTION, KEEP AN ACCURATE RECORD OF ALL DEVIATIONS BETWEEN THE WORK AS SHOWN ON DRAWINGS AND THAT WHICH IS ACTUALLY INSTALLED. THIS RECORD SET OF PRINTS SHALL BE KEPT AT JOB SITE FOR INSPECTION.

3. UPON COMPLETION OF THE INSTALLATION, SUBMIT ONE SET OF BLACK AND WHITE PRINTS OF THESE "AS-BUILT" RECORD DRAWINGS TO THE ARCHITECT/ENGINEER FOR REVIEW. AFTER REVIEW BY THE ARCHITECT/ENGINEER, MAKE NECESSARY CHANGES TO THESE DRAWINGS AND DELIVER TO THE OWNER FOR RECORD. FINAL PAYMENT WILL BE WITHHELD UNTIL COMPLETION OF "AS-BUILT" DRAWINGS.

4. AS-BUILT DRAWINGS MUST CONTAIN EXACT ROUTING AND ELEVATIONS OF CONDUIT BANKS, ACTUAL PANELBOARD CIRCUIT BREAKER POLE POSITIONS USED FOR EACH CIRCUIT, AND EXACT LOCATION OF ALL EQUIPMENT. ALL DIMENSIONS SHALL BE REFERENCED TO BUILDING STRUCTURE CENTERLINES.

E. LAB EQUIPMENT SPECIFICATIONS

1. EQUIPMENT AND MATERIALS SHALL BE NEW, LISTED AND SHALL CONFORM TO ANY ADDITIONAL LABELING, TESTING AND CONSTRUCTION REQUIREMENTS ESTABLISHED BY THE AHJ. SAME SHALL BE GUARANTEED FOR 1 YEAR SUBSEQUENT TO FINAL ACCEPTANCE.

2. CLEAN EXISTING EQUIPMENT TO BE RELOCATED OR TO BE INSTALLED FROM STORAGE.

3. INTERMEDIATE METAL CONDUIT SHALL BE USED WHERE SUBJECTED TO ANY WATER OR MOISTURE CONDITIONS.

4. LOCATE CONDUIT EXPANSION FITTINGS TOGETHER WITH BONDING JUMPER AND SUITABLE SLEEVES WHERE EXPANSION JOINTS ARE ENCOUNTED. INSTALL CONDUIT EXPANSION FITTINGS IN EACH CONDUIT RUN WHEREVER IT CROSSES AN EXPANSION JOINT IN THE STRUCTURE. INSTALL EXPANSION FITTING ON ONE SIDE OF THE JOINT WITH ITS SLIDING SLEEVE END FLUSH WITH THE JOINT AND WITH A LENGTH OF BONDING JUMPER IN THE EXPANSION JOINT EQUAL TO AT LEAST THREE TIMES THE NORMAL WIDTH OF THE JOINT.

5. FOR VOLTAGE DROP CONSIDERATIONS, USE #10 MINIMUM WIRE FOR 20A, SINGLE POLE, 120 VOLT OR 208 VOLT BRANCH CIRCUIT RUNS IN EXCESS OF 100 FEET FROM THE PANEL TO THE DEVICE.

6. LOCATE JUNCTION OR PULL BOXES WHEREVER SUCH A BOX MAY BE NECESSARY TO FACILITATE INSTALLATION OR CONFORM TO CODE REQUIREMENTS. COORDINATE LOCATIONS OF JUNCTION/PULL BOXES WITH ENGINEER FOR ACCESSIBILITY AND AESTHETIC CONSIDERATIONS. INSTALL JUNCTION BOXES AND PULL BOXES EVERY 100 FEET IN CONDUIT HORIZONTAL RUNS. DO NOT EXPOSE JUNCTION/PULL BOXES IN FINISHED SPACES. TAG AND IDENTIFY CABLES WITHIN PULL BOXES. LABEL CONDUITS WITH FEEDER DESIGNATION AT ENTRY AND EXIT TO THE BOX.

SCOPE NOTES:

THE DRAWINGS ARE SCOPE DOCUMENTS THAT INDICATE THE GENERAL SCOPE-OF-WORK OF THE PROJECT AND DO NOT NECESSARILY INDICATE OR DESCRIBE ALL WORK REQUIRED FOR THE FULL PERFORMANCE AND COMPLETION OF THE WORK. WORK REQUIRED TO PROPERLY COMPLETE THE SCOPE-OF-WORK DEFINED BY THE GENERAL SCOPE SHOWN ON AND REQUIRED BY THE CONTRACT DOCUMENTS IS INCLUDED. COMPREHEND THE FULL SCOPE -OF-WORK AND ANTICIPATE ALL THE WORK REASONABLY INFERABLE IN THE CONTRACT DOCUMENTS.

DEFINITION OF WORK:

1. PROVIDE A COMPLETE AND FULLY FUNCTIONING ELECTRICAL SYSTEM INCLUDING, BUT NOT LIMITED TO THE FOLLOWING REQUIREMENTS, ALL OF WHICH CONSTITUTE THE WORK TO BE PERFORMED:
   A. LABOR, MATERIAL, EQUIPMENT, FREIGHT, SUPERVISION, TAXES, ETC. REQUIRED TO FURNISH A COMPLETE AND WORKING SYSTEM.
   B. EXPANSION FITTINGS FOR CONDUITS AS FOLLOWS:
      a. AT EACH POINT WHERE AN EXPOSED OR CONCEALED CONDUIT CROSSES A BUILDING EXPANSION JOINT.
      b. AT EACH CROSSING OF A BUILDING EXPANSION JOINT WITH CONDUIT WHICH IS EMBEDDED IN CONCRETE.
      c. AT UNINTERRUPTED CONDUIT RUNS WHICH ARE IN EXCESS OF 200 FT. IN LENGTH. THIS PROVISION APPLIES TO CONDUIT WHICH IS RUN HORIZONTALLY AND TO CONDUIT WHICH IS RUN VERTICALLY.
      d. TRANSITION FITTINGS IF REQUIRED FOR APPLICATION WITH EMT CONDUIT.
      e. FOR NONMETALLIC PVC CONDUIT INSTALL FITTINGS AS RECOMMENDED BY THE MANUFACTURER.
   C. FIRE SAFE OF RACEWAY PENETRATIONS.
   D. HOOKUP ALL POWER WIRING OF ALL PIECES OF EQUIPMENT SHOWN ON THE CONTRACT DOCUMENTS REGARDLESS OF WHETHER OR NOT THESE CONNECTIONS ARE SHOWN ON THE ELECTRICAL DRAWINGS. PROVIDE CONDUIT, JUNCTION BOXES, CONDUCTORS, WIRING DEVICES, AND DISCONNECTS AS REQUIRED FOR A FULLY FUNCTIONING SYSTEM.
   E. TESTING REQUIRED BY THE DOCUMENTS, INCLUDING ARC FLASH AND SHORT CIRCUIT STUDIES, IN THE PRESENCE OF THE ENGINEER OR TESTING LABORATORY. INCLUDE LOAD TEST AS REQUIRED BY GOVERNING AGENCY OR DOCUMENTS. DEVICES, MATERIALS, SUPPLIES, LABOR AND POWER AS REQUIRED TO PROPERLY CONDUCT REQUIRED TESTING OF ALL SYSTEMS INSTALLED UNDER THIS CONTRACT AS REQUIRED. PARTIAL TESTING, PARTIAL EQUIPMENT START-UP, AND REBALANCING AS NECESSARY TO ACCOMPLISH THE PHASED OCCUPANCY AND MULTIPLE TURNOVER DATES AS SPECIFIED AND AS REQUIRED.
   F. LAYOUT AND PLACING OF ALL SLEEVES, EMBEDS AND BOX-OUTS.
2. PROVIDE EXTENDED WARRANTIES ON ALL PERMANENT ELECTRICAL EQUIPMENT USED TEMPORARILY DURING CONSTRUCTION SO THAT THE WARRANTY PERIOD FOR ALL EQUIPMENT BEGINS ON THE DATE THE ENTIRE PROJECT IS SUBSTANTIALLY COMPLETE, NOT A PHASED OCCUPANCY.
3. IDENTIFICATION REQUIRED BY THE CONTRACT DOCUMENTS AND CODE.
4. SLEEVES AND WALL SUPPORT FOR ELECTRICAL SYSTEMS INCLUDING WATERPROOF FIRE- SAFING, STOPS AS SEALANT REQUIRED.
5. SLEEVES AND/OR FIRESTOPPING FOR ALL RACEWAY PASSING THROUGH ANY FIRE RESISTIVE WALLS AND SHAFT WALLS.

ELECTRICAL POWER SCOPE CLARIFICATION NOTES:

A. FOR ALL SYSTEMS, PROVIDE ALLOWANCES FOR ALL COMPONENTS AND ACCESSORIES REQUIRED FOR A COMPLETE AND OPERATING SYSTEM.

B. 20A-1P RECEPTACLES SHALL BE CIRCUITED TO NO MORE THAN (6) DUPLEX RECEPTACLES PER CIRCUIT.

ELECTRICAL POWER GENERAL NOTES:

A. PROVIDE CODE-REQUIRED LOCAL DISCONNECTS FOR ALL MOTORS AND HARDWIRED EQUIPMENT.

B. UNLESS STATED OTHERWISE, CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS, APPURTENANCES, EQUIPMENT AND SERVICES TO COMPLETE ALL WORK AS INDICATED ON DRAWINGS AND/OR SPECIFIED ON NOTES.

C. UNLESS STATED OTHERWISE, CONTRACTOR SHALL FOLLOW MANUFACTURERS' DIRECTIONS WITH APPLICABLE CODES, INSTRUCTIONS AND RECOMMENDATIONS FOR ALL MATERIALS AND PROCESSES USED IN THIS CONTRACT. CONTRACTOR SHALL PROVIDE ALL ITEMS REQUIRED FOR A COMPLETE WORKABLE INSTALLATION.

D. UPON COMPLETION OF THE WORK, CONTRACTOR SHALL COMPLETELY CLEAN THE CONSTRUCTION AREA TO MAKE SUITABLE FOR THE OWNER'S USE. THIS INCLUDES REMOVING ALL LABELS (AFTER ARCHITECTS INSPECTION) AND CLEANING ALL EQUIPMENT, CONSTRUCTION WORK, WINDOWS AND ANY OTHER NEW OR OLD WORKING IN THAT CONSTRUCTION AREA.

E. CONTRACTOR IS RESPONSIBLE FOR PATCHING AND REFINISHING ANY WALL, CEILING, OR OTHER SURFACE REQUIRED TO BE DEMOLISHED FOR THE INSTALLATION OF ELECTRICAL APPURTENANCES, INCLUDING BUT NOT LIMITED TO CONDUIT, WIRING, WIRING DEVICES, AND DISTRIBUTION EQUIPMENT. PATCHING AND FINISH SHALL MATCH EXISTING BUILDING FINISHES.

F. CONTRACTOR IS RESPONSIBLE FOR FIRESTOPPING AND SEALING ANY PENETRATIONS IN WALLS, CEILINGS, OR FLOORS REQUIRED TO COMPLETE THE ELECTRICAL INSTALLATION.

Notes

Rev	Description	Date	Drn	Ch'd

STAMP

COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL — JEREMY SNYDER — ENGINEER — PE034402

FOR CONSTRUCTION

Status of drawing

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Project: **CCAC CEIT - ROOM 202, 220, 222 ELECTRICAL AND COMPRESSED AIR REVISIONS**

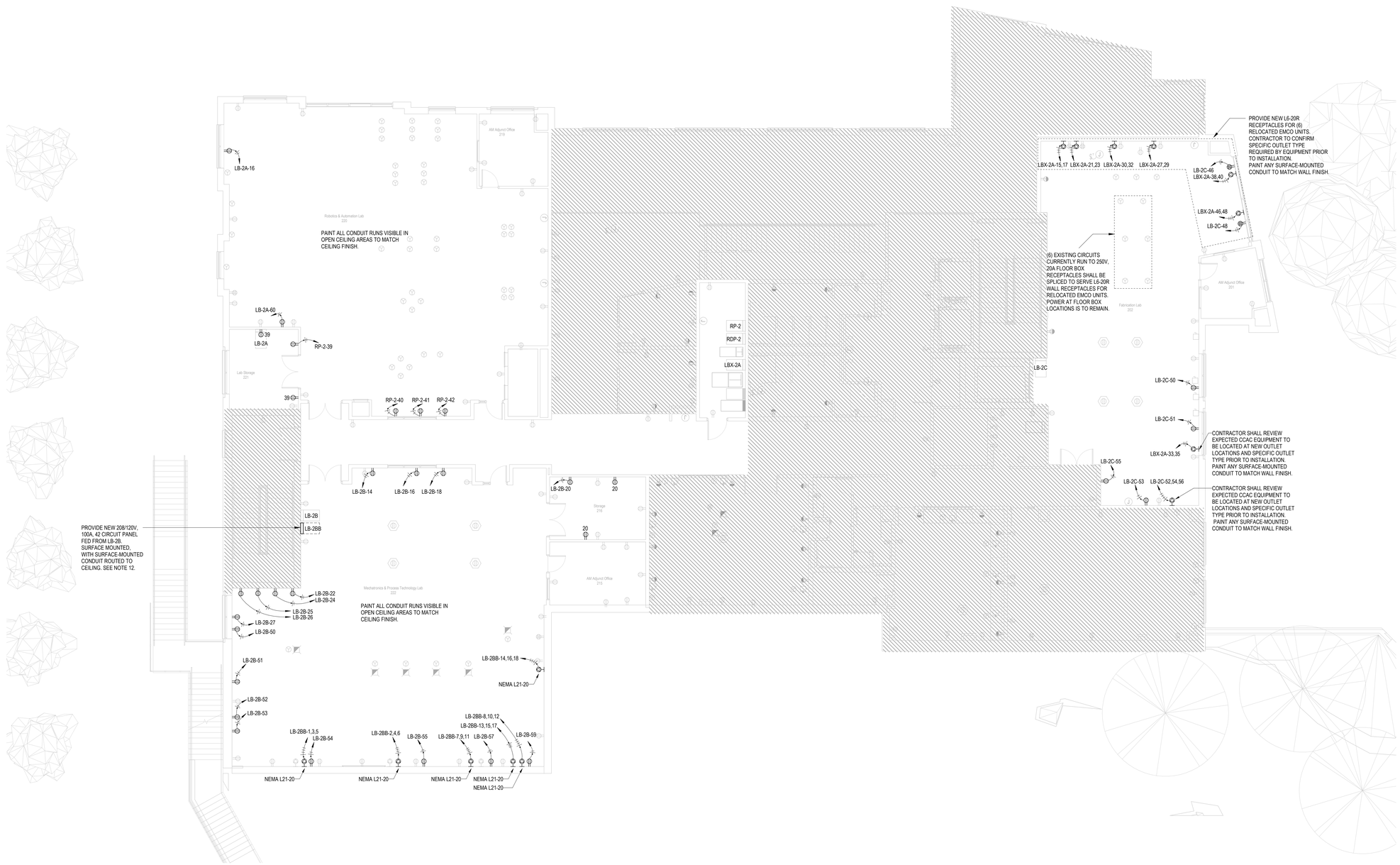
Address: 807 Ridge Ave, Pittsburgh, PA 15212

Drg Title: GENERAL NOTES

Scale	12" = 1'-0"	Job No.	P064636
Drawn By	MH	Drawing No.	E-002
Checked By	JG	Rev	
Date	11/07/24		

Notes

1. CONTRACTOR SHALL VERIFY THE RECEPTACLE TYPE AND WIRE SIZE REQUIRED BY EQUIPMENT BEFORE PURCHASE. RECEPTACLE CONFIGURATIONS SHOWN ARE TAKEN FROM FIELD SURVEY AND EXISTING DRAWINGS.
2. CONTRACTOR IS RESPONSIBLE FOR PATCHING AND REFINISHING ANY WALL, CEILING, OR OTHER SURFACE REQUIRED TO BE DEMOLISHED FOR THE INSTALLATION OF ELECTRICAL APPURTENANCES, INCLUDING BUT NOT LIMITED TO CONDUIT, WIRING, WIRING DEVICES, AND DISTRIBUTION EQUIPMENT. PATCHING AND FINISH SHALL MATCH EXISTING BUILDING FINISHES.
3. CONTRACTOR IS RESPONSIBLE FOR FIRESTOPPING. AND SEALING ANY PENETRATIONS IN WALLS, CEILINGS, OR FLOORS REQUIRED TO COMPLETE THE ELECTRICAL INSTALLATION.
4. FINISH COLORS OF NEW WIRING DEVICE COVER PLATES SHALL MATCH EXISTING.
5. WHERE CONDUIT IS PAINTED, CONTRACTOR SHALL MATCH AND PAINT NEW CONDUIT INSTALLATIONS.
6. CONTRACTOR SHALL TEMPORARILY REMOVE PORTIONS OF EXISTING CEILING FOR ABOVE CEILING WORK AND REPLACE CEILING WHEN COMPLETE. CONTRACTOR SHALL REPLACE ANY DAMAGED TILES, CEILING GRID OR CEILING ELEMENTS.
7. CONTRACTOR SHALL COORDINATE INWALL CONSTRUCTION AND SHALL PATCH BACK WALL TO NEW FINISH AND PAINT TO MATCH EXISTING.
8. CONTRACTOR SHALL ROUTE CONDUIT PARALLEL AND PERPENDICULAR TO EXISTING STRUCTURE AND EXISTING CONDUIT INSTALLATIONS.
9. CONTRACTOR SHALL COORDINATE HANGER INSTALLATIONS. WHERE FIREPROOFING IS REMOVED FOR INSTALLATION OF HANGERS OR BEAM CLAMPS, CONTRACTOR SHALL PROVIDE REPLACEMENT FIREPROOFING.
10. PROVIDE 2#12 COPPER WIRE AND 1#12 EGC IN 3/4" CONDUIT FOR 120V, 20A DEDICATED BRANCH CIRCUITS.
11. PROVIDE 3#12 COPPER WIRE AND 1#12 EGC IN 3/4" CONDUIT FOR 240V, 20A BRANCH CIRCUITS.
12. PROVIDE 4#1 COPPER WIRE AND 1#8 EGC IN 2" CONDUIT FOR FEEDER TO NEW PANEL LB-2BB.



1 SECOND FLOOR ELECTRICAL POWER PLAN
1/8" = 1'-0"

Rev	Description	Date	Drn	Ch'd

STAMP
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Address	807 Ridge Ave, Pittsburgh, PA 15212
Drg Title	SECOND FLOOR ELECTRICAL POWER PLAN
Scale	1/8" = 1'-0"
Drawn By	MH
Checked By	JG
Date	11/07/24
Job No.	P064636
Drawing No.	E-102
Rev	

Notes

LBX-2A - EXISTING

ROOM: Elec 213 **VOLTS:** 240/120V, 3P 4W **A.I.C.:** 42 kA
MOUNTING: SURFACE **BUS AMPS:** 400 A **MCB:** 400 A MCB
FED FROM: **NEUTRAL:** 100% **LUGS:** STANDARD
NOTE: CIRCUITS 15/17/19, 23/25/27, 30/32/34, 31/33/35, 38/40/42, AND 46/48/50 SHALL BE RELOCATED TO THE BOLD LOCATIONS TO SERVE ROOM 202 EMCO UNITS. REUSE SHUNT TRIP.

CKT #	CKT BKR	# OF POLES	CIRCUIT DESCRIPTION	A		B		C		CIRCUIT DESCRIPTION	# OF POLES	CKT BKR	CKT #
1	20 A	3	VERTICAL BANDSAW ROOM 202	0									2
3	--	--	--			0	0			EMCO CM 105 ROOM 220 SHUNT TRIP	3	20 A	4
5	--	--	--					0	0	--	--	--	6
7	20 A	1	BANDSAW SHUNT TRIP	0	0					--	--	--	8
9	20 A	3	EMCO CT 105, ROOM 220 SHUNT TRIP			0	0			SCA 3600 ROOM 202 SHUNT TRIP	3	20 A	10
11	--	--	--					0	0	--	--	--	12
13	--	--	--	0	0					--	--	--	14
15	50 A	2	**EMCO CONCEPT MILL 105**			550	0			COLD SAW ROOM 202 SHUNT TRIP	3	20 A	16
17	--	--	--					550	0	--	--	--	18
19	--	1	**SHUNT TRIP**	--	0					--	--	--	20
21	50 A	2	**EMCO CONCEPT MILL 105**			550	0			COLD SAW SHUNT TRIP	1	20 A	22
23	--	--	--					550	0	BALCO WATERJET ROOM 202	3	20 A	24
25	--	1	**SHUNT TRIP**	--	0					--	--	--	26
27	50 A	2	**EMCO CONCEPT MILL 105**			550	0			--	--	--	28
29	--	--	--					550	550	**EMCO CONCEPT MILL 105**	2	50 A	30
31	--	1	**SHUNT TRIP**	--	550					--	--	--	32
33	50 A	2	240V RECEPTACLE ROOM 202 EAST WALL			0	--			**SHUNT TRIP**	1	--	34
35	--	--	--					0	--	SPACE	1	--	36
37	20 A	3	BELT / DISC SANDER ROOM 202	0	550					**EMCO CONCEPT MILL 105**	2	50 A	38
39	--	--	--			0	550			--	--	--	40
41	--	--	--					0	--	**SHUNT TRIP**	1	--	42
43	20 A	1	SANDER SHUNT TRIP	0	--					SPACE	1	--	44
45	20 A	2	SHUNT TRIP POWER ROOM 220			0	550			**EMCO CONCEPT MILL 105**	2	50 A	46
47	--	--	--					0	550	--	--	--	48
49	20 A	3	METERING	0	--					**SHUNT TRIP**	1	--	50
51	--	--	--			0	0			SHUNT TRIP POWER ROOM 202	2	20 A	52
53	--	--	--					0	0	--	--	--	54
				1,100 VA		2,750 VA		2,750 VA					
				9 A		23 A		23 A					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND	CALCULATED DEMAND
LIGHTING	0.000 kVA	125%	0.000 kVA
MOTORS	0.000 kVA	125% LARGEST + 100% REMAINDER	0.000 kVA
RECEPTACLES	0.000 kVA	100% FIRST 10KVA, 50% REMAINDER	0.000 kVA
HEATING/COOLING	0.000 kVA	100%	0.000 kVA
KITCHEN	0.000 kVA	PER NEC TABLE 220.56	0.000 kVA
CONTINUOUS	0.000 kVA	125%	0.000 kVA
NONCONTINUOUS	6.600 kVA	100%	6.600 kVA
NONCOINCIDENTAL	0.000 kVA	0%	0.000 kVA

TOTALS
TOTAL CONNECTED LOAD: 6,600 VA
TOTAL CALCULATED DEMAND: 6,600 VA
BALANCED THREE PHASE AMPS: 16 A

0.1

LB-2A - EXISTING

ROOM: Lab Storage 221 **VOLTS:** 208Y/120V, 3P 4W **A.I.C.:** 42 kA
MOUNTING: SURFACE **BUS AMPS:** 225 A **MCB:** 225 A MLO
FED FROM: **NEUTRAL:** 100% **LUGS:** STANDARD
NOTE:

CKT #	CKT BKR	# OF POLES	CIRCUIT DESCRIPTION	A		B		C		CIRCUIT DESCRIPTION	# OF POLES	CKT BKR	CKT #
1	20 A	1	FLOOR BOX ROOM 220	0	0					FLOOR BOX ROOM 220	1	20 A	2
3	20 A	1	FLOOR BOX ROOM 220			0	0			RECEPT. WEST WALL RM 220	1	20 A	4
5	20 A	1	RECEPT. WEST WALL RM 220					0	0	FLOOR BOX ROOM 220	1	20 A	6
7	20 A	1	FLOOR BOX ROOM 220	0	0					FLOOR BOX ROOM 220	1	20 A	8
9	20 A	1	FLOOR BOX ROOM 220			0	0			FLOOR BOX ROOM 220	1	20 A	10
11	20 A	1	FLOOR BOX ROOM 220					0	0	RECEPT. STORAGE RM 221	1	20 A	12
13	20 A	3	RECEPT. COLUMN ROOM 220	0	0					RECEPT OFFICE RM 219	1	20 A	14
15	--	--	--			0	180			DEDICATED RECEPT. ROOM 220	1	20 A	16
17	--	--	--					0	0	RECEPTACLE ROOM 220	1	20 A	18
19	20 A	1	RECEPT. COLUMN ROOM 200	0	0					RECEPT. NORTH WALL RM 220	1	20 A	20
21	20 A	1	RECEPT. NORTH WALL RM 220			0	0			RECEPT. NORTH WALL RM 220	1	20 A	22
23	20 A	1	RECEPT. NORTH WALL RM 220					0	0	RECEPT. NORTH WALL RM 220	1	20 A	24
25	20 A	1	RECEPT. NORTH WALL RM 220	0	0					RECEPT. NORTH WALL RM 220	1	20 A	26
27	20 A	1	RECEPT. NORTH WALL RM 220			0	0			RECEPT. NORTH WALL RM 220	1	20 A	28
29	20 A	1	FLOOR BOX ROOM 220					0	0	FLOOR BOX ROOM 220	1	20 A	30
31	20 A	1	FLOOR BOX ROOM 220	0	0					FLOOR BOX ROOM 220	1	20 A	32
33	20 A	1	FLOOR BOX ROOM 220			0	0			FLOOR BOX ROOM 220	1	20 A	34
35	20 A	1	FLOOR BOX ROOM 220					0	0	FLOOR BOX ROOM 220	1	20 A	36
37	20 A	1	FLOOR BOX ROOM 220	0	0					FLOOR BOX ROOM 220	1	20 A	38
39	20 A	1	RECEPTACLE ROOM 220			0	0			FURNITURE FEED RM 220	3	20 A	40
41	20 A	3	FURNITURE FEED RM 220					0	0	--	--	--	42
43	--	--	--	0	0					--	--	--	44
45	--	--	--			0	0			FURNITURE FEED RM 220	3	20 A	46
47	20 A	3	FURNITURE FEED RM 220					0	0	--	--	--	48
49	--	--	--	0	0					--	--	--	50
51	--	--	--			0	0			RECEPT. WEST WALL ROOM 220	3	20 A	52
53	20 A	1	SHUNT TRIP POWER					0	0	--	--	--	54
55	20 A	3	RECEPT. ON COLUMN ROOM 220	0	0					--	--	--	56
57	--	--	--			0	0			RECEPTACLE ROOM 220	1	20 A	58
59	--	--	--					0	180	DEDICATED RECEPT. ROOM 220	1	20 A	60
				0 VA		180 VA		180 VA					
				0 A		2 A		2 A					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND	CALCULATED DEMAND
LIGHTING	0.000 kVA	125%	0.000 kVA
MOTORS	0.000 kVA	125% LARGEST + 100% REMAINDER	0.000 kVA
RECEPTACLES	0.360 kVA	100% FIRST 10KVA, 50% REMAINDER	0.360 kVA
HEATING/COOLING	0.000 kVA	100%	0.000 kVA
KITCHEN	0.000 kVA	PER NEC TABLE 220.56	0.000 kVA
CONTINUOUS	0.000 kVA	125%	0.000 kVA
NONCONTINUOUS	0.000 kVA	100%	0.000 kVA
NONCOINCIDENTAL	0.000 kVA	0%	0.000 kVA

TOTALS
TOTAL CONNECTED LOAD: 360 VA
TOTAL CALCULATED DEMAND: 360 VA
BALANCED THREE PHASE AMPS: 1 A

0.1

RP-2 - EXISTING

ROOM: Elec 213 **VOLTS:** 208Y/120V, 3P 4W **A.I.C.:** 42 kA
MOUNTING: SURFACE **BUS AMPS:** 225 A **MCB:** 225 A MCB
FED FROM: **NEUTRAL:** 100% **LUGS:** STANDARD
NOTE: THE BOLDED CIRCUIT (CIRCUIT 39) IS NEW AND REQUIRES A NEW CIRCUIT BREAKER.

CKT #	CKT BKR	# OF POLES	CIRCUIT DESCRIPTION	A		B		C		CIRCUIT DESCRIPTION	# OF POLES	CKT BKR	CKT #
1	20 A	1	RECEPT. CORRIDOR	0	0					RECEPTACLE ROOM 216	1	20 A	2
3	20 A	1	RECEPT. ROOM 217			0	0			RECEPTACLE ROOM 218	1	20 A	4
5	20 A	1	ELECTRIC ROOM RECEPT.					0	0	GFCI RESTROOMS RM 211/212	1	20 A	6
7	20 A	1	CORRIDOR RECEPTACLE	0	0					RECEPTACLE ROOM 214	1	20 A	8
9	20 A	1	BATHROOM DOOR CONTROLLER			0	0			GFCI SHOWER ROOM 208/209	1	20 A	10
11	20 A	1	RECEPTACLE ROOM 214					0	0	CORRIDOR RECEPTACLE	1	20 A	12
13	20 A	1	RECEPTACLE ROOM 214	0	0					RECEPTACLE ROOM 214	1	20 A	14
15	20 A	1	RECEPTACLE ROOM 214			0	0			RECEPTACLE ROOM 214	1	20 A	16
17	20 A	1	RECEPTACLE ROOM 215					0	0	RECEPTACLE ROOM 215	1	20 A	18
19	20 A	1	EWC	0	0					EWC	1	20 A	20
21	20 A	1	RECEPTACLE ROOM 214			0	0			RECEPTACLE ROOM 214	1	20 A	22
23	20 A	1	RECEPTACLE ROOM 214					0	0	2ND FLOOR LOBBY RECEPTACLE	1	20 A	24
25	20 A	1	AV RECEPT. ROOM 222/220	0	0					TV WALL RECEPTACLE	1	20 A	26
27	20 A	1	AV RECEPT. ROOM 218			0	0			FIRE SMOKE DAMPERS	1	20 A	28
29	20 A	1	FLOOR BOX RECEPT. RM 214					0	0	AV RECEPT. ROOM 203	1	20 A	30
31	20 A	1	RECEPTACLE ROOM 202	0	0					METERING	3	20 A	32
33	20 A	1	JCI CONTROL PANEL			0	0			--	--	--	34
35	20 A	1	AV RECEPTACLE RM 220					0	0	--	--	--	36
37	20 A	1	SPARE	0	0					LIGHTS ROOM 217/218	1	20 A	38
39	20 A	1	**RECEPTACLES LAB STORAGE 221**			540	180			**DEDICATED RECEPT. ROOM 220**	1	20 A	40
41	20 A	1	**DEDICATED RECEPT. ROOM 220**					180	180	**DEDICATED RECEPT. ROOM 220**	1	20 A	42
43	--	1	SPACE	--	--					SPACE	1	--	44
45	--	1	SPACE			--	--			SPACE	1	--	46
47	--	1	SPACE					--	--	SPACE	1	--	48
49	--	1	SPACE	--	--					SPACE	1	--	50
51	--	1	SPACE			--	--			SPACE	1	--	52
53	--	1	SPACE					--	--	SPACE	1	--	54
55	--	1	SPACE	--	--					SPACE	1	--	56
57	--	1	SPACE			--	--			SPACE	1	--	58
59	--	1	SPACE					--	--	SPACE	1	--	60
				0 VA		720 VA		360 VA					
				0 A		6 A		3 A					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND	CALCULATED DEMAND
LIGHTING	0.000 kVA	125%	0.000 kVA
MOTORS	0.000 kVA	125% LARGEST + 100% REMAINDER	0.000 kVA
RECEPTACLES	1.080 kVA	100% FIRST 10KVA, 50% REMAINDER	1.080 kVA
HEATING/COOLING	0.000 kVA	100%	0.000 kVA
KITCHEN	0.000 kVA	PER NEC TABLE 220.56	0.000 kVA
CONTINUOUS	0.000 kVA	125%	0.000 kVA
NONCONTINUOUS	0.000 kVA	100%	0.000 kVA
NONCOINCIDENTAL	0.000 kVA	0%	0.000 kVA

TOTALS
TOTAL CONNECTED LOAD: 1,080 VA
TOTAL CALCULATED DEMAND: 1,080 VA
BALANCED THREE PHASE AMPS: 3 A

0.1

LB-2B - EXISTING

ROOM: Mechatronics & Process Technology Lab 222 **VOLTS:** 208Y/120V, 3P 4W **A.I.C.:** 42 kA
MOUNTING: SURFACE **BUS AMPS:** 400 A **MCB:** 400 A MLO
FED FROM: **NEUTRAL:** 100% **LUGS:** STANDARD
NOTE:

CKT #	CKT BKR	# OF POLES	CIRCUIT DESCRIPTION	A		B		C		CIRCUIT DESCRIPTION	# OF POLES	CKT BKR	CKT #
1	20 A	1	RECEPT. SOUTH WALL RM 222	0	0					RECEPT. SOUTH WALL RM 222	1	20 A	2
3	20 A	1	RECEPT. SOUTH WALL RM 222			0	0			RECEPT. SOUTH WALL RM 222	1	20 A	4
5	20 A	1	RECEPT. SOUTH WALL RM 222					0	0	RECEPT. SOUTH WALL RM 222	1	20 A	6
7	20 A	3	RECEPT. SOUTH WALL RM 222	0	0					RECEPT. SOUTH WALL RM 222	3	20 A	8
9	--	--	--			0	0			--	--	--	10
11	--	--	--					0	0	--	--	--	12
13	20 A	3	RECEPT. SOUTH WALL RM 222	0	180					RECEPT. NORTH WALL RM 222	1	20 A	14
15	--	--	--			0	180			RECEPT. NORTH WALL RM 222	1	20 A	16
17	--	--	--					0	180	RECEPT. NORTH WALL RM 222	1	20 A	18
19	20 A	3	METERING	0	540					RECEPTACLES STORAGE 216	1	20 A	20
21	--	--	--			0	180			RECEPT. STAIR WALL RM 222	1	20 A	22
23	--	--	--					0	180	RECEPT. STAIR WALL RM 222	1	20 A	24
25	20 A	1	RECEPT. STAIR WALL RM 222	180	180					RECEPT. STAIR WALL RM 222	1	20 A	26
27	20 A	1	RECEPT. WEST WALL RM 222			180	0			RECEPT. ROOM 222	1	20 A	28
29	20 A	1	FLOOR BOX ROOM 222					0	0	CORD REEL ROOM 222	1	20 A	30
31	20 A	1	CORD REEL ROOM 222	0	0					RECEPTACLE ROOM 222	1	20 A	32
33	20 A	1	RECEPTACLE ROOM 222			0	0			CORD REEL ROOM 222	1	20 A	34
35	20 A	1	CORD REEL ROOM 222					0	0	FURNITURE FEED ROOM 222	3	20 A	36
37	20 A	3	FURNITURE FEED ROOM 222	0	0					--	--	--	38
39	--	--	--			0	0			--	--	--	40
41	--	--	--					0	0	FLOOR BOX RECEPT. RM 222	1	20 A	42
43	20 A	3	FURNITURE FEED ROOM 222	0	0					FURNITURE FEED ROOM 222	3	20 A	44
45	--	--	--			0	0			--	--	--	46
47	--	--	--					0	0	--	--	--	48
49	20 A	1	SHUNT TRIP POWER	0	180					RECEPT. WEST WALL RM 222	1	20 A	50
51	20 A	1	RECEPT. WEST WALL RM 222			180	180			RECEPT. WEST WALL RM 222	1	20 A	52
53	20 A	1	RECEPT. WEST WALL RM 222					180	180	RECEPT. SOUTH WALL RM 222	1	20 A	54
55	20 A	1	RECEPT. SOUTH WALL RM 222	180	0					PANEL LB-2BB	3	100 A	56
57	20 A	1	RECEPT. SOUTH WALL RM 222			180	0			--	--	--	58
59	20 A	1	RECEPT. SOUTH WALL RM 222					0	0	--	--	--	60
				1,440 VA		1,080 VA		720 VA					
				12 A		9 A		6 A					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND	CALCULATED DEMAND
LIGHTING	0.000 kVA	125%	0.000 kVA
MOTORS	0.000 kVA	125% LARGEST + 100% REMAINDER	0.000 kVA
RECEPTACLES	3.240 kVA	100% FIRST 10KVA, 50% REMAINDER	3.240 kVA
HEATING/COOLING	0.000 kVA	100%	0.000 kVA
KITCHEN	0.000 kVA	PER NEC TABLE 220.56	0.000 kVA
CONTINUOUS	0.000 kVA	125%	0.000 kVA
NONCONTINUOUS	0.000 kVA	100%	0.000 kVA
NONCOINCIDENTAL	0.000 kVA	0%	0.000 kVA

TOTALS
TOTAL CONNECTED LOAD: 3,240 VA
TOTAL CALCULATED DEMAND: 3,240 VA
BALANCED THREE PHASE AMPS: 9 A

0.1

LB-2BB

ROOM: Mechatronics & Process Technology Lab 222 **VOLTS:** 208Y/120V, 3P 4W **A.I.C.:**
MOUNTING: SURFACE **BUS AMPS:** 100 A **MCB:** 100 A MLO
FED FROM: LB-2B **NEUTRAL:** 100% **LUGS:** STANDARD
NOTE:

CKT #	CKT BKR	# OF POLES	CIRCUIT DESCRIPTION	A		B		C		CIRCUIT DESCRIPTION	# OF POLES	CKT BKR	CKT #
1	20 A	3	FESTO WORKBENCH	0	0					FESTO WORKBENCH	3	20 A	2
3	--	--	--			0	0			--	--	--	4
5	--	--	--					0	0	--	--	--	6
7	20 A	3	FESTO WORKBENCH	0	0					FESTO WORKBENCH	3	20 A	8
9	--	--	--			0	0			--	--	--	10
11	--	--	--					0	0	--	--	--	12
13	20 A	3	FESTO WORKBENCH	0	0					THREE PHASE RECEPT. ROOM 222	3	20 A	14
15	--	--	--			0	0			--	--	--	16
17	--	--	--					0	0	--	--	--	18
19	20 A	1	SPARE	0	0					SPARE	1	20 A	20
21	20 A	1	SPARE			0	0			SPARE	1	20 A	22
23	20 A	1	SPARE					0	0	SPARE	1	20 A	24
25	--	1	SPACE	--	--					SPACE	1	--	26
27	--	1	SPACE			--	--			SPACE	1	--	28
29	--	1	SPACE					--	--	SPACE	1	--	30
31	--	1	SPACE	--	--					SPACE	1	--	32
33	--	1	SPACE			--	--			SPACE	1	--	34
35	--	1	SPACE					--	--	SPACE	1	--	36
37	--	1	SPACE	--	--					SPACE	1	--	38
39	--	1	SPACE			--	--			SPACE	1	--	40
41	--	1	SPACE					--	--	SPACE	1	--	42
				0 VA		0 VA		0 VA					
				0 A		0 A		0 A					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND	CALCULATED DEMAND
LIGHTING	0.000 kVA	125%	0.000 kVA
MOTORS	0.000 kVA	125% LARGEST + 100% REMAINDER	0.000 kVA
RECEPTACLES	0.000 kVA	100% FIRST 10KVA, 50% REMAINDER	0.000 kVA
HEATING/COOLING	0.000 kVA	100%	0.000 kVA
KITCHEN	0.000 kVA	PER NEC TABLE 220.56	0.000 kVA
CONTINUOUS	0.000 kVA	125%	0.000 kVA
NONCONTINUOUS	0.000 kVA	100%	0.000 kVA
NONCOINCIDENTAL	0.000 kVA	0%	0.000 kVA

TOTALS
TOTAL CONNECTED LOAD: 0 VA
TOTAL CALCULATED DEMAND: 0 VA
BALANCED THREE PHASE AMPS: 0 A

0.1

LB-2C - EXISTING

ROOM: Fabrication Lab 202 **VOLTS:** 208Y/120V, 3P 4W **A.I.C.:** 42 kA
MOUNTING: SURFACE **BUS AMPS:** 225 A **MCB:** 225 A MCB
FED FROM: **NEUTRAL:** 100% **LUGS:** STANDARD
NOTE:

CKT #	CKT BKR	# OF POLES	CIRCUIT DESCRIPTION	A		B		C		CIRCUIT DESCRIPTION	# OF POLES	CKT BKR	CKT #
1	20 A	2	RECEPTACLE ROOM 202 SHUNT TRIP	0	0					FLOOR BOXES ROOM 202 SHUNT TRIP	2	20 A	2
3	--	--	--			0	0			--	--	--	4
5	20 A	2	CONNEX 260 SHUNT TRIP					0	0	CORD REELS	1	20 A	6
7	--	--	--	0	0					RECEPTACLE ROOM 206/203	1	20 A	8
9	20 A	2	F370 SHUNT TRIP			0	0			CNC PLASMA SHUNT TRIP	2	20 A	10
11	--	--	--					0	0	--	--	--	12
13	20 A	2	GRINDER ROOM 202 SHUNT TRIP	0	0					RECEPTACLE ROOM 202	1	20 A	14
15	--	--	--			0	0			RECEPTACLE ROOM 206	1	20 A	16
17	20 A	1	OFFICE 201 RECEPTACLE					0	0	RECEPTACLE ROOM 202	1	20 A	18
19	20 A	1	RECEPTACLE ROOM 206	0	0					RECEPTACLE ROOM 206	1	20 A	20
21	20 A	1	RECEPTACLE ROOM 206			0	0			DRILL PRESS ROOM 202 SHUNT TRIP	2	20 A	22
23	20 A	2	LASER PLS6MW SHUNT TRIP					0	0	--	--	--	24
25	--	--	--	0	0					BANDSAW ROOM 202 SHUNT TRIP	2	20 A	26
27	20 A	1	RECEPTACLE ROOM 206			0	0			--	--	--	28
29	20 A	1	RECEPTACLE ROOM 203					0	0	FURNITURE FEED ROOM 203	3	20 A	30
31	20 A	3	FURNITURE FEED ROOM 203	0	0					--	--	--	32
33	--	--	--			0	0			--	--	--	34
35	--	--	--					0	0	FURNITURE FEED ROOM 203	3	20 A	36
37	20 A	3	FURNITURE FEED ROOM 203	0	0					--	--	--	38
39	--	--	--			0	0			--	--	--	40
41	--	--	--					0	0	RECEPTACLE ROOM 203	1	20 A	42
43	20 A	1	SHUNT TRIP POWER - DO NOT TURN OFF	0	0					RECEPTACLE ROOM 206	1	20 A	44
45	20 A	3	METERING			0	180			RECEPT. EAST WALL RM 202	1	20 A	46
47	--	--	--					0	180	RECEPT. EAST WALL RM 202	1	20 A	48
49	--	--	--	0	180					RECEPT. EAST WALL RM 202	1	20 A	50
51	20 A	1	RECEPT. EAST WALL RM 202			180	0			THREE-PHASE RECEPT. RM 202	3	20 A	52
53	20 A	1	RECEPT. SOUTH WALL RM 202					180	0	--	--	--	54
55	20 A	1	RECEPTACLES	180	0					--	--	--	56
57	--	1	SPACE			--	--			SPACE	1	--	58
59	--	1	SPACE					--	--	SPACE	1	--	60
				360 VA		360 VA		360 VA					
				3 A		3 A		3 A					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND	CALCULATED DEMAND
LIGHTING	0.000 kVA	125%	0.000 kVA
MOTORS	0.000 kVA	125% LARGEST + 100% REMAINDER	0.000 kVA
RECEPTACLES	1.080 kVA	100% FIRST 10KVA, 50% REMAINDER	1.080 kVA
HEATING/COOLING	0.000 kVA	100%	0.000 kVA
KITCHEN	0.000 kVA	PER NEC TABLE 220.56	0.000 kVA
CONTINUOUS	0.000 kVA	125%	0.000 kVA
NONCONTINUOUS	0.000 kVA	100%	0.000 kVA
NONCOINCIDENTAL	0.000 kVA	0%	0.000 kVA

TOTALS
TOTAL CONNECTED LOAD: 1,080 VA
TOTAL CALCULATED DEMAND: 1,080 VA
BALANCED THREE PHASE AMPS: 3 A

0.1

Rev	Description	Date	Drn	Ch'd

STAMP

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FOR CONSTRUCTION

Status of drawing

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Drg Title: ELECTRICAL SCHEDULES

Scale:
Drawn By: MH
Checked By: JG
Date: 11/07/24

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