The Procurement Division of Knox County, Tennessee will receive sealed bids for the provision of **HVAC Replacement, Controls and Electrical Upgrades** as specified herein. Bids must be received by **2:00 p.m.** on **February 7, 2024.** Late bids will be neither considered nor returned.

Deliver Bids to:

Bid Number 3515
Knox County Procurement Division
Suite 100, 1000 North Central Street
Knoxville, Tennessee 37917

The Bid Envelope must show the Company Name, Bid Number, Bid Name and Bid Opening Date.

SECTION I GENERAL TERMS AND CONDITIONS

1.1 **ADDITIONAL INFORMATION:** Knox County wants requests for additional information routed to Donnie Fawver, CPPB, Construction & Contract Specialist/Senior Buyer, at 865.215.5756. Questions may be emailed to donnie.fawver@knoxcounty.org. If you have not heard from the Buyer in a reasonable amount of time, please call for further assistance. Information about the Knox County Procurement Division and current solicitations may be obtained on the Internet at www.knoxcounty.org/Procurement.

1.2 **ACCEPTANCE:** Vendors shall hold their price firm and subject to acceptance by Knox County for a period of ninety (90) business days from the date of the bid opening, unless otherwise indicated in their bid.

1.3 **ALTERNATIVE BIDS:** Knox County will not accept alternate bids (those not equal to specifications) unless authorized by the Invitation for Bid.

1.4 **AUDIT HOTLINE:** Knox County has established an Audit Hotline to report potential fraud and waste. To report potential fraud, waste, or abuse, please call 1-866-858-4443 (toll-free). You can also file a report online by accessing http://www.knoxcounty.org/hotline/index.php.

Vendors are hereby cautioned that this Audit Hotline does not replace the Award Protest Procedures found in Section VI, Item M of the Knox County Procurement Regulations.

1.5 **AWARD:** Award will be made to the most responsive, responsible bidder meeting specifications, who presents the product or service that is in the best interest of Knox County. Knox County reserves the right to award this bid on an all-or-none basis. The evaluation criteria are listed herein. Knox County also reserves the right to not make an award.

1.6 **BID DELIVERY:** Knox County requires bidders, when hand delivering bids, to time and date stamp the envelope before depositing it in the bid box. Knox County will not be responsible for any lost or misdirected mail sent by common carrier, nor will Knox County be responsible for submittals delivered to addresses and Suites other than the delivery address and Suite specified at the top of this solicitation.. The time clock in the Procurement Division shall serve as the official record of time. Electronic submissions are recorded electronically.

Responses must be in a sealed envelope/box prior to entering the Procurement Division office. Procurement Division personnel are not allowed to see the submittal nor assist in placing documents in an envelope/box. Additionally, the Procurement Division is not responsible for providing materials (e.g. envelopes, boxes, tape) for submittals.

1.7 **BIDS REQUESTED ON BRANDS OR EQUAL:** Unit price bids are requested on products that equal or exceed the quality and performance of the brands and model numbers listed. References to brand names, trade names, model numbers or other descriptions particular to specific brand products are made to establish a required level of quality and functional capabilities, and are not intended to exclude other products of that level. Comparable products of other manufacturers will be considered if proof of comparability is contained in the bid.

It shall be the responsibility of the bidders, including bidders whose product is referenced, to furnish with the bid such specifications, catalog pages, brochures or other data as will provide an adequate basis for determining the quality and functional capabilities of the product offered. Failure to provide this data may be considered valid justification for rejection of a bid.

1.8 **BUSINESS OUTREACH PROGRAM:** Knox County has established a Business Outreach Program, which has the responsibility of increasing opportunity for small, minority and women owned businesses. This is being accomplished through community education programs, policy edification, active recruitment of interested businesses and process re-engineering.

Knox County is committed to ensuring full and equitable participation for all disadvantaged businesses. Knox County welcomes submittals from those disadvantaged businesses that have an interest in providing goods and/or services listed herein. In addition, Knox County strongly encourages the inclusion of disadvantaged businesses by non-disadvantaged contractors who may wish to partner or subcontract portions of this agreement in order to accomplish the successful delivery of goods and/or services. If you are a disadvantaged business and would like additional information about our Business Outreach Program, please contact:

Diane Woods, CPPB, Business Outreach Administrator
Telephone: 865.215.5760
Fax: 865.215.5778
Email: diane.woods@knoxcounty.org

1.9 **CLOSURES:** During periods of closure due to unforeseen circumstances in Knox County or closures at the direction of the Knox County Mayor, the Procurement Division will enact the following procedures in regards to solicitations and closures:

- If the Mayor closes the Administrative offices prior to the time set for solicitation opening of any business day, all solicitations due that same day will be moved to the next operational business day.
- Other unforseen circumstances shall be at the sole discretion of the Procurement Director.
- Knox County shall not be liable for any commercial carrier's decision regarding deliveries during any unforeseen circumstances.

1.10 **CONFLICT OF INTEREST:** Vendors must have read and complied with the "non-conflict of interest" statement provided in the vendor registration process prior to the opening of this solicitation.

1.11 **DECLARATIVE STATEMENTS:** Any statement or words (e.g.: must, shall, will) are declarative statements and the vendor must comply with the condition. Failure to comply with any such condition may result in the bid being non-responsive and disqualified.

1.12 **DRUG-FREE WORKPLACE:** If **Contractor** has five (5) or more employees receiving pay: **Contractor** shall have a drug-free workplace program that complies with Title 50, Chapter 9 of the Code of Tennessee, shall obtain a certificate of compliance with the applicable portions of the Drug-Free Workplace Act from the Department of Labor and Workforce, and shall Provide the Affidavit required by Public Acts, 2000, Chapter 918. **Contractor** shall ensure that it is in compliance with Public Acts, 2000, Chapter No. 918.

1.13 **DUPLICATE COPIES:** Knox County requires that bids be submitted as one (1) marked original and one (1) exact copy.

1.14 **ELECTRONIC TRANSMISSION OF BIDS:** Knox County's Procurement Division will **not** accept electronically transmitted bids for this solicitation. Emails and Facsimile submission is strictly prohibited.

1.15 **HOW TO DO BUSINESS:** Knox County utilizes a web-based Procurement software system, "KNOXBUYS." The system provides our clients (vendors, county departments and the citizens of Knox County) with a more enhanced and end-user friendly means of accessing our services. The system allows for on-line vendor registration and maintenance, electronic receipt of purchase orders, on-line retrieval and submittal of quotes, bids and proposals for our vendor-clients and on-line requisitioning and receiving for our county departments. In order for the County to maximize its investment and minimize the cost associated with office operations we need your help. When doing business with Knox County we are urging you to please go to our website at www.knoxcounty.org/Procurement, register as a vendor in our on-line Procurement system, "KNOXBUYS" if you have not done so and whenever possible to conduct your business with the County through this site. If you have any questions please contact the Procurement Division Representative listed in Section 1.1 of this document.

1.16 **INCURRED COSTS:** Knox County will not be responsible for any costs incurred by the bidder in the preparation of their bid.

1.17 **MULTIPLE BIDS:** Knox County will consider multiple bids that meet specifications.

1.18 **NEW MATERIAL:** Unless specified otherwise in the bid package, the Contractor must provide new supplies. New, as used in this clause, means previously unused materials. Material includes but is not limited to, raw material, parts, items, components and end products. Contractor submission of other than new materials may be cause for the rejection of their bid.

1.19 **NON-COLLUSION:** Vendors, by submitting a signed bid or proposal, certify that the accompanying bid or proposal is not the result of, or affected by, any unlawful act of collusion with any other person or company engaged in the same line of business or commerce, or any other fraudulent act punishable under Tennessee or United States law.

1.20 **PAYMENT METHOD:** Knox County utilizes two (2) methods of placing orders for products. The first is the use of Purchase Orders. These Purchase Orders will be issued from Knox County Procurement Division via email. The Purchase Order will detail the quantity, specific item(s) and the contracted price for each item.

The second method is the use of the Knox County E-Commerce Card (VISA). Orders placed with the credit card will list the same information as the Purchase Order. Vendors will be given the card information and approval to process the transactions by the requesting department. Vendors must indicate in their bid response if the vendor will accept the Knox County E-Commerce Card (VISA) as a form of payment. Bidders are prohibited to charge Knox County any type of merchant fee from their financial institution to accept this type of payment.

1.21 **POSSESSION OF WEAPONS:** All vendors and their employees and their agents are prohibited from possessing any weapons on Knox County property without prior written consent from the County. In the case of a vendor whose contract requires possession of firearms or other weapons to successfully complete their contract, vendor must provide personnel who are bonded to bear said weaponry.

1.22 **PROCESSING TIME FOR PAYMENT:** Vendors are advised that a minimum of thirty (30) days is required to process invoices for payment.

1.23 **PROOF OF FINANCIAL AND BUSINESS CAPABILITY:** Bidders must, upon request, furnish satisfactory evidence of their ability to furnish products or services in accordance with the terms and conditions of these specifications. Knox County will make the final determination as to the bidder's ability.

1.24 **RECYCLING:** Knox County, in its continuing efforts to lessen the amount of landfill waste and to further recycling efforts, requests that bids being submitted on paper shall:

- Be submitted on recycled paper
- Not include pages of unnecessary advertising
- Be made on both sides of each sheet of paper

1.25 **RESTRICTIVE OR AMBIGUOUS SPECIFICATIONS:** It is the responsibility of the prospective bidder to review the entire Invitation for Bid packet and to notify the Procurement Division if the specifications are formulated in a manner that would unnecessarily restrict competition. Any such protest or question regarding the specifications or bidding procedures must be received in the Procurement Division by **January 25, 2024 at 4:30 p.m. local time**. These requirements also apply to specifications that are ambiguous.

1.26 **SIGNING OF BIDS:** **In order to be considered all bids must be signed. Please sign the original in blue ink.** By signing the bid document, the vendor acknowledges and accepts the term and conditions stated in the bid document.

1.27 **TAXES:** Knox County purchases are not subject to taxation. Tax exemption certificates will be provided upon request.

1.28 **TITLE VI OF THE 1964 CIVIL RIGHTS ACT:** "Nondiscrimination in Federally Assisted Programs"—"No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." 42 U.S.C. Section 2000 et seq. It is the policy of Knox County Government that all its services and activities be administered in conformance with the requirements of Title VI.

1.29 **USE OF BID FORMS:** Vendors must complete the bid forms contained in the bid package. Failure to complete the bid forms may result in bid rejection.

1.30 **VENDOR DEFAULT:** Knox County reserves the right, in case of vendor default, to procure the articles or services from other sources and hold the defaulting vendor responsible for any excess costs occasioned thereby. Should vendor default be due to a failure to perform or because of a request for a price increase, Knox County reserves the right to remove the vendor from the County's bidders list for twenty-four (24) months.

1.31 **VENDOR REGISTRATION:** Prior to the opening of this bid, ***ALL BIDDERS*** must be registered with the Procurement Division. A vendor application may be submitted online at www.knoxcounty.org/Procurement. Select the On-Line Vendor Registration link and complete the forms. Vendors must be registered with the Procurement Division prior to submitting their bid.

1.32 **WAIVING OF INFORMALITIES:** Knox County reserves the right to waive minor informalities or technicalities when it is in the best interest of Knox County.

SECTION II OBLIGATIONS, RIGHTS AND REMEDIES

These terms and conditions shall be part of the Contract. Knox County reserves the right to negotiate other terms and conditions it deems appropriate and necessary under the circumstances to protect the public's trust.

2.1 **ALTERATIONS OR AMENDMENTS:** No alterations, amendments, changes, modifications or additions to this Contract shall be binding on Knox County without the prior written approval of the County.

2.2 **ASSIGNMENT:** Contractor shall not assign or sub-contract this agreement, its obligations or rights hereunder to any party, company, partnership, incorporation or person without the prior written specific consent of Knox County.

2.3 **APPROPRIATION:** In the event no funds are appropriated by Knox County for the goods or services in any fiscal year or insufficient funds exist to purchase the goods or services, then the Contract shall expire upon the expenditure of previously appropriated funds or the end of the current fiscal year, whichever occurs first, with no further obligations owed to or by either party.

2.4 **BOOKS AND RECORDS:** Contractor shall maintain all books, documents, accounting records and other evidence pertaining to the goods and services provided under this Contract and make such materials available at its offices at all reasonable times during the contract period and for three (3) years from the date of the final payment under this agreement for inspection by County or by any other governmental entity or agency participating in the funding of this agreement, or any authorized agents thereof; copies of said records to be furnished if requested. Such records shall include those books, documents and accounting records that represent the Contractor's costs of manufacturing, acquiring or delivering the products and services governed by this agreement.

2.5 **CHILD LABOR:** Contractor agrees that no products or services will be provided or performed under this Contract that have been manufactured or assembled by child labor.

2.6 **COMPLIANCE WITH ALL LAWS:** Contractor is assumed to be familiar with and agrees to observe and comply with all federal, state, and local laws, statutes, ordinances, and regulations in any manner affecting the provision of goods and/or services, and all instructions and prohibitive orders issued regarding this work and shall obtain all necessary permits.

2.7 **DEFAULT:** If Contractor fails to perform or comply with any provision of this Contract or the terms or conditions of any documents referenced and made a part hereof, Knox County may terminate this Contract, in whole or in part, and may consider such failure or noncompliance a breach of contract. Knox County expressly retains all its rights and remedies provided by law in case of such breach, and no action by Knox County shall constitute a waiver of any such rights or remedies. In the event of termination for default, Knox County reserves the right to purchase its requirements elsewhere, with or without competitive bidding.

2.8 **GOVERNING LAW; VENUE:** This agreement shall be exclusively construed, governed, and controlled by the Laws of the State of Tennessee without regard to principles of law, including conflicts of law, of any other jurisdiction, territory, country, and/or province. Any dispute arising out of or relating to this agreement shall exclusively be brought in the Chancery Court or the Circuit Court of Knox County, Tennessee. Each party consents to personal jurisdiction thereto and waives any defenses based on personal jurisdiction, venue and inconvenient forum.

2.9 **INCORPORATION:** All specifications, drawings, technical information, Invitation for Bid, Bid, Award and similar items referred to or attached or which are the basis for this Contract are deemed incorporated by reference as if set out fully herein.

2.10 **INDEMNIFICATION/HOLD HARMLESS:** Contractor shall indemnify, defend, save and hold harmless Knox County, its officers, agents and employees from all suits, claims, actions or damages of any nature brought because of, arising out of, or due to breach of the agreement by Contractor, its subcontractors, suppliers, agents, or employees or due to any negligent act or occurrence or any omission or commission of Contractor, its subcontractors, suppliers, agents or employees.

2.11 **INDEPENDENT CONTRACTOR:** Contractor shall acknowledge that it and its employees serve as independent contractors and that Knox County shall not be responsible for any payment, insurance or incurred liability.

2.12 **INSPECTION AND ACCEPTANCE:** Warranty periods shall not commence until Knox County inspects and formally accepts the goods and/or services. The terms, conditions and timing of acceptance shall be determined by Knox County. Knox County reserves the right to reject any or all items or services not in conformance with applicable specifications, and Contractor assumes the costs associated with such nonconformance. Acceptance of goods or services does not constitute a waiver of latent or hidden defects or defects not readily detectable by a reasonable person under the circumstances.

2.13 **IRAN DIVESTMENT ACT:** By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each bidder is not on the list created pursuant to Tennessee Code Annotated § 12-12-106.

2.14 **LIMITATIONS OF LIABILITY:** In no event shall Knox County be liable for any indirect, incidental, consequential, special or exemplary damages or lost profits, even if Knox County has been advised of the possibility of such damages.

2.15 **NO BOYCOTT OF ISREAL:** Pursuant to Tennessee Code Annotated Title 12, Chapter 4, Part 1, by submission of a response to this solicitation, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint response each party thereto as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each person is not currently engaged in, and will not for the duration of the contract engage in, a boycott of Israel.

2.16 **NON-DISCRIMINATION AND NON-CONFLICT STATEMENT:** Contractor agrees that no person on the grounds of handicap, age, race, color, religion, sex, national origin, or any individual trait or characteristic found to be an illegal consideration, shall be excluded from participation in, or be denied benefits of, or be otherwise subjected to discrimination in the performance of this agreement, or in the employment practices of vendor. Contractor shall upon request show proof of such non-discrimination, and shall post in conspicuous places available to all employees and applicants notices of non-discrimination. Contractor covenants that it complies with the Fair Wage and Hour Laws, the National Labor Relations Act, and other federal and state employment laws as applicable. Contractor covenants that it does not engage in any illegal employment practices.

Contractor covenants that it has no public or private interest, and shall not acquire directly or indirectly any interest, which would conflict in any manner with the provision of its goods or performance of its services. Contractor warrants that no part of the total contract amount provided herein shall be paid directly or indirectly to any officer or employee of Knox County as wages, compensation, or gifts in exchange for acting as officer, agent, employee, subcontractor or consultant to Contractor in connection with any goods provided or work contemplated or performed relative to the agreement.

2.17 **ORDER OF PRECEDENCE:** In the event of inconsistent or conflicting provision of this Contract and referenced documents, the following descending order of precedence shall prevail: (1) Written Contract, (2) Invitation for Bid, (3) Bid, (4) Award, (5) Special Terms and Conditions, (6) General Terms and Conditions, (7) Specifications, (8) Drawings.

2.18 **REMEDIES:** Knox County shall have all rights and remedies afforded under the U.C.C. and Tennessee law in contract and in tort, including but not limited to rejection of goods, rescission, right of offset, refund, incidental, consequential and compensatory damages and reasonable attorney's fees.

2.19 **RIGHT TO INSPECT:** Knox County reserves the right to make periodic inspections of the manner and means the service is performed or the goods are supplied.

2.20 **SEVERABILITY:** If any provision of this Contract is declared illegal, void or unenforceable, the remaining provisions shall not be affected but shall remain in force and in effect.

2.21 **TAX COMPLIANCE:** Pursuant to Resolution R-07-1-903 passed by the Commission of Knox County, Tennessee, Contractor hereby acknowledges by submission of its bid or proposal and signature that it is current in its respective Federal, State, County and City taxes of whatever kind or nature and is not delinquent in any way. Delinquent status must be disclosed or risk debarment by the Knox County Procurement Division.

2.22 **TERMINATION:** County may terminate this agreement with or without cause at any time. In the event of termination by either party, fees due for services satisfactorily performed or goods accepted prior to the termination date shall be paid.

2.23 **WARRANTY:** Contractor warrants to Knox County that all items delivered and all services rendered shall conform to the specifications, drawings, bid and/or other descriptions furnished and/or incorporated by reference, and will be fit for the particular purpose purchased, of merchantable quality, good workmanship, and free from defects. Contractor extends to Knox County all warranties allowed under the U.C.C. Contractor shall provide copies of warranties to the County. Return of merchandise not meeting warranties shall be at contractor's expense.

SECTION III SPECIAL TERMS AND CONDITIONS

3.1 **INTENT:** The intent of these specifications is to obtain HVAC Replacement, Controls and Electrical Upgrades for Cedar Bluff Middle School for the contract period as desired by Knox County and Knox County Schools (KCS). For the purpose of this bid document "KCS" shall be used to refer to any and all departments. The award of this Contract will be based on a Best Value procurement. Best Value means more than low cost. It includes the initial cost, service quality, and other factors detailed herein.

3.2 **ACCEPTANCE:** Contractors are advised that neither the signing of delivery receipts nor the payment of an invoice necessarily constitutes acceptance of product installations. Acceptance requires a specific written action by Knox County or KCS so stating.

3.3 **BID ENVELOPE COVER:** The bid envelope cover sheet must be filled out completely and attached to the outside of your bid. **Failure to do so will result in the rejection of your bid.**

3.4 **BID EVALUATION:** In evaluating the bids, Knox County reserves the right to use any or all of the ideas from the bids submitted without limitation and to accept any part or the entire successful bid in selecting an operation which is judged to be in the best interest of Knox County. All material submitted becomes the property of Knox County.

3.5 **CHANGES AFTER AWARD:** It is possible that after award, Knox County might change its needs or requirements. Knox County reserves the right to make such changes after consultation with the vendor. Should additional costs arise, Knox County reserves the right to consider accepting these charges provided the vendor can document the increased costs. Knox County also reserves the right to accept proposed service changes from the vendor if they will lower the cost to Knox County and/or provide improved service.

3.6 **COMMUNICATIONS WITH THE CONTRACTOR:** Upon award, KCS will communicate extensively and continually with the Contractor. While information may occasionally be transmitted via telephone, it should always be followed up with a fax or email confirmation. Due to the volume of information that must be transmitted, it is essential that the Contractor have an efficient and properly functioning fax machine. Ideally, the Contractor will have email capabilities.

3.7 **COMPLIANCE WITH ALL APPLICABLE REGULATIONS:** Contractor agrees and covenants that the company, its agents and employees will comply with all City, County, State, and Federal codes, laws, rules, and regulations.

3.8 **CONTACT PERSONNEL:** It shall be essential to the success of this contract to develop a good working relationship with the successful bidder(s). It is imperative that the Knox County account be handled efficiently and professionally. Knox County should be assigned no more than two (2) vendor contacts to handle billing inquiries and service related issues. In the event one (1) or both contacts leave the Knox County account, the successful bidder shall formally introduce the new contacts to Knox County personnel. These contacts must be knowledgeable of Knox County so as to avoid any interruption of service.

3.9 **CONTRACT EXECUTION:** The award of this bid may result in a Contract between the County and the successful bidder(s). Knox County will draft this contract and no vendor forms (e.g.: Terms and Conditions, Service Agreements, or other standard Company forms) will be accepted as Contract attachments.

3.10 **COST FOR BONDS:** KCS will reimburse the vendor for the actual cost of any required performance and payment bonds. Vendor is to provide a price for the bond with the bid submission. However, vendor will not be required to obtain bond until the first project is assigned to the vendor.

3.11 **CRIMINAL HISTORY CHECK:** Any and all contractors, sub-contractors, successful vendors, vendor employees and school employees agree to comply with Tennessee Code Annotated Section 49-5-413. Tennessee Code Annotated Section 49-5-413 requires that all parties providing services at Knox County Schools must submit to a criminal history records check at their expense. The criminal history check is to be conducted by the Tennessee Bureau of Investigation and the Federal Bureau of Investigation prior to permitting the party to have contact with students or enter school grounds when students are present.

3.12 **DESTINATION AND DELIVERY:** Vendors are to include all destination and delivery charges in their price. **There will be no extra hidden charges.**

3.13 **ENTRANCE TO KNOX COUNTY SCHOOLS SITE:** Only authorized employees of the successful Contractor(s) Allowed on the premises of the KCS building. Contractor(s) employees are not to be accompanied in the work area by any acquaintances, family members, assistants or any person unless said person is an authorized employee of the Contactor(s). All employees must wear a company uniform, or a name badge identified with the company name at all times. Contractor and/or employees of contractor must contact KCSMO's Environmental Department prior to a site for work.

3.14 **EVALUATION CRITERIA:** The following criteria will be the basis for award:

Price	**100 Points**

3.15 **EVALUATION REVIEW:** Knox County reserves the right to use all pertinent information that might affect the County's judgment as to the appropriateness of an award to the best evaluated bidder(s). This information may be appended to the bid evaluation process results. Information on a service provider from reliable sources, and not within the service provider's bid, may also be noted and made part of the evaluation file.

Knox County shall have sole responsibility for determining a reliable source. Knox County reserves the right to conduct written and/or oral discussions/interviews after the bid opening. The purpose of such discussions/interviews is to provide clarification and/or additional information to make an award that is in the best interest of Knox County.

3.16 **INVOICING:** All invoices shall be mailed in duplicate to Knox County Schools Maintenance Operations. All invoices must be uniquely numbered and show the purchase order number or contract number. Without this information, the invoice may be rejected for payment.

3.17 **INSURANCE:** The successful Contractor(s) must carry the insurance as indicated on the Insurance Attachment hereto. As proof of the Contractor's willingness to obtain and maintain the insurance, the Contractor must complete, sign and have its insurance agent sign the attachment and submit it with the bid response. Upon the Notification of Intent to Award, the successful Contractor(s) will be required to submit a Certificate of Insurance (COI) with the appropriate coverage and listing Knoxville/Knox County KCS as additional insured. It shall be the successful Contractor's responsibility to keep a current COI on file with Knox County Procurement at all times.

3.18 **LICENSING:** All Contractors must be properly licensed by the State of Tennessee and all other authorities having jurisdiction. ***COPIES OF ALL SUCH LICENSES AND/OR PERMITS ARE TO BE SUBMITTED WITH THE BID. FAILURE TO SUBMIT COPIES OF SUCH MAY LEAD TO BID REJECTION.***

3.19 **MATERIAL/LABOR QUALITY:** Unless otherwise specified, all materials must be of commercial grade or better.

3.20 **MINIMUM STATE GENERAL CONTRACTORS LICENSE AMOUNT:** Vendors must have a minimum of $25,000 licensing capability as described by the State of Tennessee.

3.21 **NEWS RELEASES BY VENDORS:** As a matter of policy, Knox County does not endorse the services of a Contractor. A Contractor will not make news releases concerning any resultant Contract from this solicitation without the prior written approval of Knox County.

3.22 **NO CONTACT POLICY:** After the date and time that the vendor receives this solicitation, any contact initiated by any bidder with any Knox County representative, other than the Procurement Division representative listed in Section 1.1, concerning this Invitation for Bid **is strictly prohibited**. Any such unauthorized contact may cause the disqualification of the bidder from this procurement transaction. Vendors may be required to sign an affidavit to this policy.

3.23 **OPEN RECORDS ACT:** Knox County is subject to the Tennessee Open Records Act 10-7-503 et seq. Bidders are cautioned that all documents submitted on behalf of this Invitation for Bid shall be open to the public for viewing and inspection and Knox County **will** comply with all legitimate requests. Submission of your bid will be an acknowledgement to this provision.

3.24 **PERFORMANCE AND PAYMENT BONDS:** The successful contractor(s) will be required to submit a Performance Bond and a Payment Bond (each equal to 100% of the job cost) when any one project exceeds $100,000 in value. Knox County reserves the right to require a Performance Bond and a Payment Bond on any project regardless of the value of the project. The bonds will be returned upon the successful and satisfactory completion of the project.

3.25 **PRE-BID CONFERENCE:** There will be a pre-bid conference held on January 24, 2024 beginning promptly at 1:00 pm local time. Location is Cedar Bluff Middle School at 707 North Cedar Bluff Road, Knoxville, TN 37923. Enter main entrance of school. Though not mandatory, all interested parties are encouraged to attend and tour the facility.

Vendors are hereby cautioned that no weapons of any kind are allowed in this building. Searches may be conducted on anyone entering these facilities.

3.26 **PERMITS:** The bidders are responsible for obtaining any and all required permits at no cost to Knox County or Knox County Schools.

3.27 **REMOVAL OF CONTRACTOR'S EMPLOYEES:** The successful Contractor(s) agrees to utilize only experienced, responsible and capable people in the performance of the work. Knox County or Knox County Schools may require that the successful Contractor(s) remove from the job covered by this contract, employees who endanger persons or property or whose continued employment under this contract is inconsistent with the interest of Knox County or Knox County Schools.

3.28 **SAFETY AND PROTECTION:** The Contractor(s) shall be solely and completely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work. Furthermore, the Contractor is solely responsible for the training of all their employees on all safety issues as required by OSHA regulations for the project.

The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent injury to, all employees on the work site and other persons including but not limited to, the general public who may be affected thereby.

Contractor shall be required to furnish their employees with the proper personal protective clothing and equipment. Contractor shall also be required to dispose of this clothing and equipment in compliance with all regulatory requirements. All work is to be done as required by OSHA, EPA and AHERA.

The Contractor shall be responsible for providing in accordance with placement of barricades, tarps, plastic, flag tape and other safety/traffic control equipment required to protect the public, surrounding areas, equipment and vehicles. The flow of vehicular traffic shall not be impeded at any time during the project. The safety of the public is of the upmost importance to KCS and all costs associated are the responsibility of the contractor.

Knox County and KCS does not assume any responsibility for the protection of or for loss of materials, from the time that the contract operations have commenced until the final acceptance of the work by the project manager. The contractor is responsible for training their employees in Safety and Health Regulations for the job, assuring compliance with Tennessee Occupational Safety and Health Regulations and any other Regulatory Agency.

3.29 **SCHEDULING OF WORK:** Contractor(s) shall cooperate with KCS in performing work so that interference with normal programing will be held to a minimum.

3.30 **SIGN-IN:** Contractor(s) must sign the Contractor Check-In Log at each school site where work is to be performed. Failure to sign-in will negate Knox County Schools responsibility to pay the resulting invoice.

3.31 **SUBMIT QUESTIONS:** Bidders may submit questions concerning this solicitation no later than **January 25, 2024 4:30 p.m. local time**. Submit questions as stated in Section 1.1.

3.32 **SUB-CONTRACTORS:** Contractors are strongly encouraged to solicit minority owned and operated sub-contractors for this bid and during the duration of the award.

3.33 **WORKMANSHIP:** Where not more specifically described in any of the various sections of these specifications workmanship shall conform to all of the methods and operations of best standards and accepted practices of the trade or trades involved, and shall include all items of fabrication, construction or installation regularly furnished or required for completion of the services. All work shall be executed by personnel skilled in their respective lines of work.

SECTION IV SCOPE OF WORK

4.1 **INTENT:** The Knox County Schools Maintenance Operations (KCSMO) intends to upgrade HVAC Replacement, Controls and Electrical Upgrades at Cedar Bluff Middle School. This upgrade will be done with strict oversight from KCSMO personnel and will require extensive communication between the parties involved.

4.1.1 Remove all existing HVAC equipment currently connected to the hydronic circulating loop piping served by the existing boilers and chiller/cooling tower. Piping to be removed as HVAC is replaced. Chiller, boilers and pumps to be abandoned in place.
4.1.2 New DX HVAC equipment to be installed in place of the hydronic system.
4.1.3 Building shall be provided with all new controls and Building Automation System.
4.1.4 Electrical work is in support of new HVAC equipment and must be completed prior to the HVAC installation.

4.2 **TURN KEY SOLUTION:** Knox County and KCSMO prefer the Contractor to have the ability to provide a turnkey solution for the equipment and services as described in this solicitation. Any sub-contracted work or service **must** be pre-approved in writing by Knox County Government.

4.3 **USER TRAINING:** The successful Contractor shall be required to provide on-site training to KCSO personnel at no additional cost. This training shall include, but not be limited to, the proper use of the equipment, proper upkeep of the equipment, troubleshooting and repair if needed. The training shall continue until a level of competency is achieved, as determined by KCSO, for individuals charged with operating, supporting and maintaining the equipment.

4.4 **OVERVIEW OF ATTACHMENETS:** To aid firms in their bid response, the following items are attached:

Attachment A: Certificate of Experience

Attachment B: Insurance Checklist

Attachment C: Drug Free Workplace Certification

Attachment D: Criminal History Affidavit

Attachment E: Bid Envelope Cover Sheet

Attachment F: Exhibit A Project Specifications

Attachment G: Drawings

BIDDERS NEED NOT RETURN PAGES ONE (1) THROUGH NINE (9) WITH THEIR BID.

SECTION V VENDOR INFORMATION FOR BID 3515, HVAC REPLACEMENT, CONTROLS AND ELECTRICAL UPGRADES

5.1 Vendor Name_____

5.2 Knox County Vendor Number _____

5.3 Vendor address_____

City _____ State _____ Zip _____

5.4 Telephone number _____Fax number_____

E-mail address _____

5.5 Contact person_____

5.6 By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each bidder is not on the list created pursuant to Tennessee Code Annotated § 12-12-106.

Pursuant to Tennessee Code Annotated Title 12, Chapter 4, Part 1, by submission of a response to this solicitation, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint response each party thereto as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each person is not currently engaged in, and will not for the duration of the contract engage in, a boycott of Israel.

Authorizing signature_____
(Please sign original in blue ink)

5.7 Vendor's Knox County Business License Number_____
(if applicable) Attach a copy with bid

5.8 I acknowledge receipt of: (Please write yes if you received one)

Addendum 1_____ Addendum 2_____ Addendum 3_____ Addendum 4_____

5.9 Do you accept the Terms and Conditions of the bid? Yes _____ No _____

With Exceptions_____

_____
(You must state any exception taken)

5.10 Will your company accept an Electronic Commerce (VISA) Card as a method of payment? (See Section 1.20)

YES: _____ NO: _____

5.11 Is your company in full compliance with Section 2.21 Tax Compliance? YES: _____ NO: _____

5.12 Did you attach a copy of your Contractor's License as detailed in Section 3.18? YES:_____ NO:_____

5.13 Did you complete "Attachment A" Certificate of Experience? YES:_____ NO:_____

5.14 Did you complete "Attachment B" Insurance Checklist? YES:_____ NO:_____

5.15 Did you complete "Attachment C" Drug-Free Workplace Affidavit? YES:_____ NO:_____

5.16 Did you include the Criminal History Affidavit as detailed in Section 3.11? YES:_____ NO:_____

SECTION VI VENDOR PRICING FOR BID 3515, HVAC REPLACEMENT, CONTROLS AND ELECTRICAL UPGRADES

VENDOR NAME: _____

Pursuant to and in compliance with the Invitation to Bid and other documents relating thereto, the undersigned hereby proposes to furnish all labor and materials and perform all work complete for Abatement and Demolition Services for Rule High School as required by and in strict conformance with the Contract Documents consisting of the Invitation to Bid and all Addenda.

In submitting this bid the Bidders acknowledge that they have received, read, and understand the bid documents, have visited the site and become familiar with conditions under which work will be performed, have correlated observations with requirements of Bid Documents, and make this bid in accordance therewith.

In submitting the Bid the Bidder agrees to:

1. **Enter into and execute a contract if presented on the basis of this bid and furnish certificate(s) of insurance, bonds and other documents related to the contract as required by the Bidding Documents.**
2. **Accomplish work in accordance with the Contract Documents.**
3. **Perform additional work by Change Order under the terms of the contract using the actual cost of the work plus ten percent (10%) for overhead and five percent (5%) for profit.**

Complete the Work of the Base Bid for The Project for the Lump Sum of:

BASE BID:

_____ **and** _____ **/100ths Dollars**

(Amount shown in both words and figures)

$ _____

Time required to achieve Final Completion for Base Bid: _____ **calendar days from Notice To Proceed**

_____ _____

Signature **Date**

Contractor's License Number:_____ **Dollar Limit:**_____

EXPIRATION DATE: ____/____/_____
MM / DD / YYYY

ATTACHMENT A
CERTIFICATE OF EXPERIENCE
IFB 3515

I ______________________________ hereby certify that (company) ____________________________

has performed the following services within the last three (3) years. Do not list Knox County as reference or experience.

NAME OF BUSINESS THAT WAS SERVICED: ______________________________________ ____________________
CONTACT NAME: ____

ADDRESS: ____ EMAIL: ____

AMOUNT OF CONTRACT: $_________________ PHONE: ____________________ FAX: __________________

TYPE OF WORK:

NAME OF BUSINESS THAT WAS SERVICED: ______________________________________ ____________________
CONTACT NAME: ____

ADDRESS: ____ EMAIL: ____

AMOUNT OF CONTRACT: $_________________ PHONE: ____________________ FAX: __________________

TYPE OF WORK:

NAME OF BUSINESS THAT WAS SERVICED: ______________________________________ ____________________
CONTACT NAME: ____

ADDRESS: ____ EMAIL: ____

AMOUNT OF CONTRACT: $_________________ PHONE: ____________________ FAX: __________________

TYPE OF WORK:

TYPE OF WORK:

ATTACHMENT B
KNOX COUNTY PROCUREMENT DIVISION
INSURANCE CHECKLIST
BID NUMBER 3515

The certificate of insurance must show all coverages & endorsements with "yes" and items 20 to 23.

REQUIRED:	NUMBER	TYPE OF COVERAGE	COVERAGE LIMITS	
YES	1.	**WORKERS COMPENSATION**	STATUTORY LIMITS OF TENNESSEE	
YES	2.	**EMPLOYERS LIABILITY**	$100,000 PER ACCIDENT $100,000 PER DISEASE $500,000 DISEASE POLICY LIMIT	
YES	3.	**AUTOMOBILE LIABILITY** ANY AUTO-SYMBOL (1) X	COMBINE SINGLE LIMIT (Per -Accident)	$1,000,000
			BODY INJURY (Per –Person)	
			BODY INJURY (Per-Accident)	
			PROPERTY DAMAGE (Per-Accident	
YES	4.	**COMMERCIAL GENERAL LIABILITY**		LIMITS
		CLAIM MADE X **OCCUR**	**EACH OCCURRENCE**	$ 1,000,000
			FIRE LEGAL LIABILITY	$ 100,000
			MED EXP (Per person)	$ 5,000
		GEN'L AGGREGATE LIMITS APPLIES PER	**PERSONAL & ADV INJURY**	$ 1,000,000
		POLICY X **PROJECT** **LOC**	**GENERAL AGGREGATE**	$ 2,000,000
			PRODUCTS-COMPLETED OPERATIONS/AGGREGATE	$ 2,000,000
YES	5.	**PREMISES/OPERATIONS**	$1,000,000 CSL BI/PD EACH OCCURRENCE $2,000,000 ANNUAL AGGREGATE	
YES	6.	**INDEPENDENT CONTRACTOR**	$1,000,000 CSL BI/PD EACH OCCURRENCE $1,000,000 ANNUAL AGGREGATE	
YES	7.	**CONTRACTUAL LIABILITY** (MUST BE SHOWN ON CERTIFICATE)	$1,000,000 CSL BI/PD EACH OCCURRENCE $1,000,000 ANNUAL AGGREGATE	
YES	8.	**XCU COVERAGE**	NOT TO BE EXCLUDED	
YES	9.	**UMBRELLA LIABILITY COVERAGE**	$ 1,000,000	
		PROFESSIONAL LIABILITY		
NO	10.	**ARCHITECTS &ENGINEERS**	$1,000,000 PER OCCURRENCE/CLAIM	
NO		**ASBESTOS & REMOVAL LIABILITY**	$2,000,000 PER OCCURRENCE/CLAIM	
NO		**MEDICAL MALPRACTICE**	$1,000,000 PER OCCURRENCE/CLAIM	
NO		**MEDICAL PROFESSIONAL LIABILITY**	$1,000,000 PER OCCURRENCE/CLAIM	
NO	11.	**MISCELLANEOUS E & O**	$500,000 PER OCCURRENCE/CLAIM	
NO	12.	**MOTOR CARRIER ACT ENDORSEMENT**	$1,000,000 BI/PD EACH OCCURRENCE UNINSURED MOTORIST (MCS-90)	
NO	13.	**MOTOR CARGO INSURANCE**		
NO	14.	**GARAGE LIABILITY**	$1,000,000 BODILY INJURY, PROPERTY DAMAGE PER OCCURRENCE	
NO	15.	**GARAGEKEEPER'S LIABILITY**	$500,000 COMPREHENSIVE $500,000 COLLISION	
NO	16.	**INLAND MARINE BAILEE'S INSURANCE**	$	
NO	17.	**DISHONESTY BOND**	$	
NO	18.	**BUILDERS RISK**	PROVIDE COVERAGE IN THE FULL AMOUNT OF THE CONTRACT UNLESS PROVIDED BY OWNER.	
NO	19.	**USL&H**	FEDERAL STATUTORY LIMITS	

20. CARRIER RATING SHALL BE BEST'S RATING OF A-VII OR BETTER OR ITS EQUIVALENT.

21. THE COUNTY SHALL BE NAMED AS AN ADDITIONAL INSURED ON ALL POLICIES EXCEPT WORKERS' COMPENSATION AND AUTO.

22. CERTIFICATE OF INSURANCE SHALL SHOW THE BID NUMBER AND TITLE.

23. OTHER INSURANCE REQUIRED _____.

INSURANCE AGENT'S STATEMENT AND CERTIFICATION: I HAVE REVIEWED THE ABOVE REQUIREMENTS WITH THE CONTRACTORS NAMED BELOW HAVE ADVISED THE CONTRACTORS OF REQUIRED COVERAGE.

AGENCY NAME: _____ AUTHORIZING SIGNATURE: _____

CONTRACTORS'S STATEMENT AND CERTIFICATION: IF AWARDED THE CONTRACT, I WILL COMPLY WITH THE CONTRACT INSURANCE REQUIREMENTS.

CONTRACTORS NAME: _____AUTHORIZING SIGNATURE: _____

ATTACHMENT C

IFB 3515

AFFIDAVIT OF COMPLIANCE

WITH

DRUG-FREE WORKPLACE REQUIREMENTS OF

TENNESSEE CODE ANNOTATED, § 50-9-113

(To be submitted with bid by contractor with 5 or more employees)

I, _____, President or other Principal

Officer of _____, swear or affirm that the
Name of Company

Company has a drug-free workplace program that complies with Title 50, Chapter 9, Tennessee Code Annotated, in effect at the time of this bid submission at least to the extent required of governmental entities. I further swear or affirm that the company is in compliance with Tennessee Code Annotated, § 50-9-113.

_____
President or Principal Officer

For: _____
Name of Company

STATE OF TENNESSEE }
COUNTY OF }

Subscribed and sworn before me by

_____,
President or Principal Officer of

_____,

On this _____ day of _____ 2_____.

_____
Notary Public

My Commission expires: _____

ATTACHMENT D
KNOX COUNTY PROCUREMENT DIVISION
AFFIDAVIT OF COMPLIANCE WITH TENNESSEE CRIMINAL HISTORY RECORDS CHECK
INVITATION FOR BID NUMBER 3515

AFFIDAVIT OF COMPLIANCE

WITH

TENNESSEE CRIMINAL HISTORY RECORDS CHECK

TENNESSEE CODE ANNOTATED, SECTION 49-5-413

(To be submitted with bid by contractor)

I, _____, president or other principal

Officer of _____, swear or affirm that the
Name of Company

Company is in compliance with Public Chapter 587 of 2007, codified at Tennessee Code Annotated 49-5-413, in effect at the time of this bid submission at least to the extent required of governmental entities. I further swear or affirm that the company is in compliance with Tennessee Code Annotated, § 49-5-413.

_____
President or Principal Officer

For: _____
Name of Company

STATE OF TENNESSEE}
COUNTY OF }

Subscribed and sworn before me by _____,

President or principal officer of _____,

On this _____ day of _____ 2_____.

_____
Notary Public

My Commission expires: _____

BID ENVELOPE COVER

NAME OF PROJECT: HVAC REPLACEMENT, CONTROLS AND ELECTRICAL UPGRADES

Invitation for Bid # 3515

SEALED BIDS WILL BE RECEIVED BY:

Knox County Procurement Division
1000 N. Central Street, Suite 100
Knoxville, Tennessee 37917

UNTIL: 2:00 p.m. EST (TIME) February 7, 2024 (DATE)

BIDDER _____

STREET ADDRESS _____

CITY/STATE/ZIPCODE _____

TENNESSEE CONTRACTORS LICENSE NUMBER _____

LICENSE CLASSIFICATION _____ _____
(If applicable to this project) Dollar Limit

LICENSE EXPIRATION DATE _____

SUBCONTRACTORS TO BE USED ON THIS PROJECT
(If no subcontract work is required, write, "none required" in each blank.)

PLUMBING _____ LICENSE NO. _____

Classification _____ Expiration Date _____

HVAC _____ LICENSE NO. _____

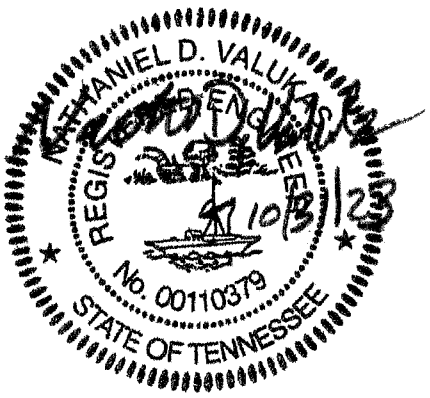
Classification _____ Expiration Date _____

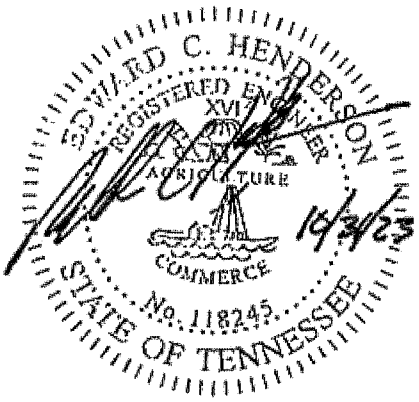
ELECTRICAL _____ LICENSE NO. _____

Classification _____ Expiration Date _____

COMPLETE ALL BLANKS!
DO NOT LEAVE ANY BLANKS EMPTY FOR BID TO BE CONSIDERED.
ATTACH THIS PAGE TO THE OUTSIDE OF YOUR SEALED BID.

TABLE OF CONTENTS





SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

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 QUALITY ASSURANCE

A. Electrical Characteristics for Plumbing Equipment: Contractor shall verify existing voltage available at the site prior to ordering equipment. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.4 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

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

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

D. All equipment shall be installed in accordance with the manufacturer's drawings and recommendations.

E. The Contractor shall furnish and install all rough-in work and make final connections to all equipment requiring water, gas, drains, and other mechanical work required for connection to equipment furnished under this contract.

F. The equipment shall be properly prepared structurally and mechanically ready to receive a single connection for each of the various mechanical items with all plumbing,

piping drains, traps, tailpieces, supply fittings, etc., internal to and part of the equipment installed by the equipment manufacturer or supplier.

1.5 CODES AND FEES

A. All work shall be installed in accordance with the applicable provisions of the local codes, latest adopted International Plumbing Code, AGA, UL, AWWA, ASTM, ASME and ANSI.

1.6 ELECTRICAL WORK

A. All control wiring and conduit not shown on Electrical drawings shall be furnished and installed under Division 22 according to the National Electrical Code and Division 26 requirements.

B. All power wiring and conduit for items furnished under Division 22 shall be furnished and installed under Division 26.

C. All disconnects shall be furnished and installed by Division 26.

D. Toggle switches for 1/2 HP motors and less shall be furnished and installed by Division 26.

E. Wiring and conduit for solenoid valves, and control transformers including the transformers shall be furnished and installed by Division 22.

F. Division 26 shall install all starters, toggle switches, disconnects, and all wiring to the respective motor or device. Wiring and conduit from starter to a controller shall be by Division 22.

G. Definitions:

1. Power wiring: Line voltage circuitry rough-in including conduit, boxes, conductors, etc. between the overcurrent protection and the equipment including the connection of the starters.
2. Control wiring: Any voltage circuitry rough-in including conduit, boxes, conductors, etc. between control activator and the controller or starter.

H. Conduit: All power wiring and 120V control wiring shall be in conduit. Low voltage control wiring shall be installed in conduit where exposed, or in return air plenums, in masonry walls, or below slab.

I. It shall be the Contractor's responsibility to determine the characteristics of electrical currents available to operate the mechanical equipment prior to ordering such equipment. All electrically operated equipment shall be designed for operation with the type of electric current available to the project.

1.7 RECORD DRAWINGS

A. The Contractor shall maintain a marked up set of prints that reflect site conditions including location of valves, underground piping, equipment, etc. that have been changed to suit job conditions. Final payment shall not be made until such document(s) is turned over to the architect upon completion of the project.

1.8 SEISMIC BRACING

A. This contractor shall examine Architectural and Structural drawings and acknowledge Seismic Classification of the building and site. Seismic bracing required will be determined by listed Classification in those documents and done in accordance with the latest locally adopted International Building Code (Chapter 16).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

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

C. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

2.4 FIRE STOPPING

A. Description: Fire stopping compounds, caulks, wraps, as required to maintain integrity of fire rated floors, ceilings, walls and floor/ceiling, roof ceiling assemblies for all pipe penetrations for metal and plastic pipe.

1. Available manufacturer's:

a. 3M Corporation
b. Hilti
c. Pro-Set

2. See plumbing drawings for U.L. system numbers and specific penetration details.

2.5 ACCESS PANELS

A. Description: For ceiling applications utilize 16 gauge bonderized steel door frame with prime coat finish, 20 gauge bonderized steel door panel with prime coat finish, automatic closure, self-latch, interior latch release, rated as required for ceiling construction. For wall applications utilize the following:

1. Block Walls and Drywall – 14 gauge galvanized steel frame with 16 gauge door panel, concealed hinge, key operated lock. Fire rating shall be consistent with wall construction.
2. Available manufacturer's:

a. Elmore Manufacturing Company
b. Milcor Products, Inc.
c. Amberaproducts, Inc.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

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

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas. Run piping parallel to principle parts of the building and avoid diagonal runs unless specifically indicated on plans.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

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

H. Install piping and hangers to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install escutcheons for penetrations of walls, ceilings, and floors chrome plated, metal at all visible locations:

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to details on plumbing drawings for U.L. system numbers and specific penetration types.

L. Verify final equipment locations for roughing-in.

M. Verify exact required rough-in dimensions with equipment manufacturer.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. 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.

F. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to manufacturer's instructions.

3.3 PIPE PRESSURE TESTING

A. Test all plumbing piping, following installation, but before it is covered or connected to the sewers or fixtures. Furnish necessary labor, materials and equipment for making test. All leaks disclosed by testing shall be reworked in an approved manner and the leaking system shall then be retested until proved tight under pressure. Test all systems for watertightness (or gas-tightness) as required by the authorities having jurisdiction, or in the absence of such requirements the minimum tests shall be made as follows:

1. Test all water supply piping by applying a hydro-static pressure of not less than 125 pounds per square inch or 1½ times the working pressure, whichever is greater.
2. Test all gas piping systems with air or inert gas only. Test pressure shall be not less than five times the maximum pressure to which the piping will be subjected in operation for a period not less than 30 minutes.

3.4 ACCESS PANELS

A. Furnish steel access panels, not smaller than 12" for single valve and 12" X 24" or 18" X 18" for two or more valves, for access of concealed valves, traps, clean outs, unions, etc., where no other means of access is shown or specified. Access panels shall be turned over to the general contractor for installation. Contractor shall include in their bid all costs charged by the general contractor for installation.

B. Access panels in fire rated construction shall have a UL label Class B rating. All panel styles to be verified by the Designer.

3.5 GUARANTEE

A. The Contractor shall guarantee all work to be in accordance with contract requirements and free from defective or inferior materials, equipment, and workmanship for a period of one year, and he shall guarantee that all equipment is of proper size and design and so installed as to produce the capacities and results specified and shown on the drawings.

3.6 SUBSTITUTIONS

A. Substitutions shall be allowed in accordance with Division 1. Substitution approval shall be at the sole discretion of the Engineer.

B. Contractor shall note on shop drawings all major differences from specified material or equipment.

C. The contractor shall be responsible to verify that all dimensions, weights, electrical and mechanical requirements of substituted materials and equipment meet project requirements. Any required modifications to other trades for substituted equipment shall be the responsibility of the contractor making the substitution.

D. All requests for substitution must be submitted to the architect and engineer a minimum of 14 calendar days prior to project bid date. Such submission does not constitute approval. Only items or manufacturers specifically stated in the project specifications, drawings or addenda for use shall be considered as approved.

3.7 SHOP DRAWINGS

A. Submit to the Architect for approval, within 30 days after receipt of Notice to Proceed with the work, detailed shop drawings of all equipment and all material required to complete the project. The shop drawing shall be complete as described herein. The Contractor shall furnish the number of copies required by the General and Special Conditions of the Contract, but in no case less than six (6) copies. Electronic shop drawings are acceptable.

B. All shop drawings to be submitted at one time in a 3-ring binder with cover and drawing index sheet, or one electronic submission.

C. The shop drawings shall be detailed, with dimensioned drawings or catalog cuts, showing construction, size, arrangement, operating clearances, performance characteristics and capacity. Each item of equipment proposed shall be a standard catalog product of an established manufacturer and of equivalent quality, finish, and durability to that specified. Submission material and all shop drawings for the various items of equipment shall be marked with the respective mark number or identification of the equipment shown on the drawing or in the specification.

D. Provide a cover sheet for all major equipment, including but not limited to, pumps, plumbing fixtures, water heaters, that shall list in detail all accessories called for in specifications and on drawings that are being supplied. Failure to list these items will result in resubmittal. A copy of a standard catalog will not be sufficient.

E. Shop drawings shall show sizes and details of required concrete and steel machine foundation, location of anchor bolts, physical dimension of equipment, equipment weight or other pertinent data required for equipment support or installation.

F. The contractor shall verify all electrical requirements of equipment with the electrical service available before ordering said equipment.

G. Approved shop drawings do not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings or specifications.

H. All shop drawings to be reviewed must bear the general contractor's stamp indicating they have reviewed the items being submitted and their approval/comments attached. Submission without this stamp is grounds for rejection of the submittal package.

END OF SECTION 22 05 00

SECTION 22 05 10 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Grinnell Corp.
3. Globe Pipe Hanger Products Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Insulation-Insert Material: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for cold piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Hilti, Inc.
c. ITW Ramset/Red Head.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

B. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

3.2 PIPING SUPPORT

A. Support spacing of piping hangers shall not exceed the following:

1. Copper Tube:

   a. 1-1/4 NPS and smaller – 6' horizontal – 3/8" rod dia., 10' vertical.
   b. 1-1/2 NPS and 2 NPS – 10' horizontal – 3/8" rod dia., 10' vertical.

2. PVC, Schedule 40:

   a. ½ NPS thru 2 NPS – 4' horizontal – 3/8" rod dia., 10' vertical plus mid-story guide.

B. Horizontal-Piping Hangers and Supports: Unless otherwise indicated, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, all sizes.
2. Trapeze hangers may be utilized where multiple pipes are to be installed side by side at same elevation.

3.3 ATTACHMENTS

A. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

B. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, support.

1. From concrete using inserts
2. From beams using beam clamps, rivets or bolts.
3. From blocks using toggle or thru-bolts.
4. Do not use plastic anchors, adhesives or explosive charges.
5. Do not support from roof deck.
6. Fasten supports to building in the following order of preference:

a. Steel Framing
b. Concrete
c. Masonry
d. Wood Sheathing

7. All hangers, rods and inserts shall be UL approved for service intended and shall be the following types per MSS SP-58:

a. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
b. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
c. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
d. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
e. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
f. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
g. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
h. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
i. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

1) Light (MSS Type 31): 750 lb.
2) Medium (MSS Type 32): 1500 lb.
3) Heavy (MSS Type 33): 3000 lb.

j. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

C. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): 12 Inch minimum length or of length recommended by manufacturer to prevent crushing insulation, if greater.
2. Steel Pipe-Covering Protection Saddles, for rollers (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

3.4 HANGER AND SUPPORT INSTALLATION

A. On all pipe, provide hanger within 18" of each elbow or fitting and within 18" of connection to each piece of equipment.

B. Pipes passing through walls shall not bear on construction.

C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Pipe Slopes: Install hangers and supports to provide specified slope for drainage piping.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support.

END OF SECTION 22 05 10

SECTION 22 05 30 – DRAINAGE, WASTE, VENT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following for soil, condensate drainage piping inside the building.

1.3 SUBMITTALS

A. Product Data: For pipe, drains, cleanouts, and fittings listed herein.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns, Schedule 40.

2.4 COPPER PIPE AND FITTINGS

A. Hard Copper Tube: ASTM B88, Type M water tube, drawn temper.

1. Wrought-copper solder-joint fittings.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground, condensate piping all sizes shall be the following:

1. Type “M” copper tube, wrought-copper solder-joints.

B. Underground, condensate piping all sizes shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings and solvent-cemented joints.

3.2 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install seismic restraints on piping per local building codes.

C. PVC piping will not be permitted in return air plenums.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

END OF SECTION 22 05 30

SECTION 22 05 55 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

1.2 SUBMITTALS

A. Product Data: For piping, valves, and regulators herein.

B. Field quality-control reports.

C. Operation and Maintenance Data: For pressure regulators to include in operation, and maintenance manuals.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating and protect from direct sunlight.

1.4 PROJECT CONDITIONS

A. Perform site survey and verify existing utility locations. Contact utility-locating service for area where Project is located.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

2.2 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

2.3 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2and Smaller: Comply with ASME B16.33.

1. CWP Rating: *125 psig*
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves *1 inch* and smaller.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.; Apollo Div.
   b. McDonald, A. Y. Mfg. Co.
   c. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket.
8. CWP Rating: 600 psig
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. McDonald, A. Y. Mfg. Co.
    b. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
    c. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

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

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

3.5 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.6 PAINTING

A. Paint exposed, exterior metal piping, valves, service regulators, and piping specialties, except components, with field-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (flat).
d. Color: Yellow.

3.7 TESTING AND ACCEPTANCE

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. For test pressures refer to Section 22 "Common Work Results for Plumbing."

3.8 PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 5.0 PSIG (34.5 kPa)

A. Aboveground, piping NPS 2 (DN 50) and smaller shall be steel pipe with malleable-iron fittings and threaded joints.

3.9 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:

1. One-piece, bronze ball valve with bronze trim.

B. Valves in branch piping for single appliance shall be the following:

1. One-piece, bronze ball valve with bronze trim.

END OF SECTION 22 05 55

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

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. It shall be the contractor's responsibility to furnish and install complete all systems, equipment, and related items described under Division 23.

B. It shall be the Contractor's responsibility to determine the characteristics of electrical currents available to operate the mechanical equipment prior to ordering such equipment. All electrically operated equipment shall be designed for operation with the type of electric current available to the project.

C. It shall further be the Contractor's responsibility to locate, layout and make provisions for all openings required in precast or cast in place concrete slabs, etc., necessary to accommodate his work.

D. Provide labor, materials, tools, and services for a complete installation of equipment and systems specified herein and indicated on drawings.

E. Contractor agrees to assume responsibility for liability, workmanship and quality of materials concerning work sublet to others. Before part of contract is sublet, submit to Architect in writing names of proposed subcontractors and obtain written approval.

F. The Contractor shall furnish and install all rough-in work and make final connections to all equipment requiring exhaust systems, ductwork and other mechanical work required for connection to equipment furnished under this contract.

G. The equipment shall be properly prepared structurally and mechanically ready to receive a single connection for each of the various mechanical items with all supply and return ductwork, piping, etc., internal to and part of the equipment installed by the equipment manufacturer or supplier.

H. All equipment shall be installed in accordance with manufacturer's drawings and recommendations.

I. Verify all connections and rough-in locations with the Architect and / or the equipment supplier or contractor prior to the start of their work.

1.3 CODES AND FEES

A. All work shall be installed in accordance with the applicable provisions of the local codes, latest adopted International Mechanical Code, NFPA, UL, ASTM, ASHRAE, SMACNA, ASME and ANSI.

B. The Contractor shall pay for fees and inspections as may be required for all systems requiring inspection by agencies having jurisdiction.

1.4 ELECTRICAL WORK

A. All control wiring and conduit not shown on Electrical drawings shall be furnished and installed under Division 23 according to the National Electrical Code and Division 26 requirements.

B. All power wiring and conduit for items furnished under Division 23 shall be furnished and installed under Division 26.

C. All disconnects shall be furnished and installed by Division 26.

D. Toggle switches for 1/2 HP motors and less shall be furnished and installed by Division 26.

E. Wiring and conduit for solenoid valves, and control transformers including the transformers shall be furnished and installed by Division 23.

F. Division 26 shall install all starters, toggle switches, disconnects, and all wiring to the respective motor or device. Wiring and conduit from starter to a controller shall be by Division 23.

G. Definitions:

1. Power Wiring: Line voltage circuitry rough-in including conduit, boxes, conductors, etc. between the overcurrent protection and the equipment including the connection of the starters.
2. Control Wiring: Any voltage circuitry rough-in including conduit, boxes, conductors, etc. between control activator and the controller or starter.

H. Conduit: All power wiring and 120V control wiring shall be in conduit. Low voltage control wiring shall be installed in conduit where exposed, or in return air plenums, in masonry walls, or below slab.

I. Smoke Detectors:

1. Smoke detectors shall be furnished and installed by Division 23 unless the project has a fire alarm system, then smoke detectors shall be furnished by Division 28, installed in ductwork by Division 23. All wiring and conduit from detector to fan shall be considered control wiring. 120 Volt wiring to the detector shall be power wiring. Wiring from the detector to fire alarm system shall be furnished and installed by Division 26 and 28.

1.5 VISIT TO JOB SITE

A. Before submitting bid, Contractor shall visit the job site for the purpose of examining the site and conditions under which the work must be performed. No extra will be allowed for situations arising from failure of Contractor to thoroughly familiarize himself with site and existing building conditions, including charges and requirements to utilities as shown for the project.

1.6 RECORD DRAWINGS

A. The Contractor shall maintain a set of prints that reflect site conditions including location of valves, dampers, underground piping, ductwork, equipment, etc. that have been changed to suit job conditions. The contractor shall prepare a corrected reproducible tracing of the project using the results of the record print. Final payment shall not be made until such document(s) is turned over to the architect upon completion of the project.

1.7 DEMOLITION

A. All demolition shall be the responsibility of Division 23. This includes removing of mechanical equipment, piping and controls from job site and patching holes in floors, ceiling and roof and reconnecting existing Mechanical items to new services and equipment. All patching to match existing conditions.

1.8 QUALITY ASSURANCE

A. Perform work of this section using skilled workers who are trained and experienced in the required crafts and who are knowledgeable and familiar with the specified requirements and the methods to be used for proper performance of the work.

1.9 COMPLETE WORK

A. Contractor shall provide and install all systems in complete working order. All items normally required for operation shall be provided.

1.10 SEISMIC DESIGN

A. Seismic restraints shall be provided in accordance with chapter 16 of the latest adopted International Building Code. Specific seismic requirements shall be determined by building site classification.

B. Seismic restraints shall not be required for the following installations:

1. Piping in boiler and mechanical rooms less than 1-1/4 inch inside diameter.
2. All other piping less than 2-1/2 inch inside diameter.
3. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the supporting structure.
4. All ducts suspended by hangers 12 inch or less in length from the top of the duct to the supporting structure.
5. Ducts which have a cross-sectional area less than 6 square feet.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

A. All pipe lines installed under the contract shall be clearly labeled to indicate their function and flow direction. Labels shall be applied by stencil, decal, printed tape, or equivalent method, and shall be so spaced that the lines may be traced from start to finish.

B. Round brass tags shall be provided to identify the function of each valve in the various piping systems, except valves for which the purpose is self evident. Tags shall be approximately 1½" in diameter, properly stamped and securely fastened to the valve. A valve tag list showing valve tag number, and valve type and function shall be framed under clear plastic glazing and placed in main mechanical room.

C. All starters and pushbutton stations shall be labeled to identify the equipment which they control.

D. All air units, fans, etc., shall be labeled with drawing mark number and with description of area served, utilizing engraved plastic laminate nameplates.

E. All air unit thermostats shall be labeled with proper mark number identifying it with air unit it serves.

2.2 INDOOR ENVIRONMENTAL QUALITY – LOW EMITTING MATERIALS

A. All adhesive and sealants used on the interior of the building (inside the weatherproofing and applied on-site) shall comply with "South Coast Air Quality Management District (SCAQMD) Rule #1168", current VOC limits.

B. Paints and coatings used on the interior of the building shall comply with the following criteria for VOC limits:

1. Architectural paints, coatings and primers - Green Seal Standard GS-11, for Paints, Coatings, Stains and Sealers.
2. Anti-corrosive and anti-rust paints - 250 g/l per Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.

2.3 SERVICE AND MAINTENANCE CONTRACT

A. The Contractor shall make arrangements with an independent service and maintenance contractor, "**other than the project mechanical contractor**" and as approved by the Architect, to perform all the required servicing and maintenance of the heating, ventilating and air conditioning system, fume exhaust systems without cost to the owner, for a period of one year after date of substantial completion. The name of the service contractor shall be part of submittals.

B. The servicing shall be complete in every respect and shall include but not be limited to the following: Replacing or washing of all filters as required for proper equipment operation, replacing bad belts, compressors, bearings, motors, controls, electric

heaters, refrigerant specialties, couplings; cleaning drain pans and piping; replacing refrigerant and oil, bearing lubrication, and keeping equipment reasonably clean.

C. This service work shall be performed a minimum of three times a year. Filters may need changing more than 3 times depending on conditions. A written report shall be submitted to the Owner describing each visit. The date the service work starts shall be clearly identified in close out documents.

2.4 EQUIPMENT LIST, SHOP DRAWINGS AND SAMPLES

A. Submit to the Architect for approval, within 30 days after receipt of Notice to Proceed with the work, detailed shop drawings of all equipment and all material required to complete the project. The shop drawing shall be complete as described herein. The Contractor shall furnish the number of copies required by the General and Special Conditions of the Contract, but in no case less than six (6) copies.

B. All shop drawings to be submitted at one time in a 3-ring binder with cover and drawing index sheet. Electronic shop drawing submittals are acceptable.

C. The shop drawings shall be detailed, with dimensioned drawings or catalog cuts, showing construction, size, arrangement, operating clearances, performance characteristics and capacity. Each item of equipment proposed shall be a standard catalog product of an established manufacturer and of equivalent quality, finish, and durability to that specified. Submission material and all shop drawings for the various items of equipment shall be marked with the respective mark number or identification of the equipment shown on the drawing or in the specification.

D. Provide a cover sheet for all major equipment, including but not limited to, air handling units, self-contained roof top units, condensing units, fans, air distribution, that shall list in detail all accessories called for in specifications and on drawings that are being supplied. Also, list operating capacities shown in schedules or described on drawings. Failure to list these items will result in resubmittal. A copy of a standard catalog will not be sufficient. Shop drawings for controls shall contain a detailed sequence of operation. Provide shop drawings for piping firestop details.

E. Shop drawings shall show sizes and details of required concrete and steel machine foundation, location of anchor bolts, physical dimension of equipment, equipment weight or other pertinent data required for equipment support or installation.

F. The contractor shall verify all electrical requirements of equipment with the electrical service available before ordering said equipment.

G. Approved shop drawings do not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings or specifications.

2.5 EQUIPMENT START-UP

A. Before final payment, provide architect and engineer with letter from each equipment supplier stating that equipment has been started and checked by factory qualified field service technicians and is installed and running satisfactory in every respect.

B. Letters are required for the following equipment: rooftop units, controls, air handling units, and condensing units.

PART 3 - EXECUTION

3.1 TEST

A. Test all piping, following installation, but before it is covered or connected to equipment. Furnish necessary labor, materials and equipment for making test. All leaks disclosed by testing shall be reworked in an approved manner and the leaking system shall then be retested until proved tight under pressure. Test all systems for watertightness (or gas-tightness) as required by the authorities having jurisdiction, or in the absence of such requirements the minimum tests shall be made as follows:

1. All refrigerant piping systems shall be tested at 200 pounds with dry nitrogen until all leaks have been made tight. After the pressure tests use suitable vacuum pump to evacuate the system to at least 1000 microns, then charge the system with refrigerant and oil as required. Prior to running the refrigerant equipment all safety and operating devices and controls shall be properly adjusted and tested for proper operation and protection of the equipment.

B. Test all heating, cooling and ventilating equipment. When installation is complete, all equipment shall be tested for proper operation and functioning as directed by Architect.

1. All equipment, motors, fans, etc., shall run at their required speed and be free from excessive vibration and noise. No bearings, journals, or any part of the motors shall heat to a temperature in excess of 40°C. above the temperature of the surrounding air.
2. The equipment, diffusers, registers, dampers, etc., shall be adjusted to deliver air at all outlets according to the amount of air shown on the drawings or as required to obtain adequate room temperature.
3. Architect reserves the right to require the Contractor to demonstrate the uniformity of heating and cooling in each area of the building.

3.2 COORDINATION

A. The mechanical work shall be installed as neatly as possible in the locations shown but shall be subject to such deviations, modifications and relocations as may be necessary to conform to the requirements of the architectural drawings and as necessary to avoid interferences with the structural work and the work of other trades, and interferences between the various trades. This shall be done at no cost to the Owner. No ductwork

or equipment shall be installed which would require ceilings to be lower than required by drawings, unless approval is obtained from the Architect.

B. It is the responsibility of the General Contractor to coordinate the work of his subcontractors. To this end, the General Contractor shall require that the various subcontractors carefully examine and familiarize themselves with the architectural and structural drawings and drawings covering the work of other trades, and that they frequently consult with all other trades so that the work may be coordinated.

C. If necessary to coordinate and expedite the work, the Contractor shall prepare "interference drawings" and submit them to the Architect for approval. Such drawings shall show the work of the various trades involved, illustrate proposed details of construction and arrangement of equipment and apparatus, and clearly indicate any deviations from contract requirements.

D. Minor changes in arrangement may be made to suit unforeseen conditions, but no major deviation shall be made without written approval from the Architect. If any deviations are deemed necessary, submit all details of proposed changes and all reasons therefore, in writing, to the Architect for approval prior to making installation of such work.

E. Do not fabricate ductwork and piping before interferences are verified. No extra will be allowed for piping or ductwork fabricated in advance which cannot be used.

F. Field verify exact sizes of fire dampers and duct balancing dampers before ordering. No extra will be allowed for dampers ordered in advance which cannot be used.

3.3 CUTTING AND REPAIRING

A. All chases, recesses, sleeves and other openings in masonry and concrete shall be built in as the construction work progresses, and it shall be the responsibility of the subcontractor to see that such chases, recesses, sleeves and other openings required for their work are properly located and installed. If this is not done by the subcontractor whose work required such accommodation, it shall be performed at his expense.

B. Structural members or finished work shall not be cut without the express permission of the Architect. Cutting shall be done neatly and patching or repairing shall match adjacent work.

3.4 PROTECTION AND CLEANING

A. Work shall be protected at all times. Pipe openings shall be closed with caps or plugs until permanent connections are made. Fixtures and equipment shall be covered, if necessary, to protect against dirt, water, chemical or mechanical damage or defacement. The installation of fixtures liable to damage shall be deferred by the Architect. Cover all machine openings and open ends of ductwork to prevent entry of dirt and debris as project construction progresses.

B. Upon completion of the work and after all tests have been made and piping systems proven tight, clean all equipment, filters, etc., and leave in correct operating condition. No air unit shall be operated without filters.

3.5 PAINTING

A. Painting of mechanical equipment, piping, and exposed ductwork in finished spaces, or exposed on the exterior, shall be finished as specified under Division 09, PAINTING. All equipment exposed on the exterior furnished without factory finish shall be painted.

B. Equipment with a factory applied finish shall have scratches, chips, etc., primed and touched up with materials which will protect the surface and match the adjacent area.

3.6 OPERATING INSTRUCTIONS

A. Furnish the services of competent personnel to instruct the Owner's personnel in the proper operation and maintenance of all equipment, for a period of not less than 3 working days. All owner training sessions shall be videotaped and at the completion of training a DVD format copy of the video shall be given to the owner with all installation, operation, and maintenance manuals.

B. Furnish and deliver to the Owner three sets of operating instructions for all equipment installed under this contract, including shop drawings, piping diagrams, wiring diagrams, maintenance recommendations and information concerning replacement parts. This information must contain mechanical and plumbing contractor names, equipment supplier names, contact personnel, telephone numbers, and facsimile telephone numbers. This information shall be contained in a three ring binder of suitable size, and labeled on the exterior with project name.

3.7 QUIETNESS OF OPERATION

A. All fans, motors and other apparatus shall be selected and installed for reasonably quiet operation. Any objectionable noise which develops shall be corrected before the work will be accepted. Equipment or duct connections and fittings which produces objectionable noise shall be adjusted or insulated so as to eliminate the noise or shall be removed and replaced by satisfactory equipment. Provide spring or rubber machine mounting isolators and flexible piping and duct connections where necessary to prevent transmission of vibration to building structure or to piping and duct system.

3.8 GUARANTEE

A. The Contractor shall guarantee all work to be in accordance with contract requirements and free from defective or inferior materials, equipment, and workmanship for a period of one year, and he shall guarantee that all equipment is of proper size and design and so installed as to produce the capacities and results specified and shown on the drawings. Compressors shall have an extended 4 year warranty.

3.9 SUBSTITUTIONS

A. Substitutions shall be allowed in accordance with Division 01. Substitution approval shall be at the sole discretion of the Engineer.

B. Contractor shall note on shop drawings all major differences from specified material or equipment.

C. When making requests for substitutions, Contractor assumes the following responsibilities:

1. To have personally investigated the proposed substitute product and determined it is equal or superior in all respects to that specified.
2. To provide the same warranty for substitute that Contractor would for that specified:
3. To provide complete cost data, and waive all claims for additional costs related to substitution, which subsequently become apparent; and
4. To coordinate installation of the accepted substitute, making such changes as may be required for Work to be complete in all respects.

D. All requests for substitution must be submitted to the architect and engineer a minimum of 10 calendar days prior to project bid date. Such submission does not constitute approval. Only items or manufacturers specifically stated in the project specifications, drawings or addenda for use shall be considered as approved.

END OF SECTION 23 05 00

SECTION 23 05 10 - BASIC MATERIALS AND METHODS

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 BASIC REQUIREMENTS

A. Equipment and materials used in the work shall be in accordance with the contract documents, of the best quality and grade for use intended, shall be new and unused and shall be the manufacturer's latest standard or current model for which replacement parts are readily available.

B. Work shall be installed under the constant supervision of a competent superintendent and by skilled and competent mechanics experienced in the trade that contractor is practicing.

C. All apparatus and equipment shall be installed and connected in accordance with the best engineering practices and in accordance with the manufacturer's recommendations. All auxiliary piping, water seals, valves, electrical connections, etc., recommended by the manufacturer or required for proper operation shall be furnished and installed complete.

D. The work of this section is subject to the requirements of the Mechanical Common Work Results and the General and Supplemental Conditions in Division 01.

PART 2 - PRODUCTS

2.1 SLEEVES AND PLATES

A. All pipes that pass through masonry partitions and walls and concrete floor slabs shall be installed with standard weight galvanized steel sleeves. Sleeves through floors shall be long enough to project a minimum of 2" above finished floor. Sleeves shall be large enough for pipe, pipe insulation and required fire caulking. Sleeves in concrete shall be accurately located in the forms and secured in place to prevent displacement during pouring of concrete.

B. Sleeves in finished spaces shall finish flush with the finished wall surface. Sleeves for insulated water or refrigerant pipe shall be large enough to accommodate the insulation.

C. Pipes passing through masonry walls and partitions in finished spaces shall be fitted with metal escutcheons or collar plates. Plates occurring in painted walls or ceiling shall be prime coated for painting; other plates shall be chromium plated.

D. Exposed ducts passing through finished walls shall be furnished with sheet metal escutcheons.

E. All pipe penetrations of fire rated floors or walls are to be protected. Space between metal pipe and wall or sleeve shall be protected with Hilti Fire Barrier Penetration Sealing System or approved substitute. Installation shall be in accordance with the manufacturer's recommendations for the hourly fire rating of the partition. The system shall be U.L. listed. For insulated chilled water, domestic cold water and refrigerant pipe, continue insulation and vapor barrier through wall. The sleeve through the wall shall be large enough for the pipe, insulation and fire caulking.

F. PVC pipe passing through rated walls, ceilings or floors shall have Hilti UL Listed Fire Protection System or approved substitute. System number shall be as required by construction and rating.

2.2 PIPE FITTINGS

A. Screwed Fittings - Screwed fitting for steel pipe shall be 150 pounds malleable iron banded fittings, except where cast iron drainage fittings are specified. Fittings for copper pipe shall be wrought copper or cast bronze, equal to those manufactured by Mueller Brass Co., Bridgeport Brass Co., NIBCO, or approved substitute. Pipe size 2½" and larger shall be flanged type.

B. Dielectric Fittings - Dielectric Fittings or Union between dissimilar metals shall be EPCO, or approved substitute. Provide 3/AWG copper bonding strap around each dielectric union.

C. Unions:

1. Unions, either screwed or flange, shall be installed on each side of all special valves, regulators, etc., on one side of each check valve and each trap, and at all equipment such as coils, tanks, compressors, pumps, etc., so that such equipment may be readily disconnected. No unions shall be placed in a location which will be inaccessible after completion of the building.
2. Where flanged valves, regulators, etc., do not permit the removal of flange bolts, two such devices shall be separated by a spool.
3. Connections between pipes of dissimilar metals shall be made with Dielectric (insulated) unions.

PART 3 - EXECUTION

3.1 GENERAL

A. Run exposed ducts and piping parallel to the principal parts of the building. Ducts and piping shall be run concealed when provisions are made in floors, walls, ceilings and

chases through all finished spaces, except at fixture connections and where specifically noted otherwise.

B. Piping, ducts, and equipment shall be kept as close as possible to ceilings, walls, columns, etc., and shall be installed in such an orderly manner as to take up a minimum of space and allow a maximum of headroom, and all offsets, fittings, etc., required to accomplish this shall be furnished and installed, whether or not each offset and fitting is specifically shown or noted. Minimum clearances on exposed piping shall be maintained as specified under "Piping Clearances" herein.

3.2 PIPE INSTALLATION

A. Service pipe, valves, fittings, etc., shall be so installed that after the insulation cover is applied there will be not less than ½" clear space between the finished covering and other work and between the finished covering of parallel and adjacent pipes. The clearances on uninsulated pipe shall be measured from the point of greatest projection of the pipe fittings.

B. Fastenings to masonry walls shall be made with metal expansion sleeves, cinch anchors, toggle bolts, or equal. Fastenings to concrete shall be made with metal expansion sleeves, metal inserts. Wood plugs will not be acceptable in any case.

3.3 JOINTS IN PIPE

A. PVC pipe joints shall be made with cement recommended by pipe manufacturer. All joints shall be cleaned with approved solvent.

B. Type "L" copper pipe joints, except as otherwise specifically noted, shall be made with 95-5 plumber's solder and noncorrosive paste flux. Acid core solder shall not be used. Tubing shall be square cut on a sawing vise and reamed to remove burrs. Outside and inside of fittings and outside of pipe shall be well cleaned and steel wool used before soldering. Soldering operations shall be performed strictly in accordance with the recommendations of the manufacturer of the pipe and fittings. Joints in copper pipe Type "K" below grade shall be made with high temperature solder, silver solder, sil-fos, or equal.

C. Connections of copper pipe to ferrous pipe shall be made with Dielectric unions. Connections of metal pipe to non-metallic pipe shall be made with adapters as specified hereinbefore. Connections of copper piping to equipment requiring threaded connections shall be made with adapters as specified hereinbefore.

D. Unions for brass or copper pipe shall be all brass, and for steel pipe shall be malleable iron with brass insert. Unions 2" and smaller shall be ground joint type.

END OF SECTION 23 05 10

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Direct drive motors less than 1 HP may have sleeve bearings.

G. Temperature Rise: Class B.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 MOTOR CONTROLS

A. All motors shall be furnished with starters under Division 23.

B. Manual starters with overload protection shall be used to control motors ½ HP and smaller. Single phase motors requiring interlock and all 3-phase motors shall be provided with magnetic starters.

C. Magnetic starters shall have thermal overload and low voltage protection. Three phase starters shall have (3) thermal overloads. Also, provide ground fault protection. All electrical and mechanical components shall be of the highest quality and parts subject to wear or deterioration shall be renewable. Starters for motors ¾ HP and larger shall be combination fused type. Holding coils shall suite the requirements of control diagrams. Provide control voltage transformers in starters as indicated on control diagrams. Starters to be UL listed.

PART 3 - EXECUTION

3.1 MOTORS

A. Each motor shall have a permanent name plate, showing name of manufacturer, model and serial numbers, amperes per phase, horsepower, voltage, speed and cycles.

END OF SECTION 23 05 13

SECTION 23 05 93 – TESTING, ADJUSTING AND BALANCING

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. The work required under this section includes all work necessary for the proper testing, adjusting and balancing of all air systems to achieve the results specified by the contract drawings and specifications.

1.3 SUBMITTALS

A. Qualification Data: Within 45 days from Contractor's Notice to Proceed, submit 6 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB Reports: Submit four copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. The mechanical contractor shall submit a complete resume of the balancing agency for approval by the architect and engineer prior to beginning any work. The resume shall contain examples of previous projects, references, personnel available, certifications and test and balancing report format.

D. TAB Report Forms: Use standard forms from:

1. AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
2. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
3. SMACNA's TAB "HVAC Systems - Testing, Adjusting, and Balancing."
4. TAB firm's forms approved by Architect.

1.4 QUALITY ASSURANCE

A. Work required under this section shall comply with American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE), National Environmental Balancing Bureau (NEBB) or Associated Air Balance Councils (AABC), Recommendations Pertaining To Measure, Instruments, and Testing, Adjusting and Balancing by Certified technicians.

B. The mechanical contractor shall make arrangements with an independent balancing agency to balance all air flow to the flow rates indicated on the contract drawings and schedules. This shall include all air handling units and exhaust fans. The balancing agency shall be one normally engaged in such work and **shall be either AABC or NEBB Certified**. Test and balance reports not prepared by an AABC or NEBB certified contractor will be rejected and the complete system shall be retested by an AABC or NEBB certified contractor at no cost to the owner. All test and balance reports shall be certified per AABC or NEBB.

C. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

D. Architect and engineer reserve the right to require the contractor to demonstrate the uniformity of heating and cooling in each area of the building.

E. All equipment, fans, motors, etc., shall run at their required speeds and be free from excessive vibration and noise. No bearings, journals, or any part of the motors shall heat to a temperature in excess of 40°C above the temperature of the surrounding air.

1.5 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed. The work required under this section includes all work necessary for the proper testing, adjusting and balancing of all air systems to achieve the results specified by the contract drawings and specifications.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used by original installer for patching holes in insulation, ductwork, and housing which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes. At technician's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housing. Leave no test holes or access openings uncovered and insure vapor barrier continuity of all insulation.

PART 3 - EXECUTION

3.1 INSPECTION AND REPORTS

A. Prior to the start of any test and balancing work, a representative of the test and balancing agency shall visit the project for the purpose of inspecting the work in place and shall prepare and submit a written report to the mechanical contractor and engineer stating work which is to be completed before testing and balancing can proceed. Do not proceed with testing and balancing until all items listed in said report have been completed. Failure to do this will render the test and balance report null and void. If the report is deemed null and void, all testing must be performed again at no additional cost to the owner, in the presence of the architect and/or engineer. The contractor shall reimburse the architect and/or engineer for any expenses and time related to supervision of system re-testing.

B. The testing and balancing agency shall record the test results in tabulated formats for both cooling and heating conditions and shall submit a minimum of three copies to the architect for review and approval. A copy of the completed and approved report shall be placed in each copy of the facility operating and maintenance manuals as stated hereinbefore.

3.2 AIR BALANCING

A. The air balance shall include the following air tests in accordance with the following requirements. Test all air systems with new, clean filters in place.

1. Test and record fan total CFM (design and actual).
2. Test and record fan outside air CFM (design & actual.)
3. Test and record fan suction static pressure and fan discharge static pressure (actual.)
4. Test and record static pressure on both sides of all filters and coils (actual.)
5. Test and record fan RPM (design and actual.)
6. Record fan sheave, motor sheave, pitch diameter after adjustment (if variable), center line to center line distance from fan shaft to motor shaft, belt size, and number of belts (actual.)
7. Change sheaves, pulleys, and belts, if required to obtain design air flow.
8. Test and record fan motor horsepower, amperage, voltage, and RPM (rated and actual.)
9. Record fan motor manufacturer, model and serial numbers and service factor (actual.)
10. Record motor starter size (actual.)
11. Test and record diffuser, register and grille CFM (preliminary, design and actual) for supply, return and exhaust systems. If the return air quantities are not shown at the return grille locations on the contract documents, use the percentage method (supply air less the outside air equals the percentage of return air) and balance the return air grilles accordingly.

12. Test and record main duct traverse readings for all air handling units and fans (preliminary, design and actual.) This shall include exhaust, supply, return and outside air ducts.
13. Record each system supply air temperature, return air temperature mixed air temperature and outside air temperature (dry bulb and wet bulb) in heating and cooling modes.
14. Record air temperature and humidity in each room at time of air balance.
15. Record AHU type, location, manufacturer, model number, and serial number.
16. Mark all damper quadrants as to final adjusted position, and lock into place.
17. Check fan rotation on all fan units.
18. Check filters for cleanliness prior to balancing. Test only with new, clean filters of the type specified in place.
19. In cooperation with the control manufacturer's representatives, set and adjust all automatically operated dampers to operate as specified.
20. Record the date, time, outside temperature and outside humidity at the time of recording unit temperatures.

3.4 TESTING TOLERANCES

A. Air and water balancing shall be as follows:

1.	Air Units	± 5%
2.	Exhaust Fans	± 5%
3.	Grilles and Registers	± 5%
4.	Heat Pumps	± 5%

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

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. Work required under this section consists of insulation for piping and duct systems and equipment as hereinafter specified.

B. The work of this section is subject to the requirements of the Mechanical Common Work Results and Basic Material Specifications.

1.3 QUALITY ASSURANCE

A. All materials used for insulation of pipe and ducts and equipment covered in this section shall be UL listed. Fire hazard ratings shall be as follows:

1. Flame spread of 25, and smoke development of 50 for all duct insulation and other insulation located in ceiling plenums or rooms utilized for return air plenums.
2. Flame spread of 25 and smoke development of 200 for other pipe and equipment insulation.

B. Increase the insulation thickness of ½" on all piping outside the building insulation envelope and weatherproof with 0.016" thick aluminum jacket with aluminum fitting covers.

C. All insulation and thicknesses are selected to meet the International Energy Conservation Code.

PART 2 - PRODUCTS

2.1 FLEXIBLE TUBULAR ELASTOMERIC

A. Provide fire-retardant closed-cell slip-on flexible type. Product must be guaranteed by manufacturer to have continuous operational temperature limit of not less than 180°F and a minimum "R" value of 3.57 at 75°F 50% RH. Provide insulation for the following:

1. Refrigerant suction and hot gas bypass lines - ½" thick on lines 1" or less - 1" thick on lines larger than 1". Install a 0.016" thick aluminum jacket on insulation outside the building.

2.2 FIBERGLASS BLANKET FOR DUCTS

A. Provide 2" thick 3/4" lb. density fiberglass blanket insulation with FSK or FRK jacket installed R value of 5.6. Install according to manufacturer's recommendations. For ducts 30" wide and over support insulation on bottom of duct with rows of welded insulpins on 18" center. Lap jacket 2" at seams and vapor seal. Provide this insulation for the following:

1. All supply air ducts. Supply ducts exposed in conditioned spaces do not require external insulation.
2. Outside air ducts.
3. Top of supply air diffusers.
4. Unlined return air ducts in attic or plenum spaces not heated or cooled.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all insulation products in strict accordance with manufacturer's instructions.

B. All items requiring service such as strainers, balancing valves, etc., provide removable insulation caps of insulation equal in thickness to pipe covering.

C. Cover and repair all joints, rips, tears, punctures, staples, insulpins, and other breaks in the insulation vapor barrier jacket with sections of foil tape to match the insulation vapor barrier facing. The integrity of the insulation vapor barrier shall be maintained.

D. No insulation shall be cut where a hanger is located.

E. Flexible tubular elastomeric piping installation shall be as follows:

1. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be adhered and sealed using Armstrong 520 Adhesive. When using AP Armaflex SS only the butt joints shall be adhered using 520 Adhesive.
2. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints.
3. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives must be used.
4. Seams shall be staggered when applying multiple layers of insulation.
5. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with 520 Adhesive.

Screwed fittings shall be sleeved and adhered with a minimum one inch overlap onto the adjacent insulation.

6. Valves, flanges, and couplings shall be insulated using Armaflex donuts that shall then be covered with sheet or oversized tubular insulation.

END OF SECTION 23 07 00

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Warranty:

1. Provide a full 2-year parts and labor guarantee on the complete control system. This includes valves, dampers, actuators, controllers, wiring, programs and building controllers.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

a. Wiring diagrams for control units with termination numbers.
b. Schematic diagrams and floor plans for field sensors and control hardware.

c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
c. Written description of sequence of operation including schematic diagram.
d. Points list.

C. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

1.6 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

A. Available Manufacturers:

1. Trane.
2. Automated Logic Corporation.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control controls equipment.

3.2 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

B. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

C. Install labels and nameplates to identify control components according to Division 23 Section "Common Work for HVAC."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, cabinets, building wire and cable according to Division 26.

B. Install signal and communication cable according to Division and as follows.

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
4. Test each system for compliance with sequence of operation.

C. DDC Verification:

1. Verify that instruments are installed before calibration and testing.
2. Check instruments for proper location and accessibility.
3. Check temperature instruments and material and length of sensing elements.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 09 00

SECTION 23 23 00 – REFRIGERANT 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. The work included under this section of the specification includes all work necessary for the complete installation of a refrigerant piping system.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING SYSTEM

A. The refrigerant piping shall be Type L copper with wrought copper fittings and high temperature solder joints, Sil-Fos, or approved equal. The piping system shall include but not be limited to the following: liquid line solenoid valves, hot gas bypass and control where noted, charging valves sight glass with moisture indicator, liquid line strainer drier, flexible connectors where required. The piping shall be installed according to the diagrams furnished by the manufacturer's Engineer for approval prior to installation. The piping system shall be tested at 200 pounds with dry nitrogen until all leaks have been made tight. After the pressure test use suitable vacuum pump to evacuate the system to a least 1000 microns, then charge the system with refrigerant, all safety and operating devices and controls shall be properly adjusted and tested for proper operation and protection of the equipment.

PART 3 - EXECUTION

3.1 Route all refrigerant piping between condensing units and evaporator coils by the most direct route possible in order to minimize refrigerant line length.

3.2 All refrigerant piping must be supported from the building structure and affixed to the structure.

3.3 Reasonable measures should be taken to insure that the installed refrigerant piping forms no traps for the system lubricating oil.

3.4 Refrigerant piping extending through the roof shall be sleeved, water proofed and flashed watertight.

3.5 All refrigerant suction and hot gas lines shall be insulated with flexible tubular elastomeric insulation as required in section 23 07 00 "HVAC Insulation" hereinbefore.

END OF SECTION 23 23 00

SECTION 23 31 00 – AIR DISTRIBUTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work required under this section includes all work necessary for the complete installation of an air distribution system.

B. The work of this section is subject to the requirements of the Mechanical General Provisions and Basic Materials specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Basic Materials and Methods, Section 230510.

B. Insulation, Section 230700.

1.3 CERTIFIED RATINGS

A. All fans shall have AMCA certified ratings and be UL listed.

PART 2 - PRODUCTS

2.1 FANS

A. Roof Exhaust Fans shall be Cook, Penn, Greenheck, or as approved low contour power roof type, each complete with: aluminum weatherproof housing with square turned down flanged base for curb mounting, centrifugal wheel; vertical grease lubricated ball bearing motor; vibration absorbing mountings for all rotating parts; bird screen; gravity back draft shutters; and direct or belt drive , as required for the fan involved. Belt drive fans shall have sealed permanently lubricated ball bearings, Vee belt drives, adjustable pitch motor sheaves, and belt adjusting means. Eash ½ hp and smaller single phase roof fan shall have suitable toggle type disconnect switch furnished and mounted in the fan enclosure by the fan manufacturer.

1. Roof curbs: All roof curbs shall be of galvanized steel construction with flashings, roof fastenings, and 1" thick fiberglass anti-sweat thermal insulation. Provide sloped curb if required by roof pitch. Roof curbs shall be selected to match the roof conditions. As a minimum, the exhaust fan base must be 12" above the roof, with height of the curb to compensate for roof insulation thickness. Contractor should determine exact height of curb required at each unit location and shall verify roof construction with the architectural drawings and specifications and existing conditions if warranted.

2. Excessive noise: At Contractor's expense, each roof exhaust fan which has a sound level higher than that scheduled for the fan involved or is otherwise excessively noisy shall be removed and replaced with an acceptable roof exhaust fan.

B. Ceiling fans shall be direct drive centrifugal type with grille, insulated housing, wall switch, backdraft damper, and discharge duct to roof with roof jack.

C. In-Line Fans shall be duct mounted type, direct connected or belt drive as scheduled, each complete with: square or tubular metal housing, with duct connection flanges: NEMA Standard 1,800 maximum rpm sealed grease lubricated ball bearing motor; centrifugal wheel; and vibration absorbing mountings for rotating parts or entire fan assembly. Each belt drive fan shall have: fan shaft mounted on grease lubricated ball bearings, either sealed type or with accessible lubricating fittings on housing exterior; Vee belt drive: adjustable pitch motor sheave ONLY for fan with single belts; belt adjusting means; and belt guard.

2.2 DUCTWORK

A. Type:

1. All ductwork shall be sheet metal unless noted otherwise (26 ga. minimum.)
2. Ductwork type as follows:

   a. Supply return and outside air duct on constant volume system to be low pressure.
   b. Exhaust duct to be low pressure.

B. Low Pressure Sheet Metal Ductwork:

1. Sheet metal work, unless noted otherwise, shall be fabricated of Armco Zincgrip-Paintgrip galvanized steel where exposed to weather or to be painted. Sheet metal for concealed ductwork shall be fabricated of galvanized steel, and a "Bethcon", as manufactured by Bethlehem Steel Company, or "Softite", as manufactured by Wheeling or approved substitute.
2. Ducts shall be sizes shown on the drawings, crossbroken, rigidly braced, adequately supported and securely fastened in place. Fabricate and install ducts in accordance with latest SMACNA Duct manual details.
3. Duct connections 24" wide and larger to be made using the "Ductmate System" or approved substitute. The installation to be complete using angles, corners, cleats, gaskets, sealer, and bolts. Install according to Manufacturers instructions.

C. Circular Duct:

a. All duct and fittings shall be as manufactured by United Sheet Metal or an approved substitute All duct and fittings shall be as manufactured by United Sheet Metal or an approved substitute.
b. Prior to bidding any company expecting to be named by the contractor as a supplier of the high pressure ductwork shall have on file with the design engineer

certified copies of test data made by an independent United States Laboratory covering all pipe and fittings as manufactured by that supplier.

c. The spiral duct test data shall cover leakage rate, bursting strength, collapsing strength, seam strength and friction loss. Friction loss test data shall cover both the duct and the assembled coupling joints. This friction loss data shall be equal to or less than the friction loss data used in the design of this system.

d. Round duct shall be manufactured of galvanized steel meeting ASTM A-527-67 by the following methods and in the minimum gauges listed:

Diameter	Minimum Gauge	Method of Manufacturer
3" – 14"	26 GA	Spiral Lockseam
15" – 26"	24 GA	Spiral Lockseam
28" – 36"	22 GA	Spiral Lockseam
37" – 50"	20 GA	Spiral Lockseam
51" – 60"	18 GA	Spiral Lockseam
61" and up	16 GA	Longitudinal Seam

Fittings and couplings shall be of the following minimum gauges:

Diameter	Gauges
3" – 36"	20GA
38" – 50"	18GA
Over 50"	16GA

e. All 90° tees and 45° laterals (wyes) up to and including 12" diameter tap size shall have a radiused entrance into the tap, produced by machine or press forming. The entrance shall be free of weld build-up, burrs, or irregularities.

D. Leakage Testing of Installed System Acceptance Criteria:

1. The installed duct system shall be tested to the designed operating pressure. This includes supply, return, and exhaust duct.
2. The air leakage at the test pressure shall be measured by a calibrated orifice type of flow meter. Total allowable leakage of the system shall not exceed ½ % of the air handling design capacity of the system.
3. Leakage concentrated at one point may result in objectionable noise even if the system passes the leakage rate criteria. This noise source must be corrected to the satisfaction of the engineer.
4. The orifice flow measurement device must have been individually calibrated against a primary standard, and this calibrated curve permanently attached to the orifice tube assembly.

E. Joint Sealing:

1. All joints shall be sealed with an approved duct sealer specifically formulated for sealing the field joints in duct systems. Sealer for low pressure duct systems (<2"w.g.) shall be Ductmate Proseal or Foster 32-17 water based sealants.
2. Flanged joints shall be sealed by neoprene rubber gaskets.

2.3 DUCT ACCESSORIES

A. Fire Dampers – All fire dampers shall be Type B, constructed and tested for compliance with the latest edition of UL Standard 555. All dampers shall bear the UL label. Each damper shall be suitable for use in either the horizontal or vertical position and must include an integral dive spring. Sleeves and collars shall be furnished with fire dampers. Dampers shall be designed so as not to restrict air flow. A suitable access door in duct shall be provided for resetting all fire dampers. Install all dampers in accordance with all manufacturer installation instructions.

B. Manual Balancing Dampers:

1. Manual balancing dampers in rectangular ducts shall be American Warming. Dampers in duct runs and branches shall be Model VC-21. Dampers to be constructed of 16 ga galvanized steel, with vinyl seals for low leakage at shutoff. All dampers to be caulked with silicone between damper and duct, and have external adjustment marked Open-Closed. Dampers shall be furnished with controls when motor operated. Dampers to be opposed blade type if either side is 12" or larger. Dampers under 12" may be single blade type.
2. Manual Balancing Dampers in round ducts shall be American Warming Model VC-22 in sizes up to and including 10" and Model VC-23 in sized 12" and larger. Dampers to be 16 ga galvanized steel. Provide EPT sponge seals for low leakage.
3. Dampers to have 1% leakage rate at 1" wg duct pressure in accordance with AMCA 500.
4. All dampers to be installed with 2" standoff bracket.
5. Dampers with motor operated control to be furnished under Section 15900 by control contractor.

C. Flexible Duct:

1. Flexible connections from main to terminal supply diffusers may be used above accessible ceiling areas.
2. Flexible duct shall be UL listed Class 1 air duct connector and be Flexmaster type 4M or approved substitute, with 1-1/2", ¾ pound density glass fiber with flame resistant vapor barrier, R=6.0. maximum lengths not to exceed 6 feet. Provide airtight inner liner, wire helix, and reinforced metalized outer jacket.
3. Use adjustable steel strap clamps for flexible nylon wire ties when attaching flexible duct to sheet metal collars. Wrap duct and collar with 2" wide cut tape before attaching clamp.
4. System to be UL 181, SBCC, BOCA, NFPA 90A & 90E, and HUD approved.
5. Do not us flexible duct in return or exhaust systems.

D. Grilles, Registers, and Ceiling Outlets:

1. All flat grilles and registers shall be as scheduled on drawings, or approved substitute, as scheduled on the drawings, with baked enamel finish; color as selected by Architect.
2. Coordinate location with reflected ceiling plans.
3. Provide square to round adaptors if required.

4. All outlets and inlets to have sealing gaskets and volume control dampers. Provide frame suitable for wall or ceiling installation used. Verify with Architectural drawings.
5. Diffusers in UL ceilings to be steel with radiation damper and insulation blanket.

E. Flexible Connectors:

1. Provide flexible connectors between each air unit or fan and the duct distribution, on both the supply side and the return side.
2. Connectors shall not exceed 10 inches in length.
3. Connectors to be of an approved flame retardant fabric with a maximum flame spread of (25) and a maximum smoke development rating of (50).
4. All connectors on supply duct to be insulated.

F. Branch Connections:

1. Main Supply Branch: (See SMACNA Manual Figure 2-7, 2-8) use unvaned radius transition elbow with splitter damper when branch width is 36" or smaller, and vaned square throat transition elbow when branch width is larger than 36".
2. Sub-Branch Supply: (See SMACNA Manual Figure 2-16) use straight tap with extractor, having manual control rod extended thru main branch side, when extractor, when extractor weight is 50 lbs or less. For sub-branch sizes where extractor would be heavier than 50 lbs, use 45° or radius entry clinch lock collar. (See SMACNA Manual Figure 2-8, and manual balancing dampers.)
3. Sub-Branch Return: (See SMACNA Manual Figure 2-8) use 45° or radius entry clinch lock collar. (Provide each with manual balancing damper.)
4. Round Supply Take-Offs: Use factory fabricated rectangular to round type galvanized steel fittings and 26 ga manual balancing damper with 2 wing nuts and handle. System to be Crown Model 3300-DS or approved substitute. Provide 2" stand off bracket.
5. Round Return/Exhaust Tap-Ins: Use factory fabricated beaded straight spin-in-type galvanized steel tap fittings.
6. For low pressure return and/or exhaust application of duct connectors to square ceiling mounted grilles or registers, use factory fabricated square-to-round galvanized steel minimum 3" deep adapter boxes having 2" long beaded round collar.

G. Vanes and Deflectors:

1. Vanes and deflectors to be galvanized steel sheet same thickness as used in ductwork of corresponding size. Vanes to be securely anchored to duct or casing and have freestanding edges braced as necessary for making rigid.

H. Transitions:

1. Increase-In-Area Transition: Transformation slope not to exceed 20°.
2. Decrease-In-Area Transition: Transition slope to be maximum 30°, but 20° if preferable.
3. Angle of transformation at connections to heaters or other equipment not to exceed 30° on approaching side of equipment and 45° on leaving side. Angle of

approach may be increased to meet space conditions when transformation section if provided with vanes.

I. Elbows:

1. Elbows shall be either full radius type or square throat with turning vanes. No mitered elbows allowed. Short radius elbows with vanes also allowed.
2. Unvaned full radius elbow, shall have throat radius equal to width of duct and full heel radius over 36" in width.
3. All square heel elbows shall have 3" square throat elbow with large class single thickness vanes thru 36" unsupported vane length and large double thickness vanes for unsupported vane length of 37" thru 72" as per SMACNA Manual Figures 2-3 and 2-4.

2.4 ELECTRIC COILS

A. The electric heating coils shall conform to the applicable portions of Paragraph 422-27 of the National Electric Code, shall be Underwriters' listed, and suitable for the use intended. The heaters shall be for the voltage and phase called for on the drawings or equipment descriptions. Multiple step heaters shall be so arranged that stratification of the heat through the heater will be at a minimum when operating at light loading. Each heater shall be complete with enclosed contactors, air flow switch, control voltage transformers, 200° F high limit thermostat, internal wiring to enclosed terminal, internal fusing, and be ready for connection by the electrician. The number and capacity of the heaters and circuits shall be as called for on the drawings.

B. Where required, fused disconnect switches shall be furnished for the heaters. The contractor shall make an allowance in his price for all field wiring and materials not shown or included on the electrical drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Air Distribution Equipment as specified above and as recommended by manufacturer.

B. Sheet metal ducts shall be securely supported, hung or suspended by metal trapeze hangers or straps having a minimum width of one inch. Nails or screws shall not be driven through the duct walls.

C. All duct joints and seams shall be securely fastened and sealed to make air tight. All leaks shall be sealed with Hardcast.

D. All exposed openings in fan housing shall be protected with screens or gratings. All fans shall have belt guards on exposed drives.

E. Flexible duct connectors shall not pass through a fire wall or a partition having a fire resistance rating of (1) hour or more.

F. Do not install flexible ducts that have more than a 90° turn.

G. Contractor to verify duct sizes and fittings required with actual field measurements before fabrication of ductwork. The contractor shall not receive compensation for duct work fabricated that cannot be used. See Section 3.02.

3.2 EXCESSIVE NOISE AND VIBRATION

A. All air distribution equipment was selected for a noise level recommended for the space it serves. Any equipment causing excess noises or vibration will be replaced at the contractor's expense.

END OF SECTION 23 31 00

SECTION 23 74 13 - PACKAGE ROOFTOP UNIT

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. The work included under this section includes all work necessary for the installation of package rooftop units.

PART 2 - PRODUCTS

2.1 PACKAGE ROOFTOP UNITS

A. Furnish and install single zone rooftop units of size and capacity indicated on the drawings. Unit shall be low silhouette, completely assembled including piping and wiring, charged with refrigerant and fully run tested prior to shipment. Approved manufacturers shall be Trane or approved equal. However, the approved manufacturers must meet the requirements contained in this section of the specifications.

B. General - Units shall be downflow or horizontal airflow as indicated on drawings. Operating cooling range shall be between 0°F and 115°F. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410 and 100 percent run-tested before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Wiring shall be secured to housing of unit in protective raceways or conduit. Units shall be UL listed and labeled. Gas heating unit to be AGA approved.

C. Casing - Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized and finished with a weather-resistant baked enamel finish. Cabinet construction shall allow for all maintenance on one side of the unit. All panels to be sealed and gasketed. The downflow unit's base pan shall have no penetrations within the perimeter of the curb other than the raised supply/return openings to provide an added water integrity precaution if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting. Insulate all interior surfaces with 1/2" thick foil faced fiberglass insulation. Insulate base of unit with 1/8" foil faced closed-cell insulation.

D. To insure rainwater integrity of the unit, there shall be no electrical wiring penetrating

any panel in the evaporator section or any panel of the base of the unit. Provide adequate access for power wiring within curb. Coordinate with electrical contractor.

E. Unit Top - The top cover shall be one piece or where seams exist, it shall be double hemmed and gasket sealed to prevent water leakage and sloped to prevent water standing.

F. Provide factory mounted hinged access doors to access filters, evaporator, supply fan, heat, compressor, and controls for all units. Doors shall have (2) quick release quarter turn door handles.

G. Filters - Provide 2" thick, UL Class 1, FARR 30-30 filters for all units unless otherwise specified. Provide filter rack sized for 2" filters access and to permit easy filter removal. The filters shall have non-creased radial pleat design with media support grip and enclosing frame. Filters shall have 30% efficiency based on ASHRAE Test Standard 52-76. Initial resistance shall be 0.08"WG at 250 FPM.

H. Compressors - All units shall be direct-drive hermetic scroll type compressor(s) with centrifugal oil pump providing positive lubrication to moving parts. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Crankcase heater, internal temperature and current-sensitive motor overloads shall be included for maximum protection. Compressor shall have spring or neoprene isolation and sound muffling to minimize vibration transmission and noise. Units over 6 tons shall have dual compressors.

I. Refrigerant Circuits - Each refrigerant circuit shall have independent thermal expansion valve, service pressure ports and refrigerant line filter driers factory installed.

J. Hot Gas Reheat – If scheduled, this option shall be factory-installed to provide demand dehumidification control independent from a call for cooling. This option shall consist of a hot-gas reheat coil located on the leaving airside of the evaporator coil pre-piped and circuited.

K. Evaporator and Condenser Coils - Coils shall be internally finned 5/16" copper tubes mechanically bonded to configured aluminum plate fin. Aluminum construction Microchannel condenser coils shall be acceptable. Coils shall be leak tested at the factory to ensure pressure integrity. The evaporator and condenser coil shall be leak tested to 600 psig.

L. Provide toolless condenser coil hail guards.

M. Gas Heating Section - The heating section shall have a progressive tubular heat exchanger design using stainless steel burners and corrosion resistant steel components. A forced combustion blower shall supply premixed fuel to a single burner ignited by a pilotless hot surface ignition system. A negative pressure gas valve shall be used that requires blower operation to initiate gas flow. On an initial call for heat, the combustion blower shall purge the heat exchanger 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat. Units shall be suitable for use with natural gas.

N. Outdoor Fans - The outdoor fans shall be direct-drive, statically and dynamically balanced, draw through in the vertical discharge position. The fan motor(s) shall be permanently lubricated and have built-in thermal overload protection.

O. Indoor Fan - Units shall have a direct or belt drive, FC centrifugal or plenum fan. Belt driven fans shall have an adjustable idler-arm assembly for quick-adjustment to fan belts and motor sheaves. All motors shall be thermally protected. Electronically commutated motors shall be acceptable. Oversized motors shall be used where high external static pressure is noted on drawings.

P. Controls - Unit shall be completely factory wired with necessary controls and contact or pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting fused disconnect device. Micro-processor controls shall be provided for all 24 volt control functions, to make all heating, cooling and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. A centralized Micro-processor shall provide anti-short cycle timing and time delay between compressors. Provide 120V amp 2 plug powered convenience outlet.

Q. Single Zone VAV control – If scheduled, the microprocessor controller shall vary the indoor fan speed as the zone cooling load changes, while cooling capacity is cycled to maintain the supply air temperature setpoint. The indoor fan shall operate at maximum speed whenever the heater is operating. Units 5 tons and less shall have 2 stage compressor.

R. Phase Monitoring protection – Unit shall have factory mounted phase monitor to provide protection against phase loss, phase imbalance, and phase reversal.

S. Roof curbs: All roof curbs shall be of galvanized steel construction with flashings, roof fastenings, and 1" thick fiberglass anti-sweat thermal insulation. Provide sloped curb if required by roof pitch. Roof curbs shall be selected to match the roof conditions. As a minimum, the rooftop air unit base pan must be 12" above the roof, with height of the curb to compensate for roof insulation thickness. Contractor should determine exact height of curb required at each unit location and shall verify roof construction with the architectural drawings and specifications and existing conditions if warranted. Provide field fabricated sheet metal extension between duct from building thru curb to bottom of roof top unit. Do not use curb as plenum.

T. Economizer - The assembly to include fully modulating 0-100 percent motor and dampers, barometric relief, minimum position setting, preset linkage, wiring harness with plug. Solid state enthalpy and differential enthalpy or dry bulb control shall be provided as indicated on drawings and factory-supplied and installed.

U. Motorized Outside Air Dampers - Manually motorized set outdoor air dampers shall provide up to 50 percent outside air, see drawings for actual amount. Once set, outdoor air dampers shall open to set position on call for heating and cooling. The damper shall close to the full closed position when request is satisfied. Provide full economizer intake hood with insect screen.

PART 3 - EXECUTION

3.1 The manufacturer's authorized representative shall supervise the mounting, installation, power, start-up and control wiring (including interlocks) and upon job completion notify the Designer in writing that all are operating properly and are complete and satisfactory in every respect. He shall be responsible for complete start-up and checkout.

3.2 Rooftop units are selected and located by the Designer to produce minimal sound and vibration to the space. Manufacturer to review drawings prior to bidding and notify the Designer if design revisions should be made to accept this unit.

3.3 Provide full 12 months warranty on all parts and labor. Provide a four year extended warranty (parts only) remainder of unit.

3.4 The weight of the unit shall be equal to or less than the unit scheduled on the drawing.

3.5 Verify prior to bidding that the units meet the electrical characteristics shown on the drawings. This includes voltage, full load amps and disconnect (as shown on electrical drawings). The successful manufacturer shall notify the contractor the size of his required disconnect.

3.6 FILTER MEDIA FILL

A. Provide initial filter media fill as described hereinbefore for each filter of each type installed for testing and adjusting AC system and left in place for Owner's immediate use.

B. Provide one complete fill and each filter of each type for Owner's future use. Store all media on premises in factory sealed containers, at a location as directed by the Owner's authorized representative. Obtain a signed receipt for these filters and include in project close-out documents.

END OF SECTION 23 74 13

SECTION 23 75 13 - SPLIT SYSTEM HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Split System Heat Pumps.
2. Condensing Units

B. Related Sections:

1. Division 23, Section "Testing, Adjusting and Balancing" for HVAC.
2. Division 23, Section "Instrumentation and Controls" for HVAC.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM HEAT PUMP (INDOOR UNIT)

A. The integral fan section shall consist of a belt-driven, centrifugal type blower mounted on a rigid steel frame secured to the blower housing by rubber mounts. Blower wheels shall be statically and dynamically balanced. Wheels shall be carried on rubber enclosed, self-aligning, solid bronze grooved, graphite filled bearings provided with grease cups for lubrication. Motor mount design shall permit both belt adjustment and pulley alignment.

B. The cooling section shall consist of a DX coil, split face capacity mounted in a cabinet, matching the main blower cabinets. Refrigerant lines shall be factory piped to outside of the cabinet and the thermostatic expansion valve shall be factory installed. Condensate drain pan shall be 1-1/2" deep, coated on both sides with corrosion resistant material and shall have two 3/4" drain connections. Coil cabinet shall be factory insulated with foil covered insulation.

C. The heating section shall be electric of the specified size shown on the drawings. The electric heating element shall be low watt density, open-wire type element designed for single zone application. The heating bank shall be equipped with automatic, and manual reset high temperature safety cut-outs, contactors, and divided into not more than 48 amp circuits with 60-amp fuses all pre-wired to the main control panel. The heating element shall be circuited to prevent electric heating operation during the

cooling cycle. Internal heating and cooling power wiring shall terminate at a single junction in the unit panel.

D. Air Filters:

1. Provide each air handling unit with a 1" thick pleated disposable filter, Farr 20-20 or approved equal. The filters shall be UL Class 2, with 20% efficiency based on ASHRAE Test 52-76. Each filter shall have a non-woven cotton and synthetic fabric media, with media support grid and enclosing frame. Initial air resistance to be 0.09" WG at 250 FPM.
2. Provide an initial fill of filter media as described above installed for testing and adjusting of system and left in place for Owner's immediate use. Additionally, provide one complete spare fill for each filter of each size for Owner's future use. Store all spare media on premises in original factory sealed containers, at a location as directed by the Owner's representative and obtain a signed and dated receipt for this spare media from the Owner's representative.

E. Provide a low-voltage, two-stage heating, one or two stage cooling thermostat with automatic changeover. Provide clear plastic locking cover. All unit wiring and controls shall be in accordance with NFPA requirements. All controls shall be furnished with the equipment as described under controls.

F. Each unit shall be suitable for air-to-air heat pump operation with a HSPF of not less than 9.0 at 47 degrees DB outside air, and a total unit cooling EER of 12.5 or greater when tested in accordance with ARI Standard 240. Each shall have an automatic defrost system, electric device to provide minimum of a 5 minute delay to prevent short cycling, emergency heat switch and indicator light to energize auxiliary heat if the compressor is inoperative due to a tripped safety device. Units shall bear UL and ARI labels. Units shall be covered by a 1-year warranty on all parts, including labor for replacement, plus an additional 4 year warranty on compressor.

G. A unit electrical disconnect shall be integral and furnished with the unit.

H. All units shall be of the same make and manufacturer.

2.2 OUTDOOR AIR-COOLED CONDENSING UNIT

A. Provide air to air electric heat pump condensing unit of cooling capacity noted on drawing and/or schedule.

B. Compressor unit(s) shall be welded, fully hermetic with crankcase heater(s) and vibration isolators. Units shall be designed to operate at +30 degrees F ambient on heating. Compressors shall have 5-year warranty.

C. Condenser fans and motors shall be direct drive fans with aluminum blades and zinc plated steel hubs. Motors with permanently lubricated ball bearings and built-in current and thermal overload protection. Vary condenser fan speed to provide low ambient cooling as called for on drawings.

D. Condenser coils shall be air-cooled condenser coil, aluminum fin secondary surface mechanically bonded to primary surface of seamless copper tubing. Sub-cooling circuit with liquid accumulator. Factory tested at 425 psig air pressure under water. Vacuum dehydrated at 175° F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all units in strict accordance with manufacturer's installation and mounting instructions. Install units plumb and level, firmly anchored in locations indicated.

B. Provide the services of a manufacturer's authorized representative to supervise the mounting, installation, power, and control wiring (including required interlocks) of all units. Upon completion of all work, notify the engineer in writing that all units are operating properly, and are complete and satisfactory in all respects.

C. Verify prior to bidding that all units meet all electrical characteristics shown in the contract documents. This shall include voltage, phase, full load amps and overcurrent protection. Coordinate exact electrical requirements with electrical contractor prior to rough-in.

D. Provide full twelve month warranty for all parts and labor. Provide an extended four year warranty (parts only) for compressors.

E. Install full size type "M" copper condensate drain with 4" deep p-trap running to floor drain.

F. All units shall have an auxiliary drain pan with a float switch wired to shut units down on water rise.

3.2 FILTER MEDIA FILL

A. Provide initial filter media fill as described hereinbefore for each filter of each type installed for testing and adjusting AC system and left in place for Owner's immediate use.

B. Provide one complete fill and each filter of each type for Owner's future use. Store all media on premises in factory sealed containers, at a location as directed by the Owner's authorized representative. Obtain a signed receipt for these filters and include in project close-out documents.

END OF SECTION 23 75 13

SECTION 23 75 15 - OUTDOOR WALL MOUNTED HEAT PUMP

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. The work required under this section includes all work necessary for the installation of a wall mounted heat pump through the wall unit.

B. The work of this section is subject to the requirements of the Division 23.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish and install a one-piece wall mounted, factory-assembled, pre-charged, pre-wired, tested and ready-to-operate heat pump unit. The unit is to be manufactured by Bard Mfg. Co. The unit shall be approved and listed by Underwriters' Laboratories, Inc. and CSA for installation on combustible surfaces for zero clearance between the unit and wall. For the first three feet the supply duct must be approved for zero clearance to combustible material.

2.2 Compressor shall be a welded hermetic type with internal vibration isolations, built-in thermal and over current protective devices. Compressor shall have a 5-year warranty, suction and discharge gauge ports, crankcase heater on reciprocating compressor.

2.3 Coils shall be of copper tube construction with mechanically bonded aluminum plate fins. The refrigerant control shall be factory installed capillary tube type.

2.4 Blowers and fans - Indoor coil blowers shall have a centrifugal forward curved blower direct driven by a 2 speed motor. Indoor blowers shall discharge horizontally and deliver CFM called for on drawings.

2.5 Propeller type outdoor coil fan shall discharge horizontally and be direct driven.

2.6 Condenser fan, motor and shroud - Condenser fan, motor and shroud shall be of "slide out" configuration for easy service and maintenance.

2.7 Controls shall be factory wired and placed in a readily accessible location. Fan motors shall have both thermal and current sensitive overload devices. Control circuit transformer (24V) shall be factory installed. The unit shall be factory wired. Furnish connection interface for Facility's Building Automation System.

2.8 Other options to include:

A. Two inch pleated filter.

B. Hot gas reheat dehumidification.

C. Commercial Room ventilator with spring return.

D. Energy recovery ventilator with exhaust.

E. Low ambient cooling control.

F. Low Pressure control.

2.9 STANDARD ONE-YEAR WARRANTY

A. Units shall be warranted against any and all defects in material and workmanship for a period of one year from date of original installation. This warranty covers repairs or replacement of alleged defective parts which shall be returned, transportation charges prepaid, to manufacturer for examination and determination as to liability. Replacements will be shipped F.O.B. factory, manufacturer shall not be liable for, consequential damage, reinstallation expense, field labor charges, or the cost of service calls to analyze problems.

2.10 EXTENDED FOUR-YEAR COMPRESSOR WARRANTY

A. Provide an additional four-year warranty on the compressor only. This additional four-year warranty becomes effective upon the expiration date of the standard warranty listed above and is limited to replacement of a defective compressor only. Specifically excluded are: loss of refrigerant, electric controls, relays, pressure controls, fan and motor assemblies, and connecting refrigeration tubing or electrical wiring.

B. Any part of the compressor which becomes defective as a result of negligence, Owner's failure to provide normal maintenance, improper repair or alteration.

C. Field labor costs for removal of compressor, transportation to exchange agency, and installation costs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and adjust for operation per manufacturer's instruction.

B. Provide factory authorized start-up and check-out.

END OF SECTION 23 75 15

SECTION 23 81 15-THRU-WALL HEAT PUMP

1.0 GENERAL

A. Furnish and install a self-contained, vertical, floor standing, interior mount, thru-the-wall, heat pump to be manufactured by Bard Manufacturing Company, Inc. The unit shall be approved and listed by Intertek ETL Listed (ETL US/C). Unit shall be factory assembled, pre-charged, pre-wired, tested and ready to operate. Unit performance shall be certified in accordance with the Air Conditioning Heating and Refrigeration Institute (AHRI) Standard 390-2003 for Single Package Vertical Units (SPVU). Unit efficiency shall be specified in terms of EER, IPLV, and COP.

1.1 WARRANTY

A. Unit shall include 5-year parts warranty covering compressor, and 5-year warranty covering parts, heat exchange coils, ventilation packages, subject to terms and conditions of Bard Limited Warranty agreement. No labor is included in Bard warranty.

B. Manufacturers: Capacities shall be as indicated on drawings and units shall be manufactured by Bard Manufacturing Company, Inc. or prior approved equal.

PART 2 - CONSTRUCTION FEATURES

2.0 CABINET

A. Constructed of 20 gauge pre-painted steel exterior finish. Exterior panels shall be of double wall construction. No screws are exposed on the exterior panels.

B. Coordinate color with Architect.

C. Front panel is hinged and lockable for filter service and access to primary functional electrical controls. Front and side panels are easily removable for separation of top and bottom sections. Back of unit to be painted in neutral color to reduce visibility from outdoors.

2.1 MODULAR CONSTRUCTION

A. Exterior panels shall be easily removable, and cabinet shall consist of two modules, easily separated by removing 4 bolts, with fork slots allowing for modules to be separated. One module shall contain complete sealed refrigeration system and one module shall contain the ventilation system. Each module shall pass thru standard door frame, and into standard sized elevator doors without tilting or laying equipment down.

2.2 INSULATION

A. No fiberglass insulation shall be exposed to the airstream. Exterior cabinet components shall consist of double wall construction with insulation between panels.

2.3 INSTALLATION LOCATIONS

A. Unit shall be suitable for right or left hand corner installation without modification. No clearance is required. All service access shall be thru the front of the unit. Side supply air grilles on air distribution box shall include adjustable opposed dampers to limit airflow in corner installations.

2.4 COMPRESSOR

A. All models shall use a high efficiency 2-stage scroll compressor for maximum efficiency and reliability. Equipment shall be designed to provide 2 stages of cooling and reverse cycle heating. The compressor shall be covered by a 5-year parts warranty. The refrigeration circuit shall be equipped with factory installed high and low pressure controls, liquid line filter dryer, and discharge muffler.

B. Modulating low ambient control to 20 degrees shall be factory installed.

C. The compressor shall be mounted on double floating isolation mounting system and be fitted with factory installed sound attenuation jacket.

D. The refrigeration control shall be a factory installed TXV. Heating and cooling TXV shall be provided. Refrigerant shall be R-410A.

2.5 CONDENSATE DRAIN SYSTEM

A. Condensate shall be removed from the unit by connections located in the back of the unit. Both indoor and outdoor coil drain pans shall be constructed of non corrosive materials and shall not allow standing water in the drain pan. A condensate overflow protection system shall monitor both drain pans and shut down system to prevent condensate overflow.

1. Two condensate drain connections are manifolded together providing for either right or left access.
2. The I-tec does not require a trap. The lower rear portion of the cabinet provides room for P trap if required.

2.6 CONDENSER FAN MOTOR

A. The condenser fan motor shall be variable speed ECM, allowing for modulating low ambient control and low sound performance.

2.7 INDOOR BLOWER MOTOR

A. The indoor blower motor shall be a variable speed (ECM) type to produce the same rated air flow from 0 to .5 inch WC of external static pressure at low sound levels. The motor is to be self adjusting to provide proper rated air flow at high static pressures without user adjustment or wiring changes by the user. The motor shall be programmed for 20-second ramp up and 60-second down rate for quiet, smooth starting and stopping. PSC motor shall not be acceptable. Motor shall automatically adjust to proper blower speed:

Ventilation, stage 1 cooling or heating operation, stage 2 cooling or heating operation. Submittals shall include rated cfm for high speed, low speed, and ventilation speed.

2.8 ELECTRICAL COMPONENTS

A. Electrical components are easily accessible for routine inspection and maintenance through front service panels. Circuit breaker is standard on all 208/230 volt models and toggle disconnect standard on all 460 volt models. Circuit breaker/toggle disconnect access is through lockable access panel. Lock and key are provided with each unit. Unit shall have single point entry for line voltage. Electrical component access point shall be located at standard eye level to allow easy serviceability

2.9 CONTROL CIRCUIT

A. The internal control circuit shall consist of a current limiting 24 VAC type 75 VA transformers with circuit breaker. The defrost circuit shall consist of a solid state electronic heat pump control. A 90-minute timer shall initiate a defrost cycle if the outdoor coil temperature indicates the possibility of an iced condition. The thermistor sensor, speed-up terminal for service, and a ten-minute defrost override shall be all be standard on the electronic heat pump control. To prevent rapid compressor short cycling, a five-minute time delay circuit shall be incorporated into the heat pump control board. A low pressure bypass shall be incorporated into the heat pump control board to prevent nuisance tripping during low temperature start-up.

B. All units with 3-phase power shall include factory mounted phase rotation monitor. This device shall protect scroll compressor from reverse rotation and also protect unit from phase failure. If 3-phase power is incorrectly connected at the field power connections, the phase monitor shall lock out the unit and a red light will illuminate indicating incorrect phase. Also if a power leg is lost, the phase monitor will lockout the unit due to phase imbalance. Once the condition is corrected, turning the power off at the circuit breaker or disconnect will reset the phase monitor.

210 HEAT OPTION

A. Electric Heat

1. The heat pump shall have a factory installed electric resistance heater available that is designed specifically for application in the I-TEC Series heat pump. Heater shall include automatic limit safety controls.

2.11 VENTILATION OPTIONS

A. Energy Recovery Ventilator

1. I-TEC™ models are designed to provide independent control of ventilation air with a dedicated low voltage ventilation terminal connection. Operation of supply air fan is also required for ventilation operation.
2. Optional ventilation packages are available to meet all of your ventilation and indoor air quality requirements. All ventilation packages are factory installed.
3. The Energy Recovery Ventilator (ERV) shall consist of 2 rotary wheels in an insulated cassette frame with seals, drive motor and belt. The ERV assembly shall also include intake and exhaust blowers. The total energy wheel shall be coated with silica gel desiccant, permanently bonded without the use of binders or adhesives. The coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve or deliquesce in the presence of water or high humidity. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts shall not require external tensioners or adjustment. Cassette wheels shall include rims to prevent belts from slipping off wheels. Intake and exhaust airflow can be modulating mode (requires CO2 controller with 2-10vdc output) or can be demand control fixed mode On/Off using relay output from CO2 controller. In fixed mode the intake and exhaust rates are individually adjustable, and can be set to maintain positive pressure if desired. The ERV cassette including parts and media shall include 5-year warranty subject to terms and conditions of Bard's warranty.
4. The ERV thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and ARI Standard 1060, Rating for Air-to-Air Energy Recovery Ventilation Equipment Cassettes, and shall be listed in the ARI Certified Products. Unit complies with ANSI/ASHRAE Standard 62.1 Ventilation for Acceptable Air Quality.

2.12 FILTER OPTIONS

A. 2" pleated MERV 8

2.13 DEHUMIDIFICATION CYCLE

A. The dehumidification circuit shall incorporate an independent DX coil in the supply air stream in addition to the standard evaporator coil. This coil shall be mounted in the reheat position and sized to nominally match the sensible cooling capacity of the evaporator coil. Extended run times in dehumidification mode can be achieved using waste heat from the refrigeration cycle to achieve the reheat process, Models that also

have electric heaters installed shall have the electric heat inhibited during dehumidification mode, unless a call for emergency heat is initiated.

B. The dehumidification cycle shall be energized by a rise in relative humidity above set point. The unit shall energize in the cooling mode and also a two position valve will energize, allowing hot refrigerant gas to pass thru the reheat coil, reheating the cold air leaving the evaporator coil. The dehumidification cycle shall have on/off capability. If the thermostat calls for cooling or heating during the dehumidification cycle, the unit shall terminate dehumidification to satisfy the call from the thermostat. A solid state circuit board shall control the dehumidification function. The dehumidification option shall be factory installed only.

2.14 COIL

A. Standard evaporator coil shall be constructed of hydrophilic fin stock (green) providing acrylic coating with no bead-up condensate, lower wet coil pressure drop and improved draining and reduced re-entrainment of moisture back into the air stream. Acrylic coating shall also provide antimicrobial properties providing resistance to microbial and fungicidal growth. Coil coating shall meet ASTM D2372- no growth.

B. Standard condenser coil shall be constructed of aluminum fin stock and copper tube.

2.15 CONTROLS

A. See control description on drawings.

2.16 ACCESSORIES

A. Wall Sleeve (wall sleeve and louver required)

1. Wall sleeve shall be factory supplied and must be constructed of galvanized steel, coated with an epoxy primer and baked-on polyester enamel paint. It shall be designed to withstand a minimum of 1000 hours of salt spray protection when tested per ASTM B117-03 standard. One sleeve size fits all models (select 1 of 3 adjustable depth sleeves: 5.5" to 8.5", 8.0" to 13.5", 13.0" to 23.5"). Sleeve location shall be at least 31" above finished floor and shall be adjustable by +3". Floor base shall be provided to raise height over 34" above finished floor. Wall sleeve shall be continuous from outside wall to rear of unit for weather tight installation. See 10.6 for optional Riser Platforms.

B. Outdoor Louver Grilles

1. Furnish factory 1" louver designed for condenser air and outside air intake and exhaust. Louver shall be aluminum construction with removable core for service. Access to removable core is by tamper-proof screws. Louver shall have a powder coat finish. See our color chart for color selections.

C Air Distribution

1. For duct-free installation, the I-TEC™ shall have a discharge air plenum box with double wall construction. Exterior finished to match the base I-Tec unit, and lined on the interior with sound deadening insulation covered with perforated galvanized metal. One front and two side diffusers are required. Diffusers shall be linear slot design with heavy gauge extruded aluminum blades on ¾" centers and fixed 30-degree up angle. Side diffusers shall be equipped with rear opposed blade balancing dampers.

D. Cabinet Extensions

1. Painted 3-sided assembly to enclose ductwork, piping as required, or to fill space from duct-free plenum boxes to ceiling if desired.

PART 3 - EXECUTION

3.0 INSTALLATION

A. Installation shall be done in strict adherence to Bard's Installation Instructions.

END OF SECTION 23 81 15

SECTION 23 81 29 - MULTIPLE INDOOR UNIT DUCTLESS SPLIT SYSTEM

PART 1 – GENERAL

1.1 SYSTEM DESCRIPTION

A. The variable capacity, heat pump air conditioning system shall be Mitsubishi or approved equal.

B. The system shall consist of the outdoor unit, multiple indoor units, and DDC (Direct Digital Controls). The outdoor unit shall be a horizontal discharge, 208/230 volt, single-phase unit. Each indoor unit or group of indoor units shall be independently controlled.

1.2 QUALITY ASSURANCE

A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.

E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

PART 2 – WARRANTY

2.1 The units shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and six (6) year compressor to the original owner from date of installation.

PART 3 – PRODUCTS

3.1 OUTDOOR UNIT

A. General: The outdoor units shall be equipped with multiple circuit boards that interface to the controls system and shall perform all functions necessary for operation. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

1. The sum of connected capacity of all indoor units shall range from 50% to 130% of outdoor rated capacity.

2. Outdoor unit shall have a sound rating no higher than 59 dB(A).
3. Both refrigerant lines from the outdoor unit to indoor units shall be individually insulated.
4. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
5. The outdoor unit shall have a high pressure safety switch, low pressure safety switch and over-current protection and DC bus protection.
6. The outdoor unit shall have the ability to operate with a maximum height difference of 98 feet and have a total refrigerant tubing length of 393 feet. The greatest length is not to exceed 262 feet between the outdoor unit and the indoor units and shall not require line size changes nor traps.
7. The outdoor unit shall have rated performance for heat operation at 0°F for the ambient temperature without additional low ambient controls.
8. The outdoor unit shall be capable of cooling operation down to 23°F outdoor ambient without additional low ambient controls.
9. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

B. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

1. The unit shall be furnished with two direct drive, variable speed motors.
2. The fans will be forward curved type blades for quiet operation.
3. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
4. The fan motor shall be mounted for quiet operation.
5. The fan shall be provided with a raised guard to prevent contact with moving parts.
6. The outdoor unit shall have horizontal discharge airflow.

D. Refrigerant

1. R410A refrigerant shall be required for all outdoor unit systems.

E. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated fins on copper tubing.
2. The coil fins will have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

F. Compressor:

1. The compressor shall be a single high performance, inverter driven, modulating capacity scroll compressor.

2. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 41% of rated capacity.
3. The compressor shall be equipped with an internal thermal overload.
4. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair, non-polar shielded cable to provide total integration of the system.

3.2 WALL MOUNTED INDOOR UNIT

A. General:

1. The unit shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front.

B. Indoor Unit

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. All casings, regardless of model size, shall have the same white finish.
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

H. Controls:

1. This unit shall use controls provided by the manufacturer to perform functions necessary to operate the system.
2. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

END OF SECTION 23 81 29

SECTION 23 81 50 - DUCTLESS SPLIT SYSTEM HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. The work required under this section includes all work necessary for the complete installation of ductless split system units.

B. The work of this section is subject to the requirements of the Mechanical General Provisions and Basic Materials Specifications.

1.3 SUBMITTALS

A. Provide drawings indicating dimensions, rough-in connections, electrical characteristics, unit performance, agency listings, and connection requirements.

B. Provide manufacturer's installation and start-up instructions.

C. Provide manufacturer's color selection charts.

D. At job closeout, provide manufacturer's installation, operation and maintenance data along with product warranty certificate.

1.4 WARRANTY

A. Provide one-year warranty on all parts and five year warranty for refrigeration compressors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Furnish and install where shown on plans, ductless split system units of sizes and capacities shown on the schedule. The units shall include the indoor evaporator section and the outdoor condenser section. Approved manufacturers shall be as follows:

1. Mitsubishi

2.2 WALL HUNG EVAPORATOR SECTION

A. Provide wall hung heat pump units with back-up resistant heat as shown on schedule. Provide hanger brackets and or trim kits as applicable.

B. Cabinet shall be constructed of cold roll steel, with structural stiffeners and powder coated finish. Inlet panel construction of high impact polystyrene with perforated steel inlet grille.

C. Discharge grille shall be high temperature Noryl with adjustable vanes.

D. Condensate drain pans shall be galvanized steel with anti-corrosion coating.

E. Fan shall be tangential type, directly mounted to the motor shaft. Motor shall be PSC type with overload protection.

F. Filter shall be permanent, washable and user accessible.

G. Coil shall be seamless copper tubing, arranged in staggered configuration, with enhanced aluminum fins, tested to 460 PSIG. Tubes shall be mechanically expanded for secure bonding to fin shoulder. Connections are sweat type.

H. Controls shall include relays and connections for condensing unit.

1. Unit mounted controls with thermostat, fan speed control, and heat/cool switch.

2.3 CONDENSER SECTION

A. Provide a single zone condensing unit with 4-way reversing valve, solenoid activated by 24V, energized for cooling operation. Provide unit with a TXV with internal check valve to provide proven operation through all temperature ranges in heat pump mode.

B. Cabinet shall be constructed of G-60 galvannealed steel, finished with corrosion inhibiting, high-gloss, powder coated. Fan guard shall be heavy-gauge, vinyl dipped wire, or stamped integral to cabinet.

C. Compressor shall be hermetically sealed, high efficiency type. Motor shall be PSC type with internal overload protection. Compressor shall be installed on resilient mountings. Minimum unit SEER shall be 10.0 and minimum COP=2.8 in reverse cycle heating mode. Shall be as sche3duled on drawings.

D. The condensing unit and evaporator section shall be precharged with refrigerant. Unit refrigeration valves shall be solid brass for sweat connection.

E. The condenser coil shall be seamless, copper tubing, arranged in staggered configuration, with enhanced aluminum fins. The tubes shall be mechanically expanded for secure bonding to fin shoulder.

F. The condenser fan shall be high efficiency propeller type, directly connected to the totally enclosed PSC motor. The motor shall be internally and thermally protected. The condensing unit shall be draw-through design.

G. System options shall include low ambient operation to 0 degrees F. Other system options shall be as noted on schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine Insert products and materials before installation. Reject Insert products and materials that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install unit in accordance with manufacturer's recommendations.

B. Verify prior to bidding that all units meet all electrical characteristics shown in the contract documents. This shall include voltage, phase, full load amps, and overcurrent protection. Coordinate exact electrical requirements with the electrical contractor prior to rough-in.

END OF SECTION 23 81 50

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, Division 26.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements

1.3 SCOPE

A. The work to be performed under this section shall require the contractor to provide all, labor, materials, equipment, and services proper to the installation of the work indicated on the electrical drawings, the principle features of which are as follows:

1. A power wiring system for distribution of power throughout the building.
2. Conduit, conductors, outlets and disconnect switches, and connections for the heating, ventilation, air conditioning and plumbing facilities.
3. Fire alarm systems.

B. The drawings indicate the general character, scope and arrangement of the electrical installation. Request for any change or departure from these drawings must be submitted to the Architect for approval.

C. The contractor shall be governed by the present specifications together with the current recommendations and regulations of the following:

1. City Electrical Code
2. State Electrical Code
3. Rules of the Electric Utility Company
4. National Electrical Code
5. International Energy Conservation Code
6. International Building Code
7. N.E.M.A. Standards
8. N.F.P.A. Codes
9. Underwriters Laboratory Standards

D. Obtain all permits and inspections required for the work and pay all fees and costs thereof.

E. No changes in contract price will be allowed for alternate work which requires approximately the same amount of material and labor. The owner reserves the right to relocate any equipment up to 10 feet in any direction prior to rough-in.

1.4 COORDINATION

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

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

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

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames" and shall be furnished as required.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

E. Before submitting bid, Contractor shall visit the job site for the purpose of examining the site and conditions under which the work must be performed. No adjustment to the contract will be allowed for situations arising from failure of Contractor to thoroughly familiarize himself with site and existing building conditions, including charges and requirements from utilities as shown for the project. Contractor shall verify that connections to existing equipment are as indicated on drawings and specifications. Any deviations shall be reported to the Engineer immediately. Any deviations shall be reported prior to bidding.

F. Wiring for Mechanical Equipment:

1. All power wiring and conduit for items Furnished under Division 23 shall be furnished and installed under Division 26. See 6a. Verify the electrical characteristics of items to be connected with equipment nameplate data and drawings prior to rough-in.
2. All disconnects shall be furnished and installed by Division 26.
3. Manual motor starters for ½ HP motors and less shall be furnished and installed by Division 26.
4. Wiring and conduit for solenoid valves, and control transformers including the transformers shall be furnished and installed by Division 23.
5. Division 26 shall install all starters, toggle switches, disconnects, and all wiring to the respective motor or device. Wiring and conduit from starter to the controller or control device and any interlocked dampers shall be by Division 23.
6. Definitions:

a. Power wiring: Line voltage circuitry rough-in including conduit, boxes, conductors, etc. between the overcurrent protection and the equipment including the connection of the starters by Division 26.
b. Control wiring: Any voltage circuitry rough-in including conduit, boxes, conductors, etc. between control activator and the controller or starter by Division 23.

7. Conduit: All power wiring and line-voltage control wiring shall be in conduit.
8. Smoke Detectors and Firestats:

a. Smoke detectors shall be furnished by Division 26. Upon activation of the fire alarm system the fire alarm control panel shall send a signal to the HVAC unit controls to cause immediate shutdown. Furnish all required fire alarm control modules. Coordinate HVAC unit shutdown with mechanical contractor. Wiring from the detector to fire alarm system shall be furnished and installed by Division 26.
b. All firestats shall be furnished, installed and wired by Division 23.

G. Connect all motors with an 18" length of liquidtight flexible metal conduit. Use proper type connectors and anchors with this type conduit.

H. Refer to architectural drawings for details such as finishes, dimensions, materials, etc. Refer to equipment plans for exact location of electrical connections, which are dimensioned prior to any rough-in of work. Confirm any dimensioned drawings with equipment rough-in drawings.

I. Protection of Roof:

1. Coordinate electrical work with roofing work in regard to any electrical items which may pierce or otherwise affect the roof.
2. Arrange for any cutting or repairing to roofing which might already be installed when an electrical installation is made.
3. Roof penetrations shall not void roofing warranty. Penetrations shall be coordinated with roofing supplier holding the warranty. Electrical contractor shall coordinate with roofing supplier for installation of pre-molded pipe seal or field fabricated pipe penetration as applicable. Electrical contractor to include all costs and coordination with and for roofing penetrations, new or existing.
4. Routing of electrical wiring thru ductwork, and penetrations of ductwork or roof curbs is not allowed.

J. Record Drawings:

1. Furnish reproducible record drawings showing the changes and modifications that occurred during the construction period.
2. The job supervisor shall maintain a set of prints in the job office to be used to illustrate and note the job changes as they occur. These drawings shall be kept current daily.

K. Include in the bid price all utility company costs relative to the types of new or modified services planned. Before submitting bid, Contractor shall contact the Electric Utility Company. The Contractor shall verify with each company the final service

arrangements and all costs involved which are to be included in the bid price. The services illustrated on the drawings are based on information which was available at the time of releasing the project for bidding.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items. Where minimum clearances are indicted, measure to any protruding fasteners, supports, or other components.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements. Do not obstruct 7'-0" minimum clear headroom along service and egress paths. If project conditions require an installation below 7'-0" along such paths, notify the Architect prior to rough-in.

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

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

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07, Section "Penetration Firestopping."

END OF SECTION 26 05 00

SECTION 26 05 10 - POWER SERVICE

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. Electrical power service shall be arranged with the local electric power distributor. Pay any and all charges as required by the power utility company.

B. Provide grounding in accordance with the National Electrical Code and as shown on the drawings. Refer to Division 26, Section "Grounding and Bonding for Electrical Systems."

C. The power service shall be as noted on drawings. Provide metering as required by the power utility company.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Division 26, section "Grounding and Bonding for Electrical Systems" for service grounding materials.

B. Refer to Division 26, sections 'Raceway and Boxes for Electrical Systems" and also "Underground Ducts and Raceways for Electrical Systems" for service raceways.

C. Refer to Division 26, section "Low-Voltage Electrical Power Conductors and Cables" for service conductors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Confirm with the power utility company the power service arrangements. Include in the bid price all costs relative to the type of service planned.

B. Where service arrangements call for a new pad-mounted utility transformer, the contractor shall be responsible for providing a poured-in-place concrete pad for the

transformer. Obtain a current copy of the power utility company's requirements for such pad and include all associated costs in the bid price.

C. Unless detailed differently by the utility company, pad mount transformers shall have a ground rod placed at each corner of the pad a minimum of 10' apart and interconnected. Extend grounding electrode conductor through the pad window into the transformer enclosure for the termination by the utility company. Grounding conductors shall be of the same size as the service grounding electrode conductor. Refer to Division 26, section "Grounding and Bonding for Electrical Systems."

D. Service entrance equipment shall bear the equipment grounding bus and the grounded conductor (neutral) bus bonded together at the first point of overcurrent protection. Bonding shall be per Article 250 of the National Electrical Code. Service entrance equipment shall be listed for such purpose by Underwriters Laboratory.

END OF SECTION 26 05 10

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Technologies Corporation.
2. Service Wire Co.
3. Southwire Company.

B. 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.

C. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable used in Variable Frequency Controller circuits.

D. Conductors: Copper, complying with NEMA WC 70/ICEA S-95-658.

1. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2 or Type XHHW-2.
2. PV Conductor Insulation: Comply with UL 4703.

E. Option:

F. Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. Hubbell Power Systems, Inc.
3. ILSCO.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Service Wire Co.
6. Thomas & Betts Corporation, A Member of the ABB Group.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway.

B. Feeders: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway.

C. Feeders in Cable Tray: Type XHHW-2, single conductors larger than No. 1/0 AWG, tray rated.

D. Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN/THWN-2 or Type XHHW-2, single conductors in raceway.

F. Cord Drops and Portable Appliance Connections: Type SOOW with ground, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.

3.4 CONNECTIONS

A. 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-486B.

B. 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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to the "Identification for Electrical Systems" Section.

B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor. Cap or tape spare conductors at each end.

3.6 FIRESTOPPING

A. Apply fire stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test all conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.

    c. Inspect compression applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. ILSCO.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Thomas & Betts Corporation, a Member of the ABB Group.

2.2 SYSTEM DESCRIPTION

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.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 12 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. 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.

2.4 CONNECTORS

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 Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum, unless noted otherwise on the drawing.

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. Provide isolated ground bus in the panelboards and switchboards as required.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated. Ground Bus shall be readily accessible and available for use by communications installers.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated. Minimum length of bus shall be 12".

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors or compression 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 or compression connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 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.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation. This is the minimum requirement; provide additional grounding per local codes and utility requirements.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.6 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 Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

C. Ground Rods: Drive rods until tops are 12 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.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

F. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel corner column and every other steel column, extending around the perimeter of building.

1. Install copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

G. Bond grounding conductor and grounding electrode conductor to reinforcing steel per National Electrical Code requirements.

3.7 FIELD QUALITY CONTROL

A. 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 service disconnect enclosure grounding terminal and as required by the National Electrical Code. 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.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed 10 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Designer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. GS Metals Corp.
   b. G-Strut.
   c. Unistrut; Part of Atkore International.

2. Material: Galvanized steel.
3. Channel Width: 1-5/8 inches
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

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 where used. Plastic expansion anchors of any type shall not be used.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

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 unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter. Where conduit supported is 2-1/2" trade size or larger, minimum rod size shall be 3/8 inch (10mm) in diameter.

D. 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.

E. 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 such 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. Raceway Support Methods: In addition to methods described in NECA 1, EMTs, IMCs, and RMCs may be supported by openings through structure members, according to NFPA 70.

C. 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.

D. 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. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. 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.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars. Anchoring in concrete with post tension cables not allowed unless noted otherwise.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 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. Bases shall be not less than 4 inches (100 mm) thick.

B. Use 4000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03, Section "Miscellaneous Cast-in-Place Concrete".

C. Anchor equipment to concrete base as follows:

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 anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. RMC: Galvanized rigid steel conduit/Rigid Metal Conduit.

B. GRS: See RMC.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by but not limited to one of the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. Western Tube and Conduit Corporation.

3. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RMC: Comply with ANSI C80.1 and UL 6.

D. EMT: Comply with ANSI C80.3 and UL 797 – steel or aluminum.

E. FMC: Comply with UL 1; zinc-coated steel or aluminum.

F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT shall be steel, set screw or compression type.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for RMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CANTEX INC.
2. Carlon: Thomas & Betts Corporation,

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Metal wireways are **not allowed** unless shown on the drawings. Refer to Part 3.2.

B. Manufacturers: Subject to compliance with requirements, provide products by but not limited to one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Square D.

C. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 as required for application, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. 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.

E. Wireway Covers: Hinged type or Flanged-and-gasketed type unless otherwise indicated.

F. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by but not limited to one of the following:

1. Crouse-Hinds, an Eaton business.
2. EGS/Appleton Electric.
3. O-Z/Gedney; a brand of Emerson Industrial Automation.
4. RACO; Hubbell.

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. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. 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.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

K. Gangable boxes are allowed where multiple wiring devices require it.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 as required by location 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.

M. Cabinets:

1. NEMA 250, Type 1, Type 3R, or Type 12 as required by location. 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 NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Oldcastle Precast, Inc.
b. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant bolts and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC" or as noted.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 24 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Above-ground Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: RMC, unless noted otherwise.
2. Concealed Conduit, Aboveground: RMC, unless noted otherwise.
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. Above-ground Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Severe Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: RMC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Encased in concrete or mortar: RNC.

5. Damp or Wet Locations: RMC.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment):

    a. Dry Locations: FMC.
    b. Dusty, Damp, or Wet Locations: LFMC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in institutional and commercial kitchens and damp or wet locations.

C. Underground: Apply raceway products as specified below unless otherwise indicated:

1. Below slab, within the building footprint: RNC, Type EPC-40-PVC.
2. Underground, beyond the building footprint: RNC, Type EPC-40-PVC.
3. Underground, within 5 feet (1.5 m) of roadways, driveways, or parking areas: RNC, Type EPC-80-PVC
4. Underground, intended for use by wiring exceeding 600 volts to ground: RNC, Type EPC-80-PVC, unless specifically noted to be Schedule 40.

D. Minimum Raceway Size:

1. Indoors, outdoors above grade, or below slab within the building footprint: 3/4-inch trade size 21.
2. Underground, beyond the building footprint: 1-inch (25-mm) trade size 27.

E. 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. EMT: Use set-screw or compression type steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with all applicable NECA Standards for installation requirements except where requirements on Drawings or in this section are stricter. Comply with NFPA 70 Chapter 3.

B. Where above slab, maintain not less than 6 inches separation from parallel runs of flues and pipes. Below slab, maintain not less than 12 inches (300 mm) separation from parallel runs of pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. 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.

G. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed and manufacturer approved for material and site involved. Open flame shall not be used.

H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

I. Support conduit within 12 inches of enclosures to which attached.

J. Raceways Underground, beyond the building footprint:

1. Minimum cover depth, measured from finished grade to top of raceway, shall comply with NFPA 70 Article 300 and the following:

    a. Wiring over 600 volts: 42 inches (1065 mm) with warning tape.
    b. Secondary wiring, between utility transformer and service entrance equipment: 24 inches (610 mm) with warning tape.
    c. Within 5 feet (1.5 m) of roadways, driveways, and parking areas: 24 inches (610 mm) with warning tape.
    d. Branch and feeder wiring: 18 inches (460 mm) with warning tape.

2. Where raceways cross between areas with different minimum cover depth requirements, such as at the edge of a parking area or leaving the building footprint, the transition shall occur in the less-strict area.
3. Arrange raceways to avoid areas planned for trees or large landscaping.
4. Where routed parallel with other underground system structures, maintain 5 feet (1.5 m) separation between raceway and foreign system structure.

K. Raceways Embedded in Slabs, within the building footprint:

1. Run conduit below reinforcement. Arrange raceways to cross building expansion joints at right angles with expansion fittings. In no case shall conduit be run in such a manner as to be exposed to saw cutting.
2. Transition from RNC to RMC before rising above floor.

    a. Exception: Where raceway turns up concealed in masonry block walls and terminates at a flush-mounted device box not more than 48 inches (1220 mm) above finished floor, elbow fitting and vertical raceway shall be permitted to be Type EPC-80-PVC. Protect such installations from damage or obstruction by debris during installation of masonry.

L. Stub-ups to Above Recessed Ceilings:

1. Use EMT or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or at enclosures.

M. 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.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings.

O. 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 bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

Q. 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.

R. 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.

S. 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 and secure each end to adjacent structure. Cap underground raceways designated as spare above grade alongside raceways in use.

T. Surface Raceways:

1. Install surface raceway with a minimum 2-inchradius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape, glue, and plastic expansion anchors are not acceptable support methods.

U. Install raceway sealing fittings at accessible locations according to 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 NFPA 70.

V. 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 conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

X. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
3. Use FMC for recessed and semi-recessed luminaires.
4. Arrange flexible conduit to minimize torque force and strain on fittings.

Z. Mount boxes 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.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall and plumb. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

BB. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel. Reference drawing for additional information. Provide appropriately rated fire stopping and sound barrier for each box.

CC. Locate boxes so that cover or plate will not span different building finishes or interfere with trim installation.

DD. 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.

EE. Fasten junction and pull boxes to, or support from building structure. Do not support boxes by conduits.

FF. Junction and/or pull boxes, and wireways, shall not contain conductors from more than six line-to-neutral branch circuits (or an equivalent number of line-to-line circuits) unless indicated on the drawings or approved via written Request for Information (RFI).

1. Requests shall detail locations and sizes of all such large junction or pull boxes and wireways proposed and include the following:

   a. Explain the construction advantage which would be provided by use of such enclosures instead of individual raceways.
   b. Proposed conduits to be connected and circuits to be contained in each enclosure.
   c. Enclosure size, enclosure fill, and applicable ampacity adjustment factor calculations, all per NEC based on planned conduit and conductors.
   d. Note: Submit RFI prior to rough-in or ordering materials. RFI may not be approved even if calculations are compliant with Code.

2. Where wireways and large junction or pull boxes are installed, ensure the following:

   a. Branch circuits routed through a common junction or pull box shall not originate from more than one panelboard.
   b. Conductors shall be routed neatly and orderly and associated ungrounded (hot) and grounded (neutral) on the same circuit shall be grouped per NEC 200.4 (exceptions to this Section shall not be utilized in this application).
   c. Conductors shall be clearly labeled, indicating panel and circuit number.
   d. Provide a typed directory affixed in a plastic sleeve to the outside of the enclosure indicating circuits present within the enclosure.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Cover Requirements – Comply with the greatest requirements of NEC 300.5 and the following. Cover is to be measured from the top of the raceway to finished grade. Where not otherwise noted, minimum cover requirements shall be:

   a. Branch and Feeder Circuits Under Interior Building Slab: Fully below planned concrete thickness.
   b. Branch and Feeder Circuits under Driveways and Parking Areas: 24 inches (600 mm) with warning tape.
   c. Branch and Feeder Circuits at locations not specified above: 18 inches (450 mm) with warning tape.
   d. Secondary Service Entrance Circuits: 24 inches (600 mm) with warning tape.

e. Primary Circuits over 600 volts: 42 inches (1050 mm) or as directed by Utility Provider, whichever is greater, with warning tape.

2. Sleeve conduits where they pass through foundation walls above footings. Do not route through footings. Coordinate lowered footings with General Contractor where required to maintain minimum cover requirements throughout.
3. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in "Earth Moving" for pipe less than 6 inches in nominal diameter.
4. Install backfill as specified in Division 31, Section "Earth Moving."
5. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
6. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

8. Underground Warning Tape: Comply with requirements in Division 26, Section "Identification for Electrical Systems." Where required, install at least 6 inches (150 mm) below finished grade, directly above conduit, with at least 12 inches (300 mm) of fill between tape and top of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom not less than 4" (100 mm) below frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.7 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, galvanized finishes, or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, 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 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE 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. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. 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.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

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 APPLICATION

A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or snap-around, color-coding bands:

1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

B. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data 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 Operation and Maintenance Manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. 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.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

H. Instruction Signs:

1. Operating Instructions: 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.
2. Emergency Operating Instructions: 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.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and 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: Self-adhesive, 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 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Emergency system boxes and enclosures.
f. Motor-control centers.
g. Disconnect switches.
h. Enclosed circuit breakers.
i. Motor starters.
j. Push-button stations.
k. Power transfer equipment.
l. Contactors.
m. Remote-controlled switches, dimmer modules, and control devices.
n. Battery inverter units.
o. Battery racks.
p. Power-generating units.
q. Voice and data cable terminal equipment.
r. Master clock and program equipment.
s. Intercommunication and call system master and staff stations.
t. Television/audio components, racks, and controls.
u. Fire-alarm control panel and annunciators.
v. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
w. Monitoring and control equipment.
x. Uninterruptible power supply equipment.
y. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 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. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color 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.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service feeder branch-circuit service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 26 05 53

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

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. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 12 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces at project location.

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. 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.

D. Comply with NEMA PB 1, UL 50, UL 67, Federal Specification W-P-115C.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1, flush or surface-mounted as indicated on drawings.
   b. Outdoor Locations: NEMA 250, Type 3R, surface-mounted.
   c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel, surface-mounted.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4, surface-mounted.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12, surface-mounted.
   f. Kitchens: NEMA 250, Type 1, flush-mounted. Provide with stainless steel door where located in dishwashing spaces or noted on drawings.

2. Height: Enclosures up to 90 inches (2.3 m) may be utilized if space permits.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
4. Finishes:

   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.

G. Incoming Mains:

1. Location: Top or Bottom per installation requirements.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

   a. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
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.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

J. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment where noted on drawing or required by code with one or more main service disconnecting and overcurrent protective devices.

K. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent minimum include spaces and spares as noted on drawing.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity. Series rated not allowed.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 current edition.

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Energy.
3. Square D; by Schneider Electric.
4. ABB/General Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

D. Mains: Circuit breaker or Lugs only as noted on drawing.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

F. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: as required.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. Siemens Energy.
3. Square D; by Schneider Electric.
4. ABB/General Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Subfeed Circuit Breakers: Vertically mounted.
5. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.

f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Shunt Trip: Voltage as required trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

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. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install floor mounted panelboards on cast-in-place concrete equipment base(s) nominal 4". Concrete compressive strength equal to floor concrete.
2. Attach panelboard to the vertical finished or structural surface behind the panelboard. Provide support backing for gypsum board walls.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mounting Height for Wall-Mounted Equipment:

1. In Dwelling Units: Mount top-most operable device at 48 inches (1220 mm) above finished floor.
2. In other than Dwelling Units:

a. Enclosures not greater than 54 inches (1370 mm) tall, mount top of enclosure 72 inches (1830 mm) above finished floor.
b. Enclosures greater than 54 inches (1370 mm) tall, mount bottom of enclosure 18 inches (460 mm) above finished floor.
c. Notwithstanding the above, ensure top-most operable device is mounted not greater than 79 inches (2000 mm) above finished floor, per NFPA 70 Article 240.24.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection. Mount panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

J. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

L. Install filler plates in unused spaces.

M. Stub six 3/4-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub six 3/4-inch empty conduits into raised floor space or below slab not on grade.

N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a black with white lettering laminated nameplate.

D. Device Nameplates: Label each branch circuit device in power panelboards with a black with white lettering laminated nameplate.

E. Install warning signs complying with requirements in National Electrical Code and local codes.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NEMA PB 1.1-2013, "General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less" prior to energizing.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports. 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.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Owner. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles and associated device plates.
2. Receptacles with integral GFCI protection.
3. Tamper-resistant receptacles.
4. Weather-resistant receptacles.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

C. SPD: Surge Protective Device.

D. TVSS: Transient voltage surge suppressor. See SPD.

E. USB: Universal Serial Bus

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Physical samples of all standard device and trim plate finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 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.

1.7 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. GFCI enabled Receptacles: One for every 25 of each type and color installed, but no fewer than two of each.
2. Wiring devices utilizing modular plug-in connectors: One for every 25 of each type and color installed, but no fewer than two of each.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (Wiring Devices - Arrow Hart).
2. Leviton Manufacturing Co., Inc.
3. Pass & Seymour; Legrand North America, LLC.
4. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. All wiring devices shall be minimum specification grade. Commercial grade not allowed.

B. Construction of thermoplastic polymer body with brass current-carrying and grounding contacts and parts. Structural parts and terminal screws shall be plated steel unless indicated otherwise. Wiring terminals shall accept No. 14-10 AWG solid conductors.

C. Comply with NFPA 70.

D. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranded building wire.

2. Devices shall comply with the requirements in this Section.

E. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Specification Grade Convenience Receptacles, 125 V, 20 A, two-pole, three-wire: Duplex configuration except where indicated to be single configuration. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596. Federal Specification grade. Commercial grade not allowed.

B. Equipment Connection Receptacles: Voltage, amperage, poles, and configurations as indicated on the drawings. Match plug configuration. Grounding type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and FS W-C-596 where applicable.

C. Specialty Device Types and Functions: Where indicated on the drawings, specification or hospital grade straight-blade receptacles shall be provided with a combination of one or more of the following integral features, compliant with the additional standards listed:

1. Tamper Resistant: Equipped with internal shutters that operate only when a compatible plug is inserted in the receptacle. Comply with UL 498 Supplement SD and marked TR.
2. Decorator Style: Smooth face configured for use with a single-opening wall plate.
3. Weather Resistant: Equipped with corrosion resistant metal parts and suitable nylon parts for use in damp or wet locations and exposed to sunlight. Comply with UL 498 Supplement SE and marked WR.
4. GFCI: Equipped with 4-6mA trip GFCI protection. Comply with UL 943 Class A. Include self-testing function with LED indicator light to show when device has malfunctioned and no longer provides proper GFCI protection. Device shall fail 'off.' Non-feed thru type, except where indicated to provide protection to downstream devices. Shall also be Weather Resistant type when utilized outdoors or in damp or wet locations.

2.4 WALL PLATES

A. Single and combination types shall match corresponding wiring devices and be obtained from the same manufacturer as the associated wiring device.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch (1-mm-) thick, satin finished, Type 302 stainless steel, unless directed by the Architect to be smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel suitable for application.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with UL 514D "Weatherproof While-In-Use Extra-Duty" Type 3R, weather-resistant, die-cast aluminum hood with gasket and lockable cover. Plastic or thermoplastic products are not acceptable.

2.5 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Grey.

B. Wall Plate Color: For thermoplastic covers, match device color.

PART 3 - EXECUTION

3.1 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.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

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.
5. 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.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 10 AWG are installed, splice No. 10 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. 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.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

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 and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings. Coordinate with Architect. Install poke-through assemblies by core-drill after walls are framed. Do not cast in place. Provide access panel in ceiling below where ceiling does not provide access to the poke-through assembly.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use machine printed label with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. In health care facilities, prepare reports that comply with NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. 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 higher than 5 percent 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. Test straight-blade hospital-grade receptacles for the retention force of the grounding blade according to NFPA 99.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosed molded case circuit breakers.
4. Enclosures.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. HD: Heavy duty.

C. RMS: Root mean square.

D. SPDT: Single pole, double throw.

1.4 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, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Field quality-control test reports including the following:

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 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

C. 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.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Corporation; Cutler-Hammer Products.
b. ABB/General Electric.
c. Siemens Energy & Automation, Inc.
d. Square D/Group Schneider.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. 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 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity. 30-mA for heat trace, 5-mA for personnel protection.

B. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Shunt Trip: Trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Voltage and requirement as noted on drawings.
5. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 16

SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:

1. Section 262416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

A. I-nominals: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, maximum OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Manufacturers requesting product approval must meet or exceed the written specification contained herein.
2. The registered service mark (brand) must be owned by the Manufacturer. No private label accepted.
3. Manufacturer shall be ISO 9001 certified: Quality Systems – Model for Quality Assurance in Design, development, Production, Installation, and Servings.
4. The Manufacturer must be regularly engaged in the manufacture of surge protection device products of the specified categories for no less than ten (10) years.

2.2 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, provided with the following features and accessories:

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Surge Counter.

B. Comply with NFPA 70.

C. Comply with UL 1449 and UL 1283.

D. MCOV of the SPD shall be at least 125% the nominal system voltage.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
3. Neutral to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120V.
4. Line to Line: 2000 V for 480Y/277 V and 1200V for 208Y/120 V.

F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700V.
3. Neutral to Ground: 700V
4. Line to Line: 1200V.

G. SCCR: Equal or exceed 100 kA.

H. Nominal Discharge Current Rating: 20 kA

2.3 SERVICE ENTRANCE OR MAIN DISTRIBUTION EQUIPMENT

A. SPDs: Listed, and complying with UL 1449, Type 2.

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

2.4 PANEL SUPPRESSORS

A. SPDs: Listed and Complying with UL 1449, Type 2.

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

2.5 ENCLOSURES

A. Shall be side-mounted, NEMA 250, Type 1, in the following conditions as noted on drawings:

1. At panelboards or transfer switches which are surface mounted indoors in a dry location, other than floor mounted.

B. Shall be mounted internal to the protected equipment enclosure in any of the following conditions:

1. At panelboards which are flush mounted.

2. At panelboards, transfer switches, or switchgear which are specified with enclosures other than NEMA 250, Type 1.
3. At switchgear or switchboards which is floor mounted.
4. Where noted on the drawings to be integral or internal to the equipment.

C. Shall be side mounted, NEMA 250, Type 3R, 4 or 4X in the following conditions:

1. At equipment which is located outdoors or in a damp or wet location and is not standardly available in the industry with internal SPDs.

2.6 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install circuit breaker as required to comply with the UL listing of the SPD. All SPDs shall be connected through an OCPD and means of disconnect. Direct connection to the bus is not acceptable. Sized OCPD to match the maximum OCPD listed by the Manufacturer.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.

3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

D. Reset surge counter after all electrical testing is complete.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 43 13

SECTION 28 31 12 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 INCLUDED

A. The scope of this work shall include the expansion or replacing of the existing fire alarm system. The existing fire alarm control panel is a Notifier NPS2-640 w/voice evac, contact Gallaher Associates 865-970-2471. Contractor shall furnish and install additional components as required to operate the new fire alarm devices as shown on the drawings. Contractor shall visit job site to verify existing conditions prior to bidding.

B. System expansion shall consist of but not limited to smoke detectors control modules, power supply, any relocation and reconnection of existing devices, control panel expansion or replacement as necessary, wiring, conduit, etc.

PART 2 PRODUCTS

2.1 MATERIALS

A. All notification and annunciation devices shall be of the same manufacturer and product family as the existing system. Devices shall be ADA compatible.

PART 3 EXECUTION

3.1 INSTALLATION

A. Contractor maintains operation of the existing fire alarm system during the construction of the new addition.

B. All fire alarm wiring shall be in conduit. Minimum conduit size shall be ¾-inch trade size. Where new devices are installed on existing walls, the contractor shall provide wire mold on all exposed surfaces. Change to conduit above the accessible ceiling.

C. Furnish and install in accordance with manufacturer's instructions all wiring, conduit and outlet boxes required for the installation of a complete system as described herein and as shown on the plans. The contractor shall have been engaged in the installation of Fire Alarm Systems for a minimum of five year prior to the award of this contract, have in his possession more than one employee who is a qualified factory trained installer, and maintain an inventory of sufficient quantities of spare equipment to replace the entire installation on a part by part basis without depending on outside sources, should the need arise. All wiring shall be installed in accordance with Article 760, "Fire Protective Signaling Systems", of the National Electrical Code, and shall be color coded using as many different insulation colors as are readily available to differentiate between circuits. Class and style of fire alarm wiring shall be per NFPA 72. Signaling line circuits (SLC's) shall be “Class B, Style 4” and signal circuits (NAC's) shall be “Class B, Style Y”.

D. Install all items as indicated on the plans and covered in the systems specifications.

E. The entire installation, including wiring supervision, initiation of devices, and proper operation of alarm signals, shall be tested by a factory trained representative of the manufacturer. A detailed report of the testing and results shall be furnished to the Owner, the Engineer and the State Fire Marshall's Office.

F. The contractor and manufacturer shall have full time service facilities with multiple numbers of factory trained technicians regularly engaged in installation, service, maintenance, and inspection of the type system installed. The contractor shall furnish the Owner a one-year inspection and testing agreement for service and semi-annual inspections to be conducted during the installers normal working hours. Seven-day/week, 24-hour/day emergency service with a minimum of one hour response time shall be available outside normal working hours at the current overtime rate. The one-year contract shall be provided at no cost to the Owner.

G. The fire alarm system provided by the bidder shall have a 1-year parts and labor factory warranty. This warranty shall allow service on all aspects of the system by the authorized installer.

H. All operational manuals, troubleshooting manuals, wiring diagrams, schematics and software needed to maintain, repair and **expand** the fire alarm system shall be provided.

3.2 SHOP DRAWINGS

A. Provide factory produced drawings illustrating all components required above to allow for a complete review of the proposed system.

B. Complete descriptive data indicating U.L. listing for all system components.

C. Complete 1/8" scale reproducible drawings of proposed system showing conduit layout, wire counts and device locations prior to beginning installation of the system. In assembly areas indicate "cd" rating for all strobes and "db" rating for all speakers for voice message.

D. Equipment shall be of same manufacturer as existing, no substitutes.

E. Submit battery calculations for review based upon N. F. P. A. criteria.

F. At close-out of project provide updated record set of the required 1/8" scale shop drawings illustrating any changes made during construction. These drawings shall also reflect the final room names and numbers which shall be obtained from the project Architect. Also, at closeout of project provide a listing of all initiating devices and their respective fire alarm addresses and locations. These items shall be included in the final O & M manuals.

END OF SECTION 28 31 12

Cedar Bluff Middle School
HVAC Renovations
for Knox County Schools

KNOXVILLE, TENNESSEE

OWNER:

KNOX COUNTY SCHOOLS

DATE: October 31, 2023

DRAWING INDEX:

DRAWING NUMBER	DRAWING DESCRIPTION	SHEET ISSUE DATE	CURRENT REVISION DESCRIPTION	REVISION ISSUE DATE
G0	COVER SHEET	10/31/2023	Rev 0	-
M1.1	FIRST FLOOR PLAN - HVAC DEMOLITION	10/31/2023	Rev 0	-
M1.2	SECOND FLOOR PLAN - HVAC DEMOLITION	10/31/2023	Rev 0	-
M1.3	ENLARGED MECHANICAL ROOM & PORTABLE CLASSROOM PLAN - HVAC	10/31/2023	Rev 0	-
M2.1	FIRST FLOOR PLAN - PART A - HVAC	10/31/2023	Rev 0	-
M2.2	FIRST FLOOR PLAN - PART B - HVAC	10/31/2023	Rev 0	-
M2.3	SECOND FLOOR PLAN - PART A - HVAC	10/31/2023	Rev 0	-
M2.4	SECOND FLOOR PLAN - PART B - HVAC	10/31/2023	Rev 0	-
M3.1	DETAILS - HVAC	10/31/2023	Rev 0	-
M4.1	SCHEDULES - HVAC	10/31/2023	Rev 0	-
M4.2	SCHEDULES & CONTROLS - HVAC	10/31/2023	Rev 0	-
P2.1	FIRST FLOOR PLAN - PART A - CONDENSATE PIPING	10/31/2023	Rev 0	-
P2.2	FIRST FLOOR PLAN - PART B - CONDENSATE PIPING	10/31/2023	Rev 0	-
P2.3	SECOND FLOOR PLAN - PART A - CONDENSATE PIPING	10/31/2023	Rev 0	-
P2.4	SECOND FLOOR PLAN - PART B - CONDENSATE PIPING	10/31/2023	Rev 0	-
ES1.1	SITE PLAN - ELECTRICAL	10/31/2023	Rev 0	-
E1.1	FIRST FLOOR PLAN - ELECTRICAL DEMOLITION	10/31/2023	Rev 0	-
E1.2	SECOND FLOOR PLAN - ELECTRICAL DEMOLITION	10/31/2023	Rev 0	-
E2.1	FIRST FLOOR PLAN - PART A - ELECTRICAL	10/31/2023	Rev 0	-
E2.2	FIRST FLOOR PLAN - PART B - ELECTRICAL	10/31/2023	Rev 0	-
E2.3	SECOND FLOOR PLAN - PART A - ELECTRICAL	10/31/2023	Rev 0	-
E2.4	SECOND FLOOR PLAN - PART B - ELECTRICAL	10/31/2023	Rev 0	-
E2.5	PORTABLE CLASSROOM - ELECTRICAL	10/31/2023	Rev 0	-
E3.1	PANEL SCHEDULES AND FEEDER DIAGRAM	10/31/2023	Rev 0	-

DESIGNER:

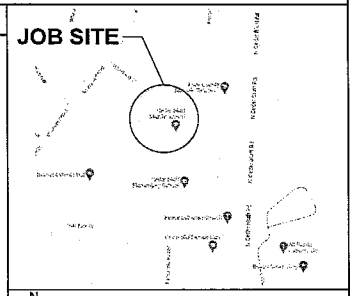
ENGINEERING SERVICES GROUP, INC.
MECHANICAL / ELECTRICAL ENGINEERS
900 E. HILL AVE. SUITE 350
KNOXVILLE , TN 37915
PHONE: 865.522.0393

BUILDING INFORMATION

TFM #
CONSTRUCTION TYPE: TYPE IV (no change)
OCCUPANCY TYPE: E (no change)
UNSPRINKLERED (no change)
BUILDING HEIGHT: Two story, 26'-0" (no change)

CODES:

2012 INTERNATIONAL EXISTING BUILDING CODE (excluding Chapter 11, and Section 3411)
2012 INTERNATIONAL FUEL GAS CODE
2012 INTERNATIONAL MECHANICAL CODE
2012 INTERNATIONAL PLUMBING CODE
2012 INTERNATIONAL FIRE CODE
2012 INTERNATIONAL ENERGY CONSERVATION CODE
2012 NFPA 101 LIFE SAFETY CODE
2017 EDITION, NFPA 70, NATIONAL ELECTRIC CODE,
For public buildings, Tennessee Public Building Accessibility Act, 2010 ADA Standards for Accessible Design (T.C.A. 68-120-204).



LOCATION MAP
707 N Cedar Bluff Rd
Knoxville, Tennessee 37923

PROJECT DESCRIPTION:

REMOVE ALL EXISTING HVAC EQUIPMENT CURRENTLY CONNECTED TO THE HYDRONIC CIRCULATING LOOP PIPING SERVED BY THE EXISTING BOILERS AND CHILLER/COOLING TOWER. NEW DX HVAC EQUIPMENT TO BE INSTALLED IN PLACE OF THE HYDRONIC SYSTEM. CONTROLS WORK TO BE CONNECTED TO THE EXISTING BUILDING AUTOMATION SYSTEM. ELECTRICAL WORK IS IN SUPPORT OF NEW HVAC EQUIPMENT.

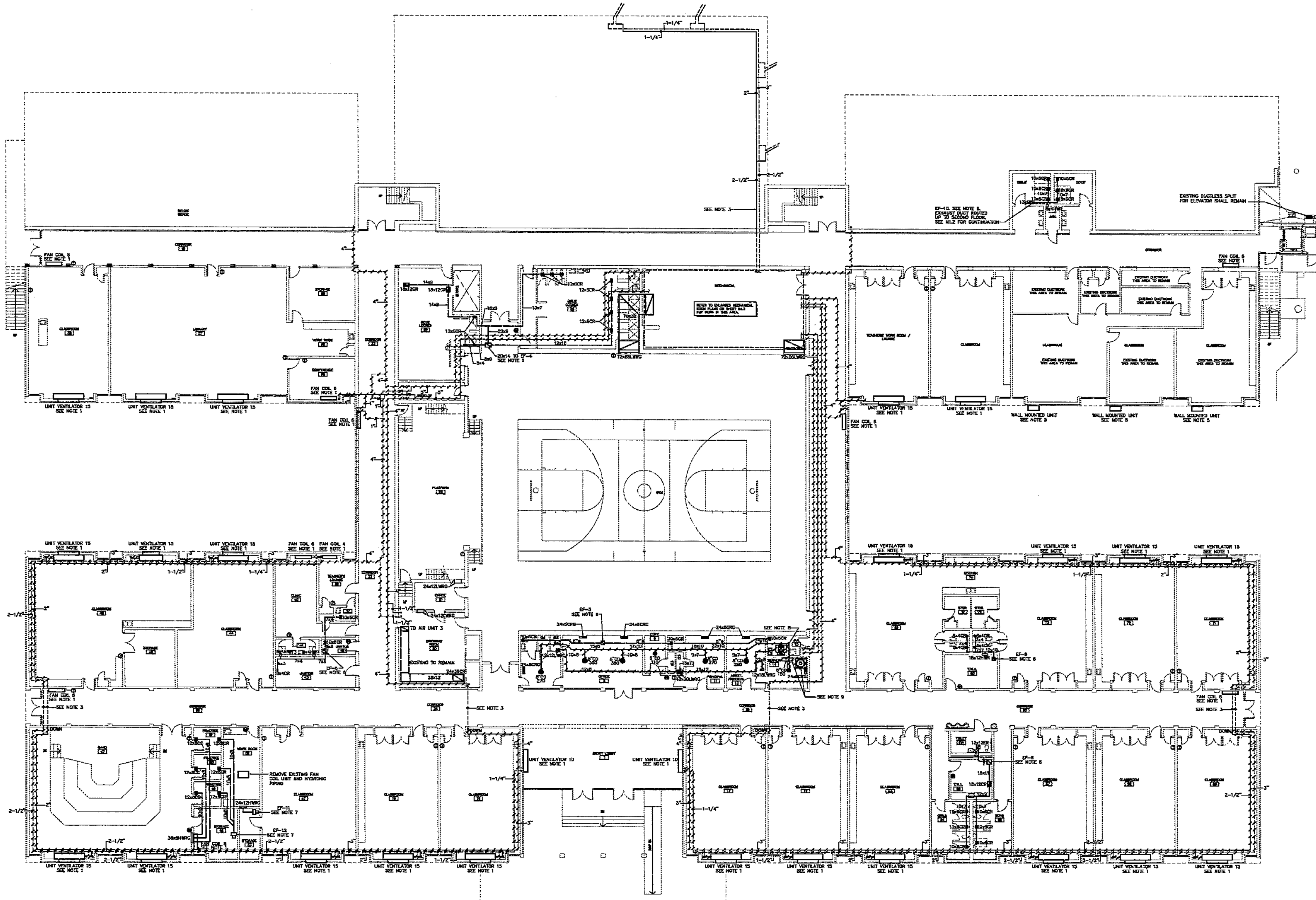
ALTERNATE 1: REMOVE COOLING TOWER
OPTION FOR REMOVAL OF CHILLER AND COOLING TOWER FROM THE SITE.

ALTERNATE 2: REMOVE BOILERS
OPTION FOR REMOVAL OF THE BOILERS FROM THE SITE.

MECHANICAL

ELECTRICAL

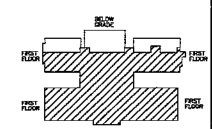
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
865.522.0393
Project No. 21409



FIRST FLOOR PLAN
HVAC DEMOLITION
3/32"=1'-0"

NOTES:

1. REMOVE EXISTING UNIT VENTILATOR OR FAN COIL UNIT THIS LOCATION. PATCH WALLS AND FLOORS TO MATCH SURROUNDING CONDITIONS WHERE UNIT IS REMOVED AND SURFACES REMAIN EXPOSED. PROVIDE FLOOR TILES AND PAINT FOR WALLS TO MATCH AS REQUIRED.
2. REMOVE ALL EXISTING HYDRONIC CIRCULATING LOOP PIPING IN CLASSROOMS, CORRIDORS, ETC. WHERE EXPOSED. WHERE PIPING IS REMOVED, PATCH ALL WALL PENETRATIONS AND PAINT TO MATCH SURROUNDING WALL CONDITIONS. WHERE PIPING IS TO BE REMOVED ABOVE CEILINGS, CONTRACTOR SHALL REMOVE WITH CARE TO AVOID DAMAGE AND REPLACE WHEN FINISHED.
3. UNDERGROUND HYDRONIC CIRCULATING LOOP PIPING SHALL BE ABANDONED IN PLACE. CAP REMAINING PIPE ROUGH-INS AS REQUIRED TO CONCEAL FROM VIEW. PATCH WALLS AND FLOOR WHERE REQUIRED TO MATCH SURROUNDING CONDITIONS.
4. THERMOSTATS OR THERMOSTAT SENSORS AT LOCATIONS SHOWN HAVE GENERALLY BEEN IDENTIFIED ON DRAWINGS AT EXISTING LOCATIONS. INSTALL NEW THERMOSTATS AT EXISTING LOCATIONS WHERE POSSIBLE. ANY EXISTING SURFACE MOUNTED CONDUIT MAY BE REUSED IF CONDITIONS ALLOW.
5. EXISTING EXTERIOR WALL MOUNTED SPVAC UNITS SHALL BE REMOVED. EXISTING SUPPLY DUCT, AIR DISTRIBUTION, DIFFUSERS, AND RETURN GRILLES SHALL REMAIN. PREPARE LOCATION FOR INSTALLATION OF NEW UNITS.
6. REMOVE AND REPLACE EXISTING EXHAUST FAN. EXISTING EXHAUST DUCT SHALL REMAIN. CLEAN INTERIOR AND EXTERIOR OF EXISTING DUCT AND EXHAUST REGISTERS. EXAMINE CONDITION OF ROOF CURBS OF ROOF EXHAUST FANS, PROVIDE CURB ADAPTER AS REQUIRED FOR NEW FAN.
7. REMOVE EXISTING EXHAUST FAN AND REPLACE WITH NEW. EXISTING EXHAUST DUCT SHALL REMAIN. CLEAN INTERIOR AND EXTERIOR OF EXISTING DUCT AND EXHAUST REGISTERS.
8. REMOVE EXISTING SPLIT SYSTEM AIR HANDLING UNIT SERVING OFFICE AREA AND ALL SUPPLY AND RETURN DUCTWORK. REPLACE WITH NEW AS SCHEDULED AS SHOWN ON M2.1.
9. REMOVE EXISTING DUCTLESS SPLIT SYSTEM UNIT IN SERVER ROOM 14, ALL REFRIGERANT PIPING, CONTROLS, AND CONDENSATE PUMPS AND PIPING. REMOVE EXISTING CONDENSING UNIT ON THE ROOF. REPLACE WITH NEW AS SCHEDULED AS SHOWN ON M2.1.



KEYPLAN

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
500 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0339
PROJECT NO. 23809

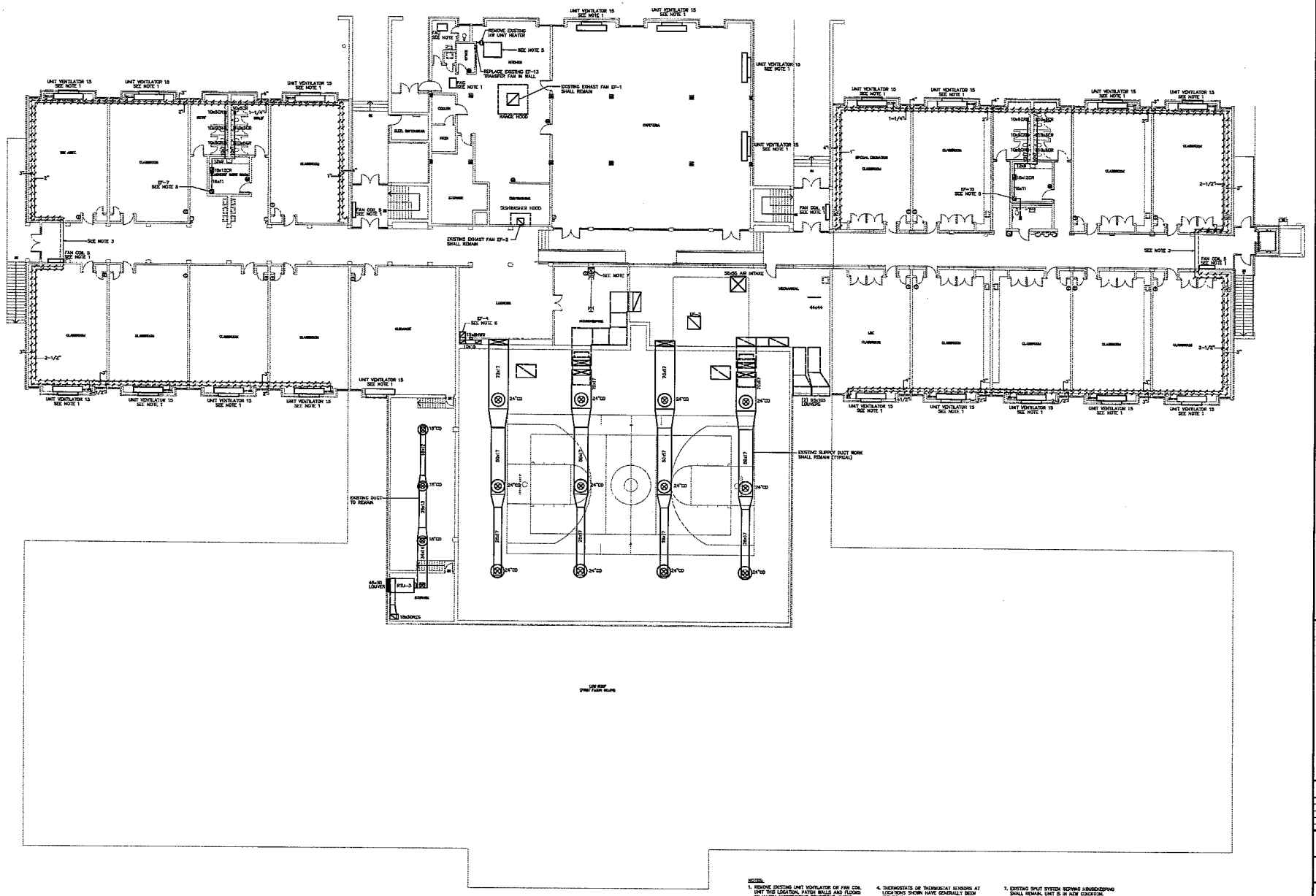
PROJECT:

CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE
FIRST FLOOR PLAN - HVAC DEMOLITION

REVISIONS	
NO.	DATE

DRAWN BY ARR
CHECKED BY NDV
APPROVED BY JRW
DATE 10/31/2023
PROJECT NO 23809
DRAWING NO.
M1.1

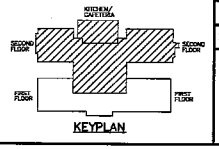


SECOND FLOOR PLAN HVAC DEMOLITION

3/32"=1'-0"

NOTES:

1. REMOVE EXISTING UNIT VENTILATOR OR FAN COIL UNIT THIS LOCATION, PATCH WALLS AND FLOORS TO MATCH SURROUNDING CONDITIONS WHERE UNIT IS REMOVED AND SURFACES REMAIN EXPOSED. PROVIDE FLOOR TILES AND PAINT FOR WALLS TO MATCH AS REQUIRED.
2. REMOVE ALL EXISTING HYDRONIC CIRCULATING LOOP PIPING IN CLASSROOMS, CORRIDORS, ETC. WHERE EXPOSED. WHERE PIPING IS REMOVED, PATCH ALL WALL PENETRATIONS AND PAINT TO MATCH SURROUNDING WALL CONDITIONS. WHERE FLOOR PENETRATIONS EXIST, CONTRACTOR SHALL REMOVE AND REPLACE TILE TO AVOID DAMAGE AND REPLACE WHEN FINISHED.
3. UNDERGROUND HYDRONIC CIRCULATING LOOP PIPING SHALL BE ABANDONED IN PLACE. CAP REMAINING PIPE ROUGH-INS AS REQUIRED TO CONCEAL FROM VIEW. PATCH WALLS AND FLOOR WHERE REMAINS TO MATCH SURROUNDING CONDITIONS.
4. THERMOSTATS OR THERMOSTAT SENSORS AT LOCATIONS SHOWN HAVE GENERALLY BEEN IDENTIFIED ON DRAWINGS AT EXISTING LOCATIONS. INSTALL NEW THERMOSTATS AT EXISTING LOCATIONS WHERE POSSIBLE. ANY EXISTING SURFACE MOUNTED CONDUIT MAY BE REUSED IF CONDITIONS ALLOW.
5. REMOVE AND REPLACE EXISTING SPLIT SYSTEM SERVING KITCHEN, PREPARE FOR INSTALLATION OF NEW EQUIPMENT.
6. REMOVE AND REPLACE EXISTING EXHAUST FAN. EXISTING EXHAUST DUCT SHALL REMAIN. CLEAN INTERIOR AND EXTERIOR OF EXISTING DUCT AND EXHAUST REGISTERS. EXAMINE CONDITION OF ROOF CURB OF ROOF EXHAUST FANS. PROVIDE CURB ADAPTER AS REQUIRED FOR NEW FAN.
7. EXISTING SPLIT SYSTEM SERVING HOUSEKEEPING SHALL REMAIN. UNIT IS IN NEW CONDITION.
8. EXISTING SUPPLY AND RETURN DUCTWORK FOR RTU-1,2,3 SHALL REMAIN. CLEAN ALL INTERIOR DUCT AND EXTERIOR DUCT WHERE EXPOSED.



KEYPLAN

ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
803 Sail Hill, Ave. Suite 350
Knoxville, Tennessee 37919
(865) 622-0393
PROJECT NO. 23809

PROJECT

CEDAR BLUFF MIDDLE SCHOOL HVAC RENOVATIONS

for Knox County Schools

707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE

SECOND FLOOR PLAN - HVAC DEMOLITION

REVISIONS

NO.	DATE

DRAWN BY ARR

CHECKED BY NDV

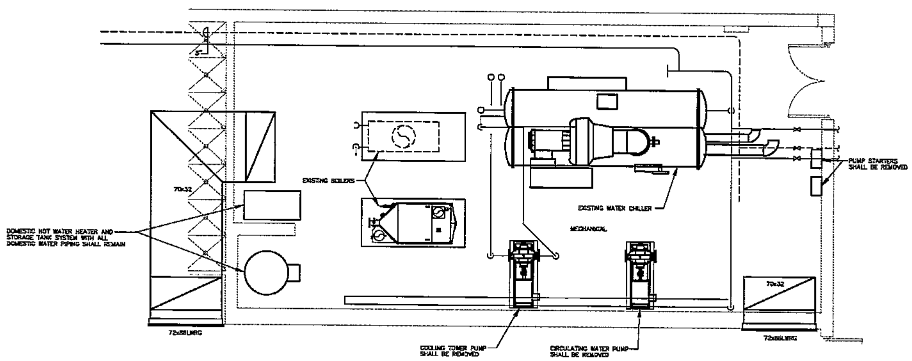
APPROVED BY JRW

DATE 10/31/2023

PROJECT NO 23809

DRAWING NO.

M1.2



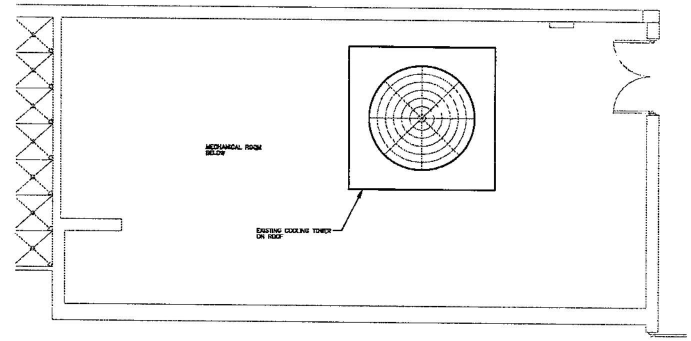
ENLARGED MECHANICAL ROOM – HVAC DEMOLITION
1/4"=1'-0"

NOTES:

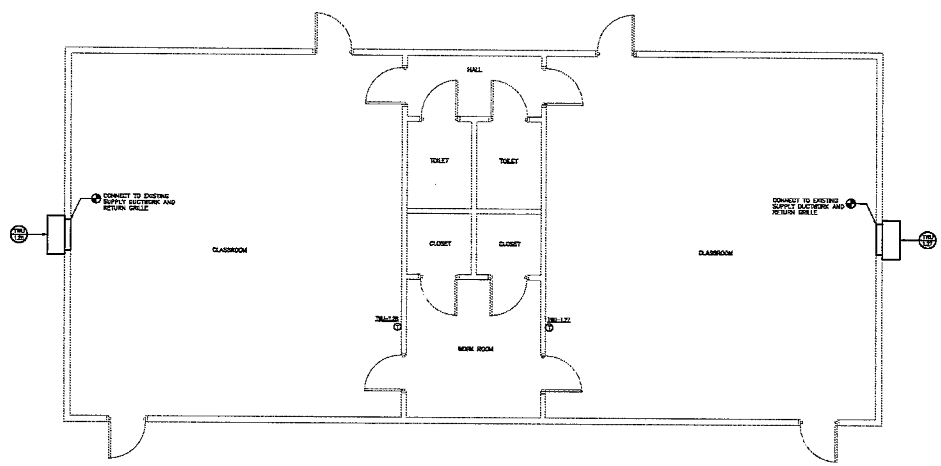
1. REMOVE ALL EXISTING HYDRONIC CIRCULATING LOOP PIPING IN MECHANICAL ROOM WHERE EXPOSED. WHERE PIPING IS REMOVED, PATCH ALL WALL PENETRATIONS AND PAINT TO MATCH SURROUNDING WALL CONDITIONS.
2. EXISTING SUPPLY AND RETURN DUCTWORK FROM RTU-1 AND RTU-2 SHALL REMAIN. (NOT ENTIRELY SHOWN FOR CLARITY)
3. EXISTING CENTRIFUGAL WATER CHILLER AND COOLING TOWER SHALL BE ABANDONED IN PLACE. REMOVE ALL POWER FROM CHILLER AND COOLING TOWER AND ALL STARTERS. COORDINATE WITH ELECTRICAL CONTRACTOR. REMOVE ALL WATER FROM THE SYSTEM AND PREPARE CHILLER AND COOLING TOWER FOR A "DORMANT" CONDITION AS REQUIRED.
4. EXISTING HYDRONIC SYSTEM BOILERS, B-1 AND B-2, SHALL BE ABANDONED IN PLACE. REMOVE ALL POWER FROM BOILERS. COORDINATE WITH ELECTRICAL CONTRACTOR. REMOVE GAS PIPING AND FLUE VENT PIPING REQUIRED. CAP, INSULATE, AND SEAL WEATHER TIGHT FLUE VENT STACK 12" BELOW ROOF DECK. REMOVE ALL WATER FROM THE SYSTEM AND PREPARE BOILERS FOR A "DORMANT" CONDITION AS REQUIRED.

ALTERNATE 1: REMOVE COOLING TOWER
CONTRACTOR SHALL PROVIDE ALTERNATE OPTION FOR REMOVAL OF CHILLER AND COOLING TOWER FROM THE SITE.

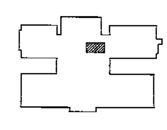
ALTERNATE 2: REMOVE BOILERS
CONTRACTOR SHALL PROVIDE ALTERNATE OPTION FOR REMOVAL OF THE BOILERS FROM THE SITE.



ENLARGED MECHANICAL ROOM – HVAC DEMOLITION
1/4"=1'-0"



PORTABLE CLASSROOM – HVAC
1/4"=1'-0" (ESTIMATED)



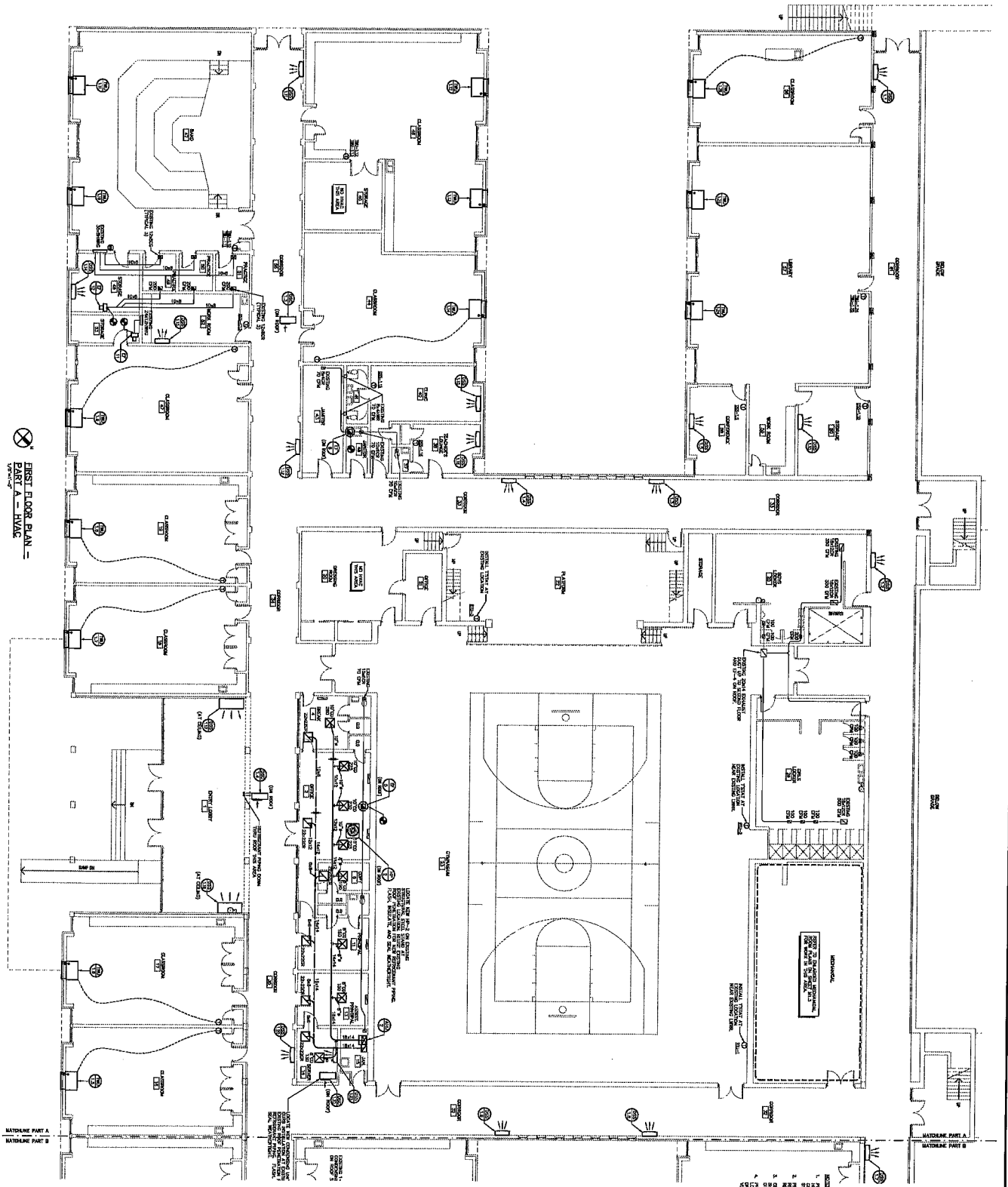
PROJECT:
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0333
PROJECT NO. 23609

DRAWING TITLE
ENLARGED MECHANICAL ROOM & PORTABLE CLASSROOM PLAN - HVAC

REVISIONS	
NO.	DATE

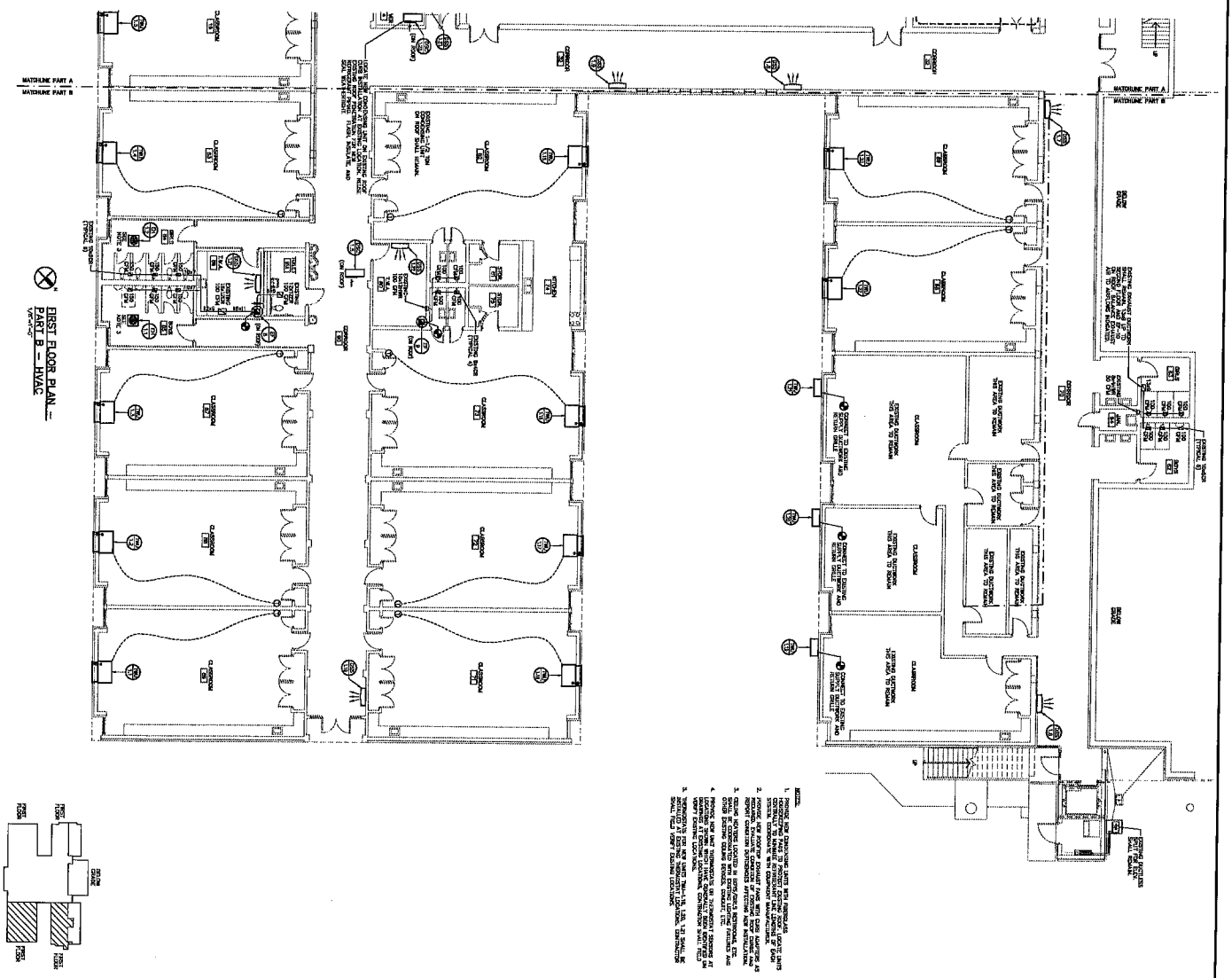
DRAWN BY ARR
CHECKED BY NDV
APPROVED BY JRW
DATE 10/31/2023
PROJECT NO 23609
DRAWING NO.
M1.3



DRAWING NO. M2.1	DRAWING TITLE: FIRST FLOOR PLAN - PART A - HVAC	PROJECT: CEDAR BLUFF MIDDLE SCHOOL HVAC RENOVATIONS for Knox County Schools, 707 N. Cedar Bluff Rd. Knoxville, Tennessee	ESGI ENGINEERING SERVICES GROUP, INC. CONSULTING ENGINEERS 500 EAST HILL AVE, SUITE 350 KNOXVILLE, TENNESSEE 37915 (865) 522-0333 PROJECT NO. 23009

PROJECT NO: 23009
DATE: 10/31/2024
APPROVED BY: JRW
CHECKED BY: NDV
DRAWN BY: ARR

REVISIONS
NO. DATE



DRAWING NO.	M2.2
PROJECT NO.	23S-S
DATE	10/31/2024
DRAWN BY	ARR
CHECKED BY	NDV
APPROVED BY	JRW

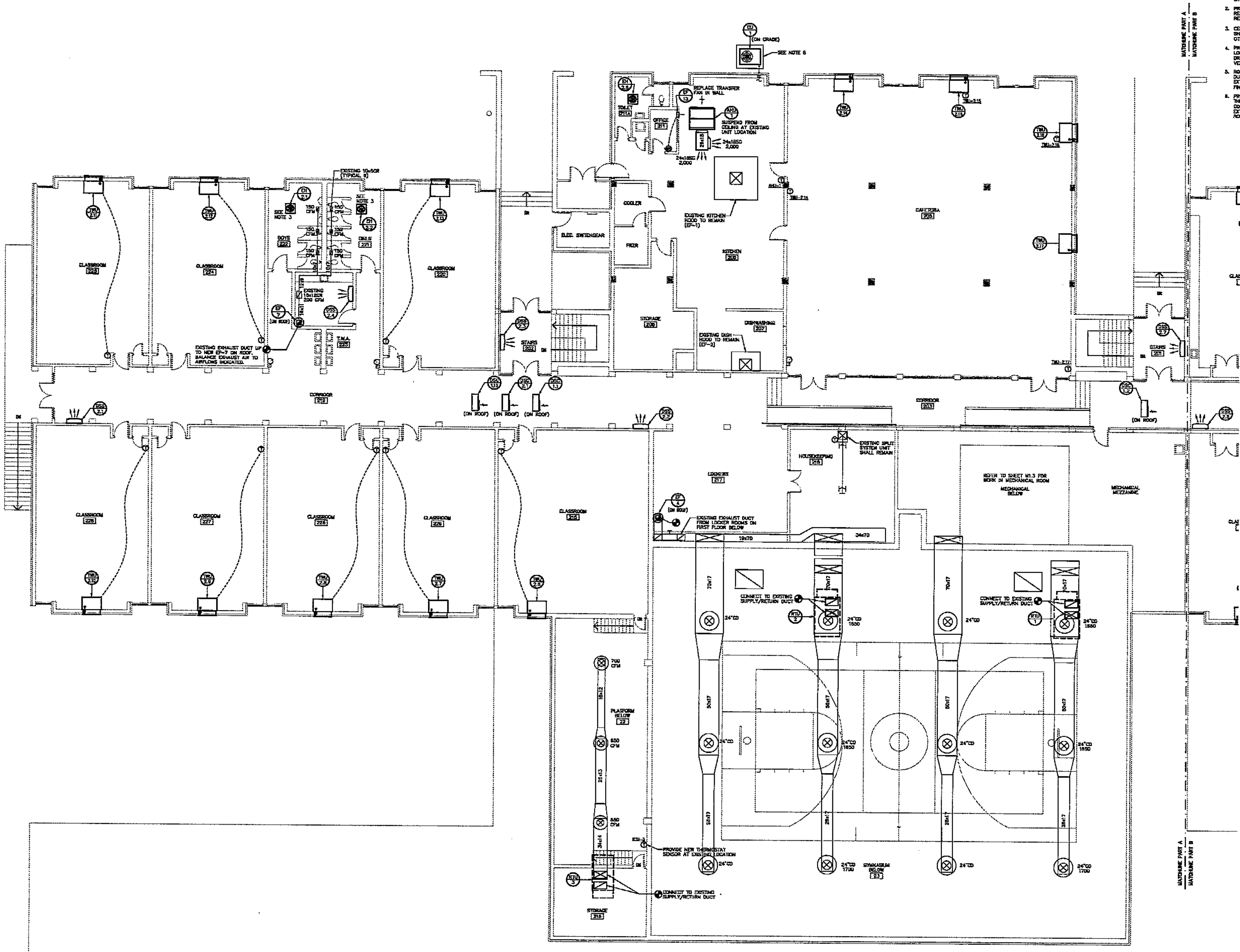
REVISIONS

NO.	DATE

DRAWING TITLE
FIRST FLOOR PLAN - PART B - HVAC

PROJECT
CEDAR BLUFF MIDDLE SCHOOL HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0333
PROJECT NO. 23809



SECOND FLOOR PLAN – PART A – HVAC

1/8"=1'-0"

NOTES:

1. PROVIDE NEW CONDENSING UNITS WITH FIBERGLASS HOUSEKEEPING PADS TO PROTECT EXISTING ROOF. LOCATE UNITS CENTRALLY TO MINIMIZE REFRIGERANT LINE LENGTHS OF EACH SYSTEM. COORDINATE WITH EQUIPMENT MANUFACTURER.
2. PROVIDE NEW ROOFTOP EXHAUST FANS WITH CURB ADAPTERS AS REQUIRED. EVALUATE CONDITION OF EXISTING ROOF CURBS AND REPORT CONDITION DEFICIENCIES AFFECTING NEW INSTALLATION.
3. CEILING HEATERS LOCATED IN BOYS/GIRLS RESTROOMS, ETC. SHALL BE COORDINATED WITH EXISTING LIGHTING FIXTURES AND OTHER EXISTING CEILING DEVICES, CONDUIT, ETC.
4. PROVIDE NEW UNIT THERMOSTATS OR THERMOSTAT SENSORS AT LOCATIONS SHOWN WHICH HAVE GENERALLY BEEN IDENTIFIED ON DRAWINGS AT EXISTING LOCATIONS. CONTRACTOR SHALL FIELD VERIFY EXISTING LOCATIONS.
5. ROOFTOP UNITS RTU-1, 2, AND 3: ALL SUPPLY AND RETURN DUCT AND GRILLES SHALL BE INTERNALLY CLEANED AND ALSO EXTERNALLY CLEANED WHERE DUCTWORK IS ROUTED EXPOSED IN FINISHED SPACES.
6. PROVIDE AND INSTALL NEW OUTDOOR CONDENSING UNIT ON 4" THICK CONCRETE PAD. ROUTE REFRIGERANT PIPING AND CONDENSATE PIPING ALONG EXTERIOR WALL AND REUSE EXISTING EXTERIOR WALL PENETRATION. CAULK AND SEAL WEATHERTIGHT. ROUTE REFRIGERANT PIPING IN A SIMILAR PATH TO EXISTING.

ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
500 EAST ELLAVIE SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0333
PROJECT NO. 23609

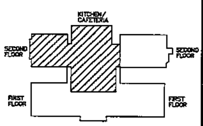
PROJECT:

CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE
SECOND FLOOR PLAN - PART A - HVAC

REVISIONS	
NO.	DATE

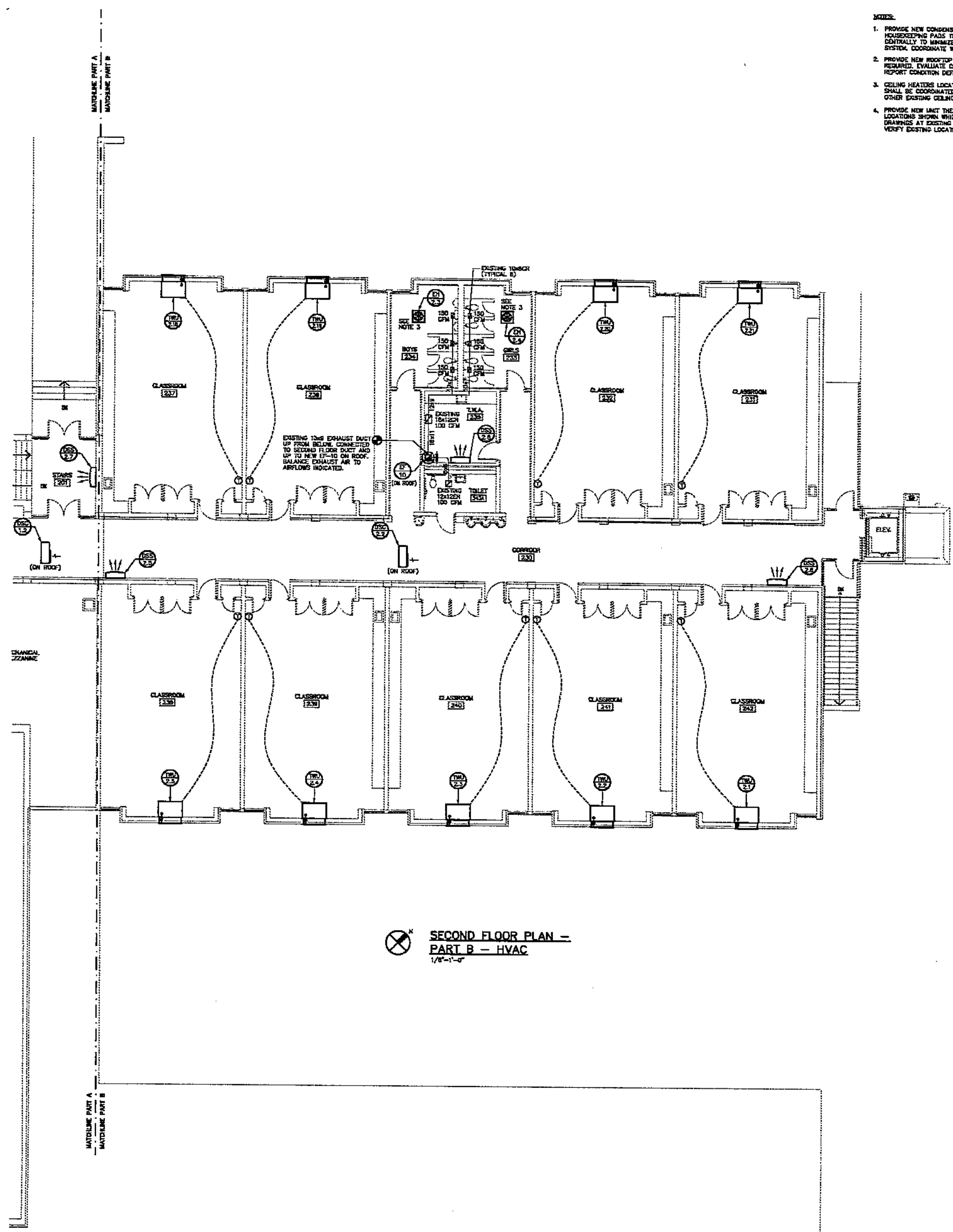
DRAWN BY	ARR
CHECKED BY	NDV
APPROVED BY	JRW
DATE	10/31/2023
PROJECT NO.	23609
DRAWING NO.	M2.3



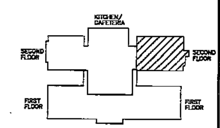
KEYPLAN

NOTES:

1. PROVIDE NEW CONDENSING UNITS WITH FIBERGLASS HOUSEKEEPING PADS TO PROTECT EXISTING ROOF. LOCATE UNITS CENTRALLY TO MINIMIZE REFRIGERANT LINE LENGTHS OF EACH SYSTEM. COORDINATE WITH EQUIPMENT MANUFACTURER.
2. PROVIDE NEW ROOFTOP EXHAUST FANS WITH CURB ADAPTERS AS REQUIRED. EVALUATE CONDITION OF EXISTING ROOF CURBS AND REPORT CONDITION DEFICIENCIES AFFECTING NEW INSTALLATION.
3. CEILING HEATERS LOCATED IN BOYS/GIRLS RESTROOMS, ETC. SHALL BE COORDINATED WITH EXISTING LIGHTING FIXTURES AND OTHER EXISTING CEILING DEVICES, CONDUIT, ETC.
4. PROVIDE NEW UNIT THERMOSTATS OR THERMOSTAT SENSORS AT LOCATIONS SHOWN WHICH HAVE GENERALLY BEEN IDENTIFIED ON DRAWINGS AT EXISTING LOCATIONS, CONTRACTOR SHALL FIELD VERIFY EXISTING LOCATIONS.



SECOND FLOOR PLAN – PART B – HVAC
1/8"=1'-0"



KEYPLAN

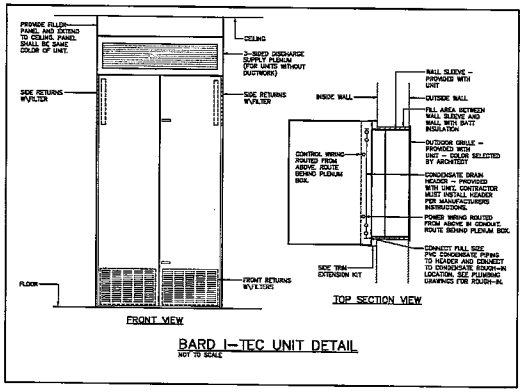
ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
500 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0333
PROJECT NO. 23809

PROJECT:
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

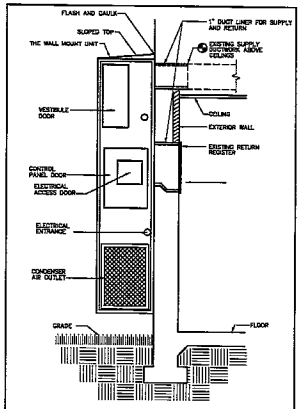
DRAWING TITLE
SECOND FLOOR PLAN - PART B - HVAC

REVISIONS	
NO.	DATE

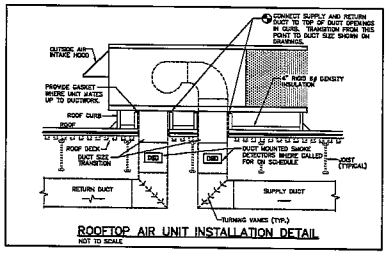
DRAWN BY ARR
CHECKED BY NDV
APPROVED BY JRW
DATE 10/31/2023
PROJECT NO. 23809
DRAWING NO.
M2.4



BARD I-TEC UNIT DETAIL
NOT TO SCALE

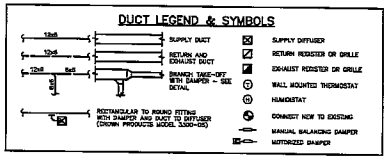


TWU WALL MOUNT UNIT INSTALLATION DETAIL
NOT TO SCALE



ROOFTOP AIR UNIT INSTALLATION DETAIL
NOT TO SCALE

DUCT LEGEND & SYMBOLS



HANGER SIZES FOR RECTANGULAR DUCT

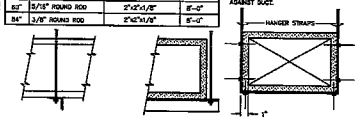
MAX SIDE	HANGER	HORIZONTAL SUPPORT ANGLE	MAXIMUM SPACING
30"	1"x18 GAUGE STRAP*	NONE REQUIRED	10'-0"
36"	1/4" ROUND ROD	1-1/2"x1-1/2"x1/8"	8'-0"
48"	1/4" ROUND ROD	2"x2"x1/8"	8'-0"
60"	3/16" ROUND ROD	2"x2"x1/8"	8'-0"
84"	3/8" ROUND ROD	2"x2"x1/8"	8'-0"

NOTE:
ALL SUPPLY AIR DUCT SHALL BE WRAPPED EXTERNALLY AS PER SPECIFICATIONS.

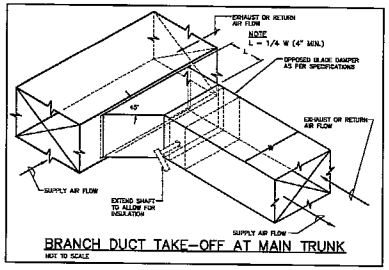
*HANGER STRAP GAUGE SHALL BE 1 GAUGE THINNER THAN DUCT GAUGE CONSTRUCTION. REFER TO SMACNA REQUIREMENTS.

NO POP RIVETS ALLOWED

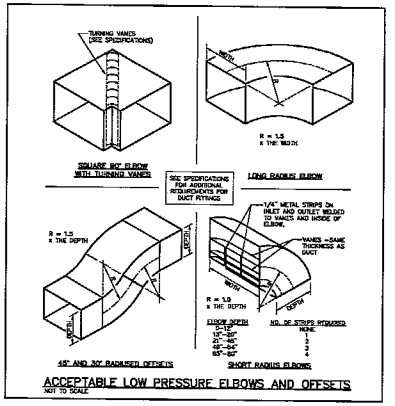
SELF TAPPING CADMIUM PLATED HEX HEAD SHEET METAL SCREW STRAPS TO BE YIGHT AGAINST DUCT.



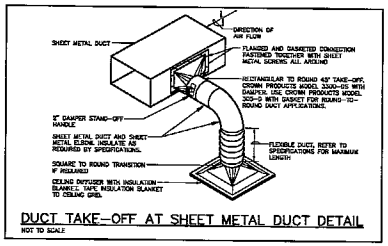
DUCT STRAP HANGER DETAIL
NOT TO SCALE



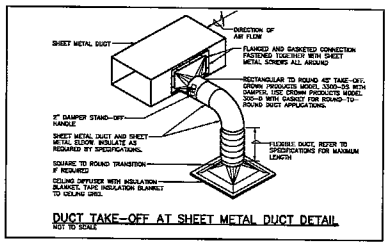
BRANCH DUCT TAKE-OFF AT MAIN TRUNK
NOT TO SCALE



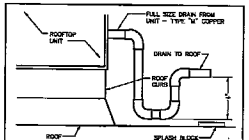
ACCEPTABLE LOW PRESSURE ELBOWS AND OFFSETS
NOT TO SCALE



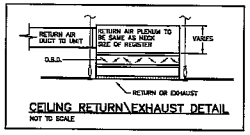
DUCT TAKE-OFF AT SHEET METAL DUCT DETAIL
NOT TO SCALE



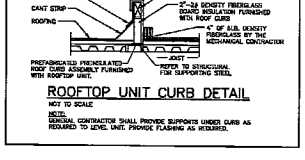
DUCT TAKE-OFF AT SHEET METAL DUCT DETAIL
NOT TO SCALE



ROOFTOP UNIT CONDENSATE DRAIN DETAIL
NOT TO SCALE

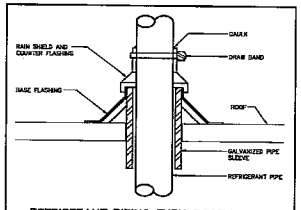


CEILING RETURN\EXHAUST DETAIL
NOT TO SCALE

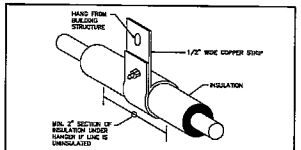


ROOFTOP UNIT CURB DETAIL
NOT TO SCALE

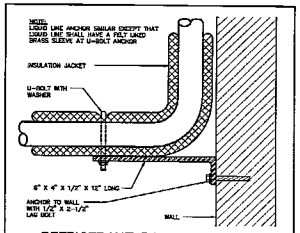
NOTE:
MECHANICAL CONTRACTOR SHALL PROVIDE SUPPORTS UNDER CURB AS REQUIRED TO LEVEL UNIT. PROVIDE FLASHING AS REQUIRED.



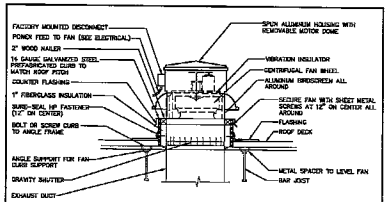
REFRIGERANT PIPING THRU ROOF DETAIL
NOT TO SCALE



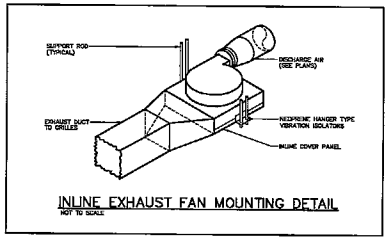
REFRIGERANT LINE HANGER DETAIL
NOT TO SCALE



REFRIGERANT PIPE WALL RISER ANCHORING DETAIL
NOT TO SCALE



ROOFTOP DOWNBLAST EXHAUST FAN DETAIL
NOT TO SCALE



INLINE EXHAUST FAN MOUNTING DETAIL
NOT TO SCALE

ENGINEERING SERVICES GROUP, INC.
800 EAST HILL AVE. SUITE 550
KNOXVILLE, TENNESSEE 37915
(865) 522-0328
PROJECT NO. 2380g

PROJECT
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE
DETAILS - HVAC

REVISIONS

NO.	DATE

DRAWN BY ARR
CHECKED BY NDV
APPROVED BY JRW
DATE 10/31/2023
PROJECT NO 2380

DRAWING NO.
M3.1

MULTIPLE ZONE DUCTLESS SPLIT SYSTEM SCHEDULE

INDOOR UNIT DATA												CONDENSING UNIT DATA									
MARK	CFM	COOLING (BTUH) SENSIBLE	COOLING (BTUH) TOTAL	HEATING (BTUH)	ELECTRIC HEAT KW	VOLTS/ PHASE	FAN F.L.A.	MOCP (AMPS)	WEIGHT (LBS)	TYPE	MANUFACTURER/ MODEL NUMBER	MARK	COOLING (BTUH)	SEER	HEATING (BTUH)	HSPF	VOLTS/ PHASE	MCA	MOCP (AMPS)	WEIGHT (LBS)	MANUFACTURER/ MODEL NUMBER
FIRST FLOOR																					
DSS-1.1	297	9,720	12,000	13,500	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P012	DSC-1.1	60,000	18.9	66,000	11.3	208/1φ	36	50	302	MITSUBISHI NTXMSM60A
DSS-1.2	297	9,720	12,000	13,500	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P012										
DSS-1.3	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-1.4	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-1.5	297	9,720	12,000	13,500	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P012										
DSS-1.6	297	9,720	12,000	13,500	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P012	DSC-1.2	48,000	19.7	54,000	11.5	208/1φ	29	40	271	MITSUBISHI NTXMSM48A
DSS-1.7	297	9,720	12,000	13,500	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P012										
DSS-1.8	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-1.9	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-1.10	SEE DUCTLESS SPLIT SYSTEM SCHEDULE																				
DSS-1.11	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015	DSC-1.3	60,000	18.9	66,000	11.3	208/1φ	36	50	302	MITSUBISHI NTXMSM60A
DSS-1.12	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-1.13	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-1.14	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-1.15	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-1.16	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-1.17	989	21,600	30,000	34,000	N/A	208/1φ	0.83	15	79	CEILING MOUNTED	MITSUBISHI TPCFY-P030	DSC-1.4	60,000	18.9	66,000	11.3	208/1φ	36	50	295	MITSUBISHI NTXMSM60A
DSS-1.18	989	21,600	30,000	34,000	N/A	208/1φ	0.83	15	79	CEILING MOUNTED	MITSUBISHI TPCFY-P030										
DSS-1.19	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015	DSC-1.5	48,000	19.7	54,000	11.5	208/1φ	29	40	271	MITSUBISHI NTXMSM48A
DSS-1.20	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-1.21	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-1.22	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-1.23	SEE DUCTLESS SPLIT SYSTEM SCHEDULE																				
SECOND FLOOR																					
DSS-2.1	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015	DSC-2.1	48,000	19.7	54,000	11.5	208/1φ	29	40	271	MITSUBISHI NTXMSM48A
DSS-2.2	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-2.3	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-2.4	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-2.5	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015	DSC-2.2	48,000	19.7	54,000	11.5	208/1φ	29	40	271	MITSUBISHI NTXMSM48A
DSS-2.6	353	12,300	15,000	17,000	N/A	208/1φ	0.19	15	29	WALL MOUNTED	MITSUBISHI TPKFY-P015										
DSS-2.7	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										
DSS-2.8	237	5,700	8,000	9,000	N/A	208/1φ	0.19	15	25	WALL MOUNTED	MITSUBISHI TPKFY-P008										

NOTES:
1. ALL UNITS TO BE U.L. LISTED.
2. PROVIDE 5 YEAR MANUFACTURER'S WARRANTY ON ALL EQUIPMENT AND 7 YEAR WARRANTY ON ALL COMPRESSORS.
3. PROVIDE CONDENSATE DRAIN, FILTERS, REFRIGERANT PIPING WITH WHITE 1/2" INSULATION. FOLLOW ALL MANUFACTURER'S RECOMMENDATIONS WITH REGARD TO REFRIGERANT LINE INSTALLATION.
4. PROVIDE EACH INDOOR UNIT WITH WIRED REMOTE THERMOSTAT / CONTROLLER. CONNECT TO EXISTING TRANE BAS CONTROLS.
5. USE 16/2 STRANDED, SHIELDED, TWISTED PAIR FOR COMMUNICATION DAISY CHAIN BETWEEN INDOOR AND OUTDOOR UNITS.
6. PROVIDE ALL UNITS WITH A FIELD INSTALLED CONDENSATE PUMP.
7. PROVIDE CONDENSATE FLOAT SWITCH IN EACH UNIT FOR OVERFLOW PROTECTION.
8. PROVIDE OUTDOOR UNIT WITH FIBERGLASS PAD AND RAIL CURB SUPPORTS AS REQUIRED BY THE MANUFACTURER AND TO PROTECT EXISTING ROOF.

DUCTLESS SPLIT SYSTEM SCHEDULE

INDOOR UNIT DATA															CONDENSING UNIT DATA						
MARK	CFM	COOLING (BTUH) SENSIBLE	COOLING (BTUH) TOTAL	SEER	HEATING BTU	HSPF	ELECTRIC HEAT KW	VOLTS/ PHASE	FAN F.L.A.	MOCP (AMPS)	WEIGHT (LBS)	TYPE	MANUFACTURER/ MODEL NUMBER		MARK	COOLING BTU	VOLTS/ PHASE	MCA	MOCP (AMPS)	WEIGHT (LBS)	MANUFACTURER/ MODEL NUMBER
DSS-1.10	455	13,140	18,000	20.2	N/A	N/A	N/A	208/1φ	0.19	SEE NOTE 4	28	WALL MOUNTED	MITSUBISHI TPKADA018ILA		DSC-1.10	18,000	208/1φ	11.0	28	99	MITSUBISHI TRUYA018IKA70
DSS-1.23	455	13,140	18,000	20.2	N/A	N/A	N/A	208/1φ	0.19	SEE NOTE 4	28	WALL MOUNTED	MITSUBISHI TPKADA018ILA		DSC-1.23	18,000	208/1φ	11.0	28	99	MITSUBISHI TRUYA018IKA70

DUCTLESS SPLIT SYSTEM SCHEDULE NOTES:
1. UNITS SHALL BE U.L. LISTED AND COMPRESSORS SHALL HAVE A 5 YEAR WARRANTY.
2. FURNISH EACH SYSTEM COMPLETE WITH A PERMANENT, WASHABLE AIR FILTER, R-410A REFRIGERANT, REFRIGERANT PIPING, AND LOW AMBIENT COOLING CONTROL TO 0° FAHRENHEIT. PROVIDE UNIT MOUNTED CONTROLS, CONNECT TO EXISTING TRANE BAS CONTROLS.
3. FURNISH EACH UNIT WITH AN INTEGRAL CONDENSATE PUMP.
4. INDOOR UNITS RECEIVE POWER FROM OUTDOOR UNITS THROUGH FIELD-SUPPLIED INTERCONNECTED WIRING.

CLASSROOM HEAT PUMP SCHEDULE – FIRST FLOOR

MARK	SUPPLY AIR CFM	OUTSIDE AIR CFM (MIN.)	COOLING AT ARI CONDITIONS: SENSIBLE MBH	TOTAL MBH	EER	HEAT MBH @ 47F	COP	ENERGY RECOVER VENTILATOR: CFM	HRT-SUMMER	HRS-SUMMER	WHEEL EFF.%	HRT-WINTER	WHEEL EFF.%	ELECTRICAL DATA: VOLTS/ PHASE	COOLING F.L.A.	EMER. HEAT (KW/STEPS)	BLOWER HP	MOCP	UNIT WEIGHT (LBS.)	MANUFACTURER AND MODEL NUMBER
CLASSROOMS																				
TWU-1.1	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.2	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.3	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.4	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.5	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.6	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.7	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.8	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.9	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.10	1700	375	38.2	54.0	11.2	54.0	3.6	375	6.7	5.3	56	19.6	81	460/3	16.1	15.0/1	3/4	30	1105	BARD I60H1DC15RN
TWU-1.11	1700	375	38.2	54.0	11.2	54.0	3.6	375	6.7	5.3	56	19.6	81	460/3	16.1	15.0/1	3/4	30	1105	BARD I60H1DC15RN
TWU-1.12	900	375	20.5	27.8	11.7	28.8	3.6	375	6.7	5.3	66	19.6	81	460/3	10	9.0/1	1/3	25	990	BARD I30H1DC09RN
TWU-1.13	900	375	20.5	27.8	11.7	28.8	3.6	375	6.7	5.3	66	19.6	81	460/3	10	9.0/1	1/3	25	990	BARD I30H1DC09RN
TWU-1.14	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.15	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.16	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.17	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.18	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
WALL MOUNT (EXTERIOR)																				
TWU-1.19	900	325	22.9	29.0	11.0	25.3	3.4	325	5.7	4.5	54	18.3	76	208/3	12.9	9.0/1	1/2	50	404	BARD W30HBDA06RN
TWU-1.20	900	325	22.9	29.0	11.0	25.3	3.4	325	5.7	4.5	54	18.3	76	208/3	12.9	9.0/1	1/2	50	404	BARD W30HBDA06RN
TWU-1.21	900	325	22.9	29.0	11.0	25.3	3.4	325	5.7	4.5	54	18.3	76	208/3	12.9	9.0/1	1/2	50	404	BARD W30HBDA06RN
CLASSROOMS																				
TWU-1.22	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.23	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.24	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.25	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-1.26	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
WALL MOUNT (EXTERIOR) – PORTABLE CLASSROOMS																				
TWU-1.27	1350	375	30.6	41.5	11.0	37.4	3.3	375	6.7	5.3	64	19.6	81	230/1	25.1	15.0/1	1/2	40/60	587	BARD W42HYDA15RN
TWU-1.28	1350	375	30.6	41.5	11.0	37.4	3.3	375	6.7	5.3	64	19.6	81	230/1	25.1	15.0/1	1/2	40/60	587	BARD W42HYDA15RN

CLASSROOM HEAT PUMP SCHEDULE – SECOND FLOOR

MARK	SUPPLY AIR CFM	OUTSIDE AIR CFM (MIN.)	COOLING AT ARI CONDITIONS: SENSIBLE MBH	TOTAL MBH	EER	HEAT MBH @ 47F	COP	ENERGY RECOVER VENTILATOR: CFM	HRT-SUMMER	HRS-SUMMER	WHEEL EFF.%	HRT-WINTER	WHEEL EFF.%	ELECTRICAL DATA: VOLTS/ PHASE	COOLING F.L.A.	EMER. HEAT (KW/STEPS)	BLOWER HP	MOCP	UNIT WEIGHT (LBS.)	MANUFACTURER AND MODEL NUMBER
CLASSROOMS																				
TWU-2.1	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.2	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.3	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.4	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.5	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.6	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.7	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.8	1100	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.9	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.10	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.11	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.12	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.13	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
CAFETERIA																				
TWU-2.14	1700	375	38.2	54.0	11.2	54.0	3.6	375	6.7	5.3	56	19.6	81	460/3	16.1	15.0/1	3/4	30	1105	BARD I60H1DC15RN
TWU-2.15	1700	375	38.2	54.0	11.2	54.0	3.6	375	6.7	5.3	66	19.6	81	460/3	16.1	15.0/1	3/4	30	1105	BARD I60H1DC15RN
TWU-2.16	1700	375	38.2	54.0	11.2	54.0	3.6	375	6.7	5.3	66	19.6	81	460/3	16.1	15.0/1	3/4	30	1105	BARD I60H1DC15RN
TWU-2.17	1700	375	38.2	54.0	11.2	54.0	3.6	375	6.7	5.3	56	19.6	81	460/3	16.1	15.0/1	3/4	30	1105	BARD I60H1DC15RN
CLASSROOMS																				
TWU-2.18	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	56	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.19	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.20	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN
TWU-2.21	1150	375	27.0	35.0	12.0	32.8	3.7	375	6.7	5.3	66	19.6	81	460/3	12.2	9.0/1	1/2	25	1020	BARD I36H1DC09RN

CLASSROOM HEAT PUMP SCHEDULE NOTES:
1. ALL UNITS SHALL BE U.L. LISTED AND HAVE 5 YEAR COMPRESSOR WARRANTY.
2. PROVIDE EACH UNIT COMPLETE WITH 2" PLEATED FILTERS, 20-GAUGE PANELS AND FRAME, INTEGRAL ELECTRICAL DISCONNECT, CONDENSATE DRAIN KIT, EXTENDED 15" WALL SLEEVE, SIDE TRIM EXTENSION KIT, AND BOTTOM TRIM PIECES.
PROVIDE EACH EXTERIOR WALL MOUNT UNIT WITH WALL MOUNT EXPANSION KIT TO ALLOW TRANSITIONS TO EXISTING SUPPLY DUCT AND RETURN OPENINGS.
3. PROVIDE HOT GAS REHEAT DEHUMIDIFICATION, AND LOW AMBIENT COOLING CONTROL TO 0F.
4. PROVIDE EACH UNIT WITH HIGH AND LOW PRESSURE SWITCHES.
5. PROVIDE EACH UNIT WITH ITEC ENERGY RECOVERY VENTILATOR (ERV) PACKAGE.
6. PROVIDE UNITS WITH OUTDOOR LOUVER GRILLE, COLOR SHALL BE FACTORY ANODIZED FINISHED. SELECT COLOR OPTION TO MATCH EXISTING EXTERIOR BRICK SURFACE AND COORDINATE SELECTION WITH OWNER.
7. ENERGY RECOVER VENTILATOR DATA IS FOR 95F DB/70F WB OUTDOOR AMBIENT SUMMER (75F DB/ 62F WB INDOOR) AND 10F AMBIENT OUTDOOR WINTER (70F INDOOR). HRT=TOTAL HEAT RECOVERED IN MBH, HRS=SENSIBLE HEAT RECOVERED IN MBH.
8. OPERATIONAL SOUND LEVEL REQUIREMENT SHALL NOT EXCEED 51dB.
9. PROVIDE CLASSROOM UNIT WHERE INDICATED WITH DISCHARGE SUPPLY PLENUM. PROVIDE ALL UNITS WITH FILLER PANEL TO EXTEND TO CEILING.
10. PROVIDE EACH UNIT WITH BACNET COMMUNICATION. EACH UNIT SHALL BE CONNECTED TO THE EXISTING TRANE BUILDING AUTOMATION SYSTEM CURRENTLY INSTALLED AT THE FACILITY.
11. BARD ITEC CABINET COLOR SHALL BE SELECTED BY THE DESIGNER.

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
600 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0393
PROJECT NO. 23809

PROJECT:
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE
SCHEDULES - HVAC

REVISIONS	
NO.	DATE

DRAWN BY ARR
CHECKED BY NDV
APPROVED BY JRW
DATE 10/31/2023
PROJECT NO 23809
DRAWING NO.
M4.1

BUILDING AUTOMATION SYSTEM (BAS) CONTROL SEQUENCES

ROOFTOP UNITS (RTU)

EACH OF THESE ROOFTOP UNITS SHALL BE CONTROLLED BY A DDC UNITARY CONTROLLER ACCORDING TO SCHEDULE. THE INDIVIDUAL CONTROLLERS SHALL BE MOUNTED WITHIN THE INDIVIDUAL ROOFTOP UNIT'S CONTROL SECTION. THE DDC CONTROLLER SHALL OPERATE THE HEATING AND COOLING STAGES OF THE INDIVIDUAL UNITS.

EACH UNIT SHALL BE FURNISHED WITH LIFE SAFETY DEVICES AS CALLED FOR ON THE DRAWINGS AND SPECIFICATIONS. EACH UNIT SHALL ALSO BE FURNISHED WITH A LOW LIMIT FREEZESTAT ON THE COIL. IN THE EVENT THE COIL TEMPERATURE DROPS TO 40° F, THEN THE UNIT SHALL BE DISABLED, AND THE OUTSIDE AIR INTAKE DAMPER SHALL CLOSE.

UNITS SHALL HAVE A ZONE MOUNTED TEMPERATURE SENSOR WITH ±3° TEMPERATURE ADJUSTMENT AND TIMED OVERRIDE SWITCH. SENSORS SHALL HAVE WIRE GYM GUARDS.

THE OUTSIDE AIR INTAKE DAMPER OF EACH UNIT SHALL BE CONTROLLED BY A ZONE MOUNTED CARBON DIOXIDE SENSOR. UPON A RISE IN THE ZONE CARBON DIOXIDE LEVEL TO 1,000 PPM, THE OUTSIDE AIR INTAKE DAMPER OF THE UNIT SHALL OPEN TO PROVIDE THE QUANTITY OF OUTSIDE AIR AS SHOWN IN THE EQUIPMENT SCHEDULE. AFTER A DROP IN THE CARBON DIOXIDE LEVEL TO 1,000 PPM THE DAMPER SHALL RETURN TO THE CLOSED POSITION. THE OUTSIDE AIR DAMPER SHALL REMAIN CLOSED AT ALL OTHER TIMES, AND EACH OUTSIDE AIR INTAKE DAMPER SHALL FAIL TO THE CLOSED POSITION.

RTU UNIT AS SCHEDULED SHALL HAVE A HOT GAS REHEAT DEHUMIDIFICATION CYCLE. WHEN THE HUMIDITY IS ABOVE THE SETPOINT OF THE SPACE MOUNTED HUMIDISTAT (BY CONTROLS CONTRACTOR), THE DEHUMIDIFICATION CYCLE SHALL START. WHEN THE HUMIDISTAT IS SATISFIED, THE SYSTEM SWITCHES BACK TO NORMAL A/C MODE. IF THE THERMOSTAT CALLS FOR COOLING WITH THE UNIT IS IN DEHUMIDIFICATION MODE, THE COOLING TAKES PRECEDENCE OVER THE DEHUMIDIFICATION AND THE UNIT WILL COOL UNTIL THE THERMOSTAT IS SATISFIED. THE DEHUMIDIFICATION CYCLE SHALL OPERATE DURING BOTH OCCUPIED AND UNOCCUPIED MODES.

DDC CONTROL POINTS (EACH UNIT):
FAN START/STOP (EACH RTU)
FAN STATUS (CT SWITCH) (EACH RTU)
SUPPLY AIR TEMPERATURE (EACH RTU)
ZONE AIR TEMPERATURE (EACH RTU)
RETURN AIR TEMPERATURE (EACH RTU)
COMPRESSOR 1 START/STOP (EACH RTU)
COMPRESSOR 1 STATUS (EACH RTU)
COMPRESSOR 2 START/STOP (EACH RTU)
COMPRESSOR 2 STATUS (EACH RTU)
HEAT STAGE 1 START/STOP (EACH RTU)
HEAT STAGE 1 STATUS (EACH RTU)
HEAT STAGE 2 START/STOP (EACH RTU)
HEAT STAGE 2 STATUS (EACH RTU)
FREEZESTAT STATUS (EACH RTU)
SUPPLY AIR DUCT SMOKE DETECTOR STATUS (EACH RTU)
RETURN AIR DUCT SMOKE DETECTOR STATUS (EACH RTU)
OUTSIDE AIR TEMPERATURE (GLOBAL) (EACH RTU)
OUTSIDE AIR RELATIVE HUMIDITY (%RH) (GLOBAL) (EACH RTU)
OUTSIDE AIR CARBON DIOXIDE LEVEL (PPM) (GLOBAL) (EACH RTU)
OUTSIDE AIR INTAKE DAMPER POSITION (EACH RTU)
OUTSIDE AIR INTAKE DAMPER MODULATE (EACH RTU)
ZONE CARBON DIOXIDE LEVEL (PPM) (EACH RTU)
ZONE RELATIVE HUMIDITY (%R.H.) (EACH RTU)
HOT GAS REHEAT STATUS (EACH RTU)

DUCTLESS SPLIT SYSTEM HEAT PUMP SYSTEM (DSS/DSC)

THE DUCTLESS SPLIT SYSTEM HEAT PUMP SYSTEMS SHALL BE CONTROLLED THROUGH A DDC UNITARY CONTROLLER ACCORDING TO SCHEDULE.

UNIT HEATING OR COOLING DECISION WILL BE BASED ON ZONE TEMPERATURE REQUIREMENTS.

WHEN ENABLED BY THE DDC SYSTEM TO RUN, THE UNIT SHALL UTILIZE ITS OWN INTERNAL CONTROLS TO MAINTAIN THE INDIVIDUAL ZONE TEMPERATURE SETPOINTS. CONNECTION TO THE FACILITY BAS SYSTEM SHALL BE FOR THE PURPOSES OF SCHEDULING, NIGHT SETBACK, AND UNIT MONITORING AS DEFINED BELOW.

THESE SYSTEMS SHALL EACH HAVE A ZONE MOUNTED TEMPERATURE SENSOR WITH ±3° TEMPERATURE ADJUSTMENT AND TIMED OVERRIDE SWITCH.

DDC CONTROL POINTS:
SYSTEM ENABLE/DISABLE
SYSTEM STATUS
SYSTEM ZONE TEMPERATURE
SYSTEM ZONE OVERRIDE
OUTSIDE AIR TEMPERATURE (GLOBAL)
OUTSIDE AIR RELATIVE HUMIDITY (%RH) (GLOBAL)

CENTRAL SYSTEM

THE CONTROL SYSTEM SHALL BE DIRECT DIGITAL CONTROL (DDC), AND WILL INCLUDE THE CONTROL OF BUILDING TEMPERATURES, PRESSURES, HUMIDITY AND THE OPERATION OF THE HVAC EQUIPMENT. MECHANICAL EQUIPMENT AS INDICATED WILL BE MONITORED AND\OR CONTROLLED AS DESCRIBED IN THE SEQUENCES LISTED HERE. CONTROL SYSTEM MANUFACTURER SHALL BE TRANE OR AUTOMATED LOGIC.

PROVIDE AN ETHERNET CONNECTION AND IP ADDRESS FOR THE NEW DDC SYSTEM AS REQUIRED. THE CONNECTION WILL BE LOCATED ADJACENT TO THE BUILDING CONTROL UNIT. THE CONTROL MANUFACTURER SHALL PROVIDE ALL GRAPHICS AND PROGRAMMING FOR THE NEW SYSTEM.

THE NEW CONTROL SYSTEM SHALL MEET ALL REQUIREMENTS OF KNOX COUNTY SCHOOLS.

ZONE SENSORS

THE ZONE SENSOR SHALL HAVE THE FOLLOWING FEATURES:

1. ZONE SETPOINT ADJUSTMENT (TEMPERATURE)
2. NIGHT SETBACK TEMPERATURE OVERRIDE BUTTON TO PROVIDE OCCUPIED CONDITIONS DURING UNOCCUPIED TIMES.
3. NIGHT SETBACK OVERRIDE CANCEL BUTTON TO END THE OVERRIDE CONDITION.
4. ZONE SETPOINT ADJUSTMENT (TEMPERATURE AND HUMIDITY FOR UNITS WITH HUMIDITY CONTROL)

WARRANTY

CONTROL SYSTEM SHALL BE FURNISHED WITH FULL PARTS AND LABOR WARRANTY FOR A PERIOD OF TWO YEARS.

ELECTRICAL

ALL 120 VOLT POWER FOR BUILDING CONTROLLERS SHALL BE THE RESPONSIBILITY OF CONTROL CONTRACTOR. COORDINATE CIRCUITS AND PANELS TO FEED FROM WITH ELECTRICAL CONTRACTOR IN FIELD. THESE CIRCUITS WILL NOT BE SHOWN ON ELECTRICAL DRAWINGS.

CLASSROOM HEAT PUMPS (TWU UNITS)

THE HEAT PUMPS SHALL EACH BE CONTROLLED THROUGH A UNITARY CONTROLLER ACCORDING TO SCHEDULE.

IN THE OCCUPIED MODE, THE CONTROLLER SHALL OPERATE THE FAN CONTINUOUSLY AND THE STAGES OF COOLING OR HEATING TO MAINTAIN SPACE TEMPERATURE SETPOINT. ON A CALL FOR HEATING OR COOLING, THE UNIT COMPRESSOR(S) SHALL BE ENABLED TO PROVIDE HEATING OR COOLING BASED ON ZONE TEMPERATURE REQUIREMENTS.

IN THE UNOCCUPIED MODE, THE CONTROLLER SHALL OPERATE THE FAN ONLY ON A CALL FOR HEATING OR COOLING AND THE STAGES OF COOLING OR HEATING TO MAINTAIN UNOCCUPIED SPACE TEMPERATURE SETPOINT.

TWU UNITS AS SCHEDULED SHALL HAVE INCLUDED FROM THE FACTORY AN ENERGY RECOVERY VENTILATOR (ERV). THE ERV SHALL BE SET TO SPEED WITHIN THE UNIT. DURING OCCUPIED TIMES THE ERV SHALL RUN CONTINUOUS. DURING UNOCCUPIED TIMES THE ERV SHALL BE OFF.

TWU UNITS AS SCHEDULED SHALL HAVE A DEHUMIDIFICATION CYCLE. WHEN THE HUMIDITY IS ABOVE THE SETPOINT OF THE SPACE MOUNTED HUMIDISTAT (BY CONTROLS CONTRACTOR), THE DEHUMIDIFICATION CYCLE SHALL START. WHEN THE HUMIDISTAT IS SATISFIED, THE SYSTEM SWITCHES BACK TO NORMAL A/C MODE. IF THE THERMOSTAT CALLS FOR COOLING WITH THE UNIT IS IN DEHUMIDIFICATION MODE, THE COOLING TAKES PRECEDENCE OVER THE DEHUMIDIFICATION AND THE UNIT WILL COOL UNTIL THE THERMOSTAT IS SATISFIED. THE DEHUMIDIFICATION CYCLE SHALL OPERATE DURING BOTH OCCUPIED AND UNOCCUPIED MODES.

THE UNITS SHALL BE FURNISHED WITH LIFE SAFETY DEVICES AS CALLED FOR ON THE DRAWINGS AND SPECIFICATIONS. THE UNITS SHALL ALSO BE FURNISHED WITH A LOW LIMIT FREEZESTAT ON THE COIL. IN THE EVENT THE COIL TEMPERATURE DROPS TO 40° F, THEN THE UNIT SHALL BE DISABLED.

UNITS (WHERE SHOWN) SHALL HAVE A ZONE MOUNTED TEMPERATURE SENSOR WITH ±3° TEMPERATURE ADJUSTMENT AND TIMED OVERRIDE SWITCH.

DDC CONTROL POINTS:
DDC CONTROL POINTS:
FAN START/STOP (EACH TWU)
FAN STATUS (CT SWITCH) (EACH TWU)
OUTSIDE AIR TEMPERATURE (GLOBAL)
OUTSIDE AIR RELATIVE HUMIDITY (%RH) (GLOBAL)
SUPPLY AIR TEMPERATURE (EACH TWU)
ZONE AIR TEMPERATURE (EACH TWU)
COMPRESSOR 1 START/STOP (EACH TWU)
COMPRESSOR 1 STATUS (EACH TWU)
REVERSING VALVE POSITION (EACH TWU)
UNIT OVERRIDE (EACH TWU) (AS REQUIRED)
FREEZESTAT STATUS (EACH TWU)

NIGHT SETBACK SYSTEM CONTROL SEQUENCE

DURING UNOCCUPIED HOURS NO EQUIPMENT WHICH IS DISABLED BY THE NIGHT SETBACK SYSTEM SHALL OPERATE UNLESS A ZONE THERMOSTAT WITHIN A ZONE DETERMINES A NEED FOR HEATING OR COOLING. IF ANY THERMOSTAT IN A ZONE DETERMINES A NEED FOR HEATING OR COOLING, THE MECHANICAL UNIT(S) FOR THAT ZONE (EXCEPT EXHAUST FANS IN THAT ZONE) SHALL BE ENABLED UNTIL THE THERMOSTAT IN THAT ZONE IS SATISFIED, THEN THE ZONE SHALL RETURN TO NIGHT SETBACK OPERATION.

EXHAUST FANS

EXHAUST FANS AS SHOWN IN THE EQUIPMENT SCHEDULES SHALL BE CONTROLLED BY THE DDC (BAS) SYSTEM. DURING OCCUPIED SCHEDULES, ONLY THOSE EXHAUST FANS NOTED AS BEING CONTROLLED BY THE BAS SHALL BE CONNECTED TO THE FACILITY BAS SYSTEM.

DURING UNOCCUPIED, HOLIDAY, OR NIGHT SETBACK SCHEDULE OPERATIONS, NO EXHAUST FAN SHOWN AS BEING CONTROLLED SHALL BE ENABLED.

DDC CONTROL POINTS:
FAN START/STOP
FAN STATUS (CT SWITCH)

PACKAGED ROOFTOP AIR UNIT SCHEDULE

	MARK	CFM	E.S.P. IN. WG	EVAP. FAN HP	OUTSIDE AIR CFM	COOLING CAPACITIES @ A.R.I. COND. (MBH-GROSS) SENS	TOTAL	NOM. TONS	GAS HEATING CAPACITIES (MBH) INPUT	OUTPUT	WEIGHT (LBS)	ELECTRICAL DATA VOLTS / ø	F.L.A.	MACR	SEER	MFG & MODEL NO.	SERVICE
* REPLACE WITH NEW	RTU-1	5,000	1.0	5.0	750	118.7	154.3	12.5	150.0	121.5	1,388	208/3	57.8	90	10.8EER	TRANE YHJ150G3	GYMNASIUM
* REPLACE WITH NEW	RTU-2	5,000	1.0	5.0	750	118.7	154.3	12.5	150.0	121.5	1,388	208/3	57.8	90	10.8EER	TRANE YHJ150G3	GYMNASIUM
* REPLACE WITH NEW	RTU-3	2,000	0.75	1.0	300	47.3	63.5	5.0	130.0	104.0	870	208/3	28.0	45	14.2EER	TRANE YHC060E3	GYMNASIUM

ROOFTOP AIR UNIT SCHEDULE NOTES:

1. ALL UNITS SHALL BE U.L. LISTED AND ADA APPROVED. ALL COMPRESSORS SHALL HAVE A 5 YEAR WARRANTY.
2. ALL UNITS SHALL BE FURNISHED COMPLETE WITH R-410A REFRIGERANT, FILTERS, ENTHALPY ECONOMIZER, ROOF CURB ADAPTOR AS REQUIRED, COIL GUARDS, HINGED ACCESS DOORS, AND LOW AMBIENT COOLING CONTROL TO 0° FAHRENHEIT.
3. PROVIDE EACH UNIT HAVING OUTSIDE AIR AS SCHEDULED WITH MOTORIZED OUTSIDE AIR INTAKE DAMPER WITH INTAKE HOOD
4. * DENOTES UNITS THAT SHALL BE PROVIDED WITH A SMOKE DETECTOR IN SUPPLY AND RETURN DUCT, BOTH WIRED TO SHUT DOWN EACH INDIVIDUAL UNIT ON DETECTION. DETECTORS FURNISHED BY THE ELECTRICAL CONTRACTOR FOR INSTALLATION BY THE MECHANICAL CONTRACTOR.
   WHERE SMOKE DETECTORS ARE EXISTING LOCATED IN THE EXISTING DUCTWORK, EXISTING SMOKE DETECTORS SHALL BE REUSED AND REMAIN IN OPERATION CONNECTED TO THE BUILDING'S FIRE ALARM SYSTEM. IF SMOKE DETECTORS ARE NOT PRESENT, CONTRACTOR SHALL PROVIDE NEW AS PREVIOUSLY DESCRIBED.
5. PROVIDE EACH UNIT WITH FULL SIZE TYPE "M" COPPER CONDENSATE DRAIN WITH P-TRAP.
6. PROVIDE EACH NEW UNIT WITH A THERMOSTAT WITH HUMIDITY CONTROL AND LOCKOUT CAPABILITY. PROVIDE AND INSTALL AT EXISTING THERMOSTAT LOCATION FROM PREVIOUS EQUIPMENT. THERMOSTAT CONTROLS SHALL BE CONNECTED TO EXISTING TRANE BAS CURRENTLY INSTALLED AT THE FACILITY.
7. PROVIDE EACH NEW UNIT WITH HOT GAS REHEAT OPTION AND DEHUMIDIFICATION CONTROL ALGORITHM.

		EXISTING UNIT WEIGHT (LBS)	NEW UNIT WEIGHT (LBS)	PERCENT CHANGE
REPLACE WITH NEW	RTU-1	1,345	1,388	3.1%
REPLACE WITH NEW	RTU-2	1,345	1,388	3.1%
REPLACE WITH NEW	RTU-3	840	870	3.6%

* WEIGHTS LISTED DO NOT INCLUDE EXISTING ROOF CURBS WHICH SHALL REMAIN IN PLACE.

SPLIT SYSTEM HEAT PUMP SCHEDULE

INDOOR UNIT DATA MARK	CFM	E.S.P. IN. WG	EVAP FAN HP	COOLING CAPACITIES AT A.R.I. CONDITIONS SENS MBH	TOT. MBH	NOM. TONS	HEATING CAPACITY MBH AT 17°F	COP	VOLTS/PHASE	COOLING F.L.A.	MOCP	EMERGENCY ELECT. HEAT (KW / STEPS)	WEIGHT LBS.	MANUFACTURER AND MODEL NUMBER	AREA SERVED	CONDENSING UNIT DATA MARK	VOLTS/PHASE	F.L.A.	MOCP	WEIGHT LBS.	EER/SEER	MANUFACTURER AND MODEL NUMBER
AHU-1	4,000	0.25"	2.0	100.0	124.1	10	104.5	3.4	208/3ø	6.8	15	N/A	388	TRANE TWE1204B	KITCHEN	HP-1	208/3ø	37.3	50	433	11.2/–	TRANE TWA1204D
AHU-2	1,600	0.5"	3/4	34.0	46.8	4.0	46.0	3.4	208/3ø	6.3	45	14.4 / 1	145	TRANE TEM4A0C48	OFFICES	HP-2	208/3ø	14.8	30	281	–/14.0	TRANE 4TWA4048

SPLIT SYSTEM HEAT PUMP SCHEDULE NOTES:

1. EQUIPMENT TAG NUMBERS USED HERE ARE FOR DESIGN COORDINATION ONLY. CONTRACTOR SHALL CONSULT WITH OWNER TO PERMANENTLY TAG EACH PIECE OF EQUIPMENT AND THEIR CONTROL DEVICES PER THE FACILITY'S EXISTING CONVENTION AND STANDARDS.
2. ALL UNITS SHALL BE U.L. LISTED, AND ALL COMPRESSORS SHALL HAVE A FIVE YEAR WARRANTY.
3. PROVIDE EACH SYSTEM COMPLETE WITH 1" DISPOSABLE AIR FILTERS, R-410A REFRIGERANT, REFRIGERANT PIPING, OUTDOOR THERMOSTAT, COIL HAIL GUARD, LOW AMBIENT COOLING CONTROL TO 30° FAHRENHEIT, TYPE M COPPER CONDENSATE DRAIN WITH 4" DEEP P-TRAP AND AUXILIARY ELECTRIC HEAT.
4. FOLLOW ALL MANUFACTURER RECOMMENDATIONS REGARDING REFRIGERANT LINE SIZES AND LENGTHS, AND REQUIREMENTS GOVERNING USE AND INSTALLATION OF SUCTION LINE ACCUMULATORS.
5. PROVIDE EACH UNIT WITH A REMOTE SENSOR WITH THUMBWHEEL ADJUSTABLE SETPOINT AND TEMPERATURE OVERRIDE BUTTON. UNIT SHALL BE CONNECTED AND CONTROLLED BY THE EXISTING BUILDING AUTOMATION SYSTEM CURRENTLY INSTALLED AT THE FACILITY.
6. PROVIDE EACH AIR HANDLER UNIT WITH AN AUXILIARY DRAIN PAN WITH FLOAT SWITCH WIRED TO SHUT UNIT DOWN ON WATER RISE.
7. AHU-1: PROVIDE AND INSTALL DUCT MOUNTED SMOKE DETECTOR IN THE SUPPLY DUCT, WIRED TO SHUT DOWN UNIT ON DETECTION. DETECTORS SHALL BE FURNISHED BY THE ELECTRICAL CONTRACTOR FOR INSTALLATION IN THE DUCT BY THE MECHANICAL CONTRACTOR.
8. EACH UNIT SHALL HAVE SINGLE POINT POWER CONNECTION.

	EXISTING UNIT WEIGHT (LBS)	NEW UNIT WEIGHT (LBS)	PERCENT CHANGE
AHU-1	411	429	4.4%
HP-2	282	281	3.5%

* OUTDOOR UNIT HP-1 IS LOCATED ON GRADE AND HAS NO BUILDING STRUCTURAL IMPLICATIONS.
* INDOOR UNIT AHU-2 IS FLOOR MOUNTED AND HAS NO BUILDING STRUCTURAL IMPLICATIONS.

EXHAUST FAN SCHEDULE

MARK	CFM	E.S.P. IN WG	HP OR WATTS	RPM	TIP SPEED	TYPE	DRIVE TYPE	SONES	CONTROL	VOLTS/PHASE	WEIGHT	MANUFACTURER AND MODEL NUMBER
EF-1	8,100	0.5	2.0	–	–	–	–	–	–	–	–	KITCHEN HOOD, EXISTING TO REMAIN
EF-2	2,400	0.25	1/2	–	–	–	–	–	–	–	–	DISHWASHER HOOD, EXISTING TO REMAIN
EF-3	14,000	0.25	2.0	–	–	–	–	–	–	–	–	MECHANICAL ROOM, EXISTING TO REMAIN
EF-4	2,200	0.375	3/4	1209	54 MPH	ROOFTOP DOWNBLAST CENTRIFUGAL	DIRECT	13.1	BUILDING EMS	120/1	51	COOK ACED 150C150
EF-5	300	0.25	73 W	1715	38 MPH	ROOFTOP DOWNBLAST CENTRIFUGAL	DIRECT	5.7	BUILDING EMS	120/1	22	COOK ACED 90C150
EF-6	350	0.25	80 W	1715	42 MPH	ROOFTOP DOWNBLAST CENTRIFUGAL	DIRECT	5.7	BUILDING EMS	120/1	22	COOK ACED 90C150
EF-7	1,100	0.25	1/2	899	36 MPH	ROOFTOP DOWNBLAST CENTRIFUGAL	DIRECT	5.4	BUILDING EMS	120/1	39	COOK ACED 135C130
EF-8	1,100	0.25	1/2	899	36 MPH	ROOFTOP DOWNBLAST CENTRIFUGAL	DIRECT	5.4	BUILDING EMS	120/1	39	COOK ACED 135C130
EF-9	500	0.25	120 W	1625	43 MPH	ROOFTOP DOWNBLAST CENTRIFUGAL	DIRECT	8.9	BUILDING EMS	120/1	23	COOK ACED 100C150
EF-10	1,750	0.375	3/4	1025	46 MPH	ROOFTOP DOWNBLAST CENTRIFUGAL	DIRECT	9.0	BUILDING EMS	120/1	51	COOK ACED 150C130
EF-11	300	0.25	85 W	1500	28 MPH	INLINE CENTRIFUGAL CIRCULATING FAN	DIRECT	4.0	WALL SWITCH, BUILDING EMS	120/1	24	COOK GN-422
EF-12	600	0.375	232 W	1375	25 MPH	INLINE CENTRIFUGAL CIRCULATING FAN	DIRECT	6.0	WALL SWITCH, BUILDING EMS	120/1	29	COOK GN-720
EF-13	485	0.1	78 W	3400	56 MPH	TRANSFER FAN IN WALL	DIRECT	9.0	WALL SWITCH, BUILDING EMS	120/1	21	COOK CBF

EXHAUST FAN SCHEDULE NOTES:

1. ALL UNITS SHALL BE U.L. LISTED AND AMCA CERTIFIED.
2. ALL FANS TO HAVE BACKDRAFT DAMPER, AND MOTOR STARTER.
3. ROOF FAN ACCESSORIES: WEATHERPROOF DISCONNECT, SPEED CONTROLLER, ALUMINUM BIRDSCREEN, 12" ROOF CURB OR CURB ADAPTOR.
4. PROVIDE INLINE FANS COMPLETE WITH BACKDRAFT DAMPER, SPEED CONTROL, AND VIBRATION ISOLATION MOUNTING HARDWARE.
5. CONNECT NEW EXHAUST FANS TO EXISTING BUILDING AUTOMATION SYSTEM. PROVIDE ENABLE/DISABLE CONTROL AND FAN STATUS MONITORING (CT SWITCH).

ELECTRIC HEAT SCHEDULE

MARK	MANUFACTURER / MODEL NO.	TYPE	CAPACITY MBH	KW/STEPS	VOLTS/ø	CONTROL	SERVICE AREA
FIRST FLOOR							
EH-1.1	MARKEL 3470 SERIES	SURFACE MOUNTED CEILING HEATER	6.8	2.0/1	208/1	INTEGRAL THERMOSTAT	BOYS 85
EH-1.2	MARKEL 3470 SERIES	SURFACE MOUNTED CEILING HEATER	6.8	2.0/1	208/1	INTEGRAL THERMOSTAT	GIRLS 84
SECOND FLOOR							
EH-2.1	MARKEL 3470 SERIES	SURFACE MOUNTED CEILING HEATER	6.8	2.0/1	208/1	INTEGRAL THERMOSTAT	BOYS 222
EH-2.2	MARKEL 3470 SERIES	SURFACE MOUNTED CEILING HEATER	6.8	2.0/1	208/1	INTEGRAL THERMOSTAT	GIRLS 221
EH-2.3	MARKEL 3470 SERIES	SURFACE MOUNTED CEILING HEATER	6.8	2.0/1	208/1	INTEGRAL THERMOSTAT	BOYS 234
EH-2.4	MARKEL 3470 SERIES	SURFACE MOUNTED CEILING HEATER	6.8	2.0/1	208/1	INTEGRAL THERMOSTAT	GIRLS 233
EH-2.5	MARKEL 3470 SERIES	SURFACE MOUNTED CEILING HEATER	6.8	2.0/1	208/1	INTEGRAL THERMOSTAT	TOILET 211A

NOTES:

1. ALL UNITS TO BE U.L. LISTED.
2. FURNISH ALL HEATERS WITH AN INTEGRAL ELECTRICAL DISCONNECT.

GRILLE, REGISTER, AND DIFFUSER SCHEDULE

MARK	SERVICE	DESCRIPTION	CONSTRUCTION/FINISH	MANUFACTURER AND MODEL NUMBER	ACCESSORIES AND FEATURES
SG	SIDEWALL GRILLE	HORIZONTAL BLADES, DOUBLE DEFLECTION	STEEL / WHITE	KRUEGER SERIES 4680H	SURFACE MOUNT OPPOSED BLADE DAMPER

GRILLE, REGISTER, AND DIFFUSER SCHEDULE NOTES:

1. VERIFY FRAME STYLE, FINISH, AND U.L. RATINGS OF ALL CEILINGS AND WALLS WITH EXISTING CONDITIONS PRIOR TO ORDERING EQUIPMENT.
2. PROVIDE SQUARE TO ROUND TRANSITIONS AS REQUIRED.

ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0393
PROJECT NO. 23809

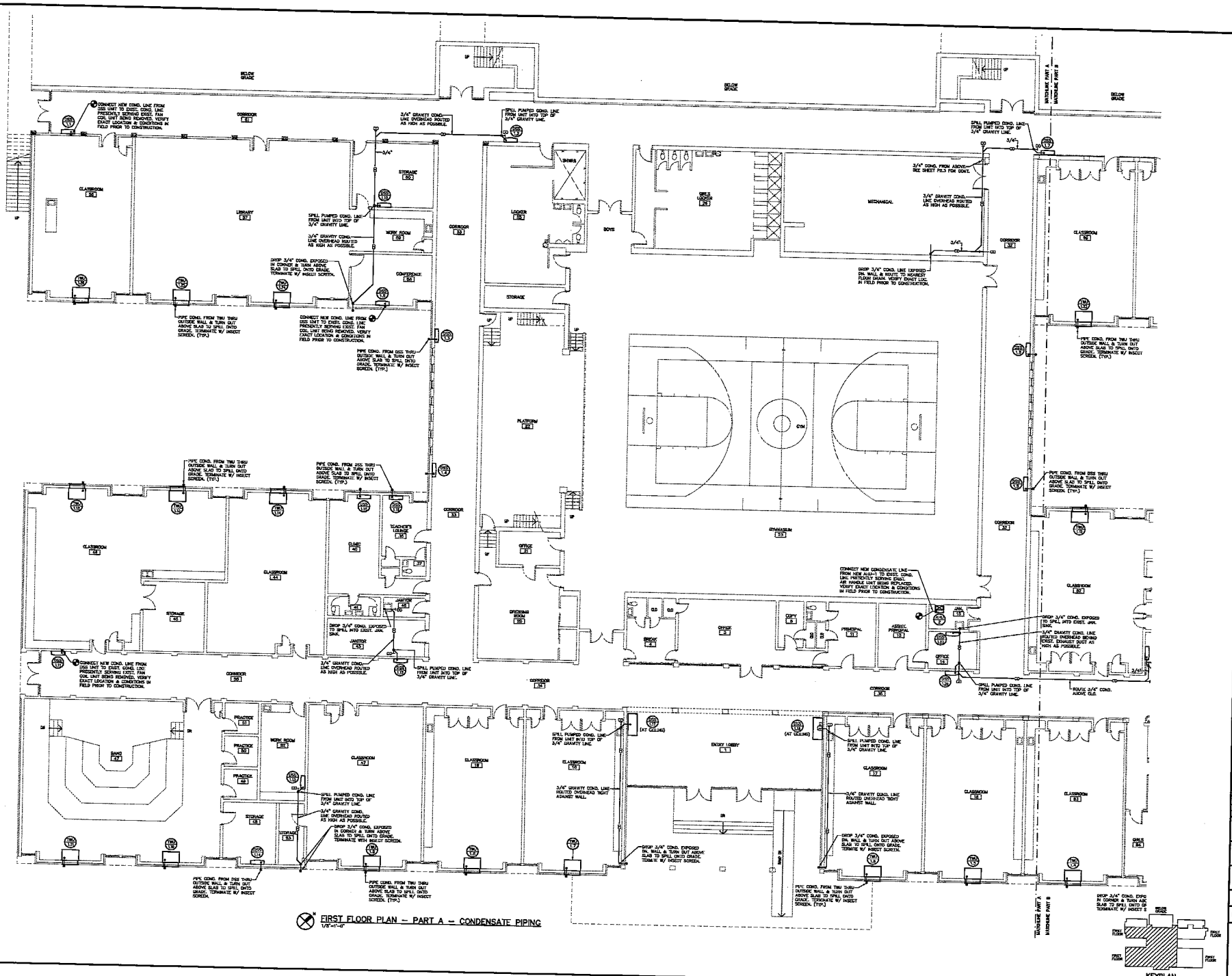
PROJECT: CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE: SCHEDULES & CONTROLS - HVAC

REVISIONS

NO.	DATE

DRAWN BY ARR
CHECKED BY NDV
APPROVED BY JRW
DATE 10/31/2023
PROJECT NO. 23809
DRAWING NO. M4.2



ENGINEERING SERVICE GROUP, INC.
CONSULTING ENGINEERS
607 EAST JACKSON AVENUE
KNOXVILLE, TENNESSEE 37915
(865) 522-0303
FAX (865) 522-0306

PROJECT
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

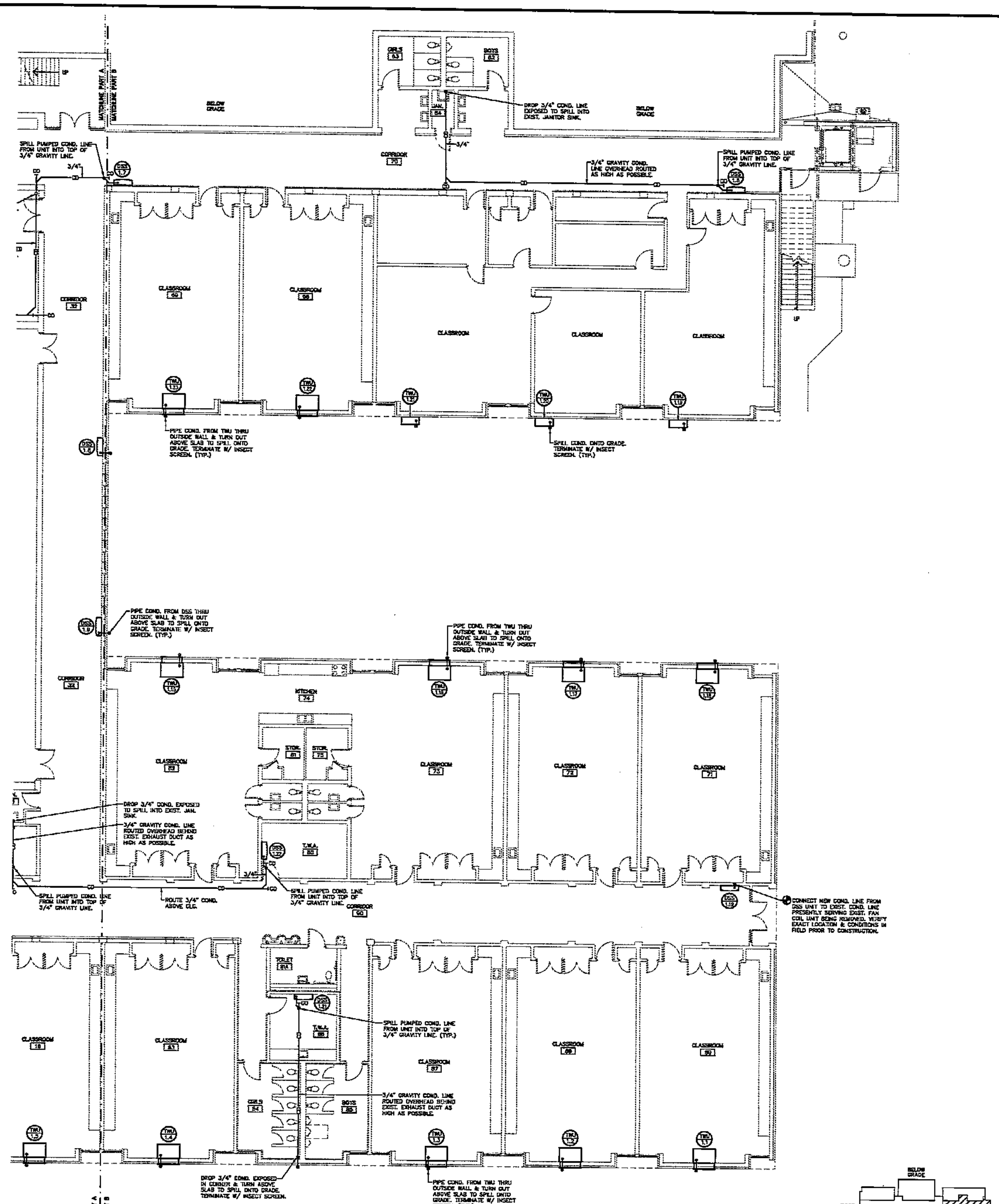
DRAWING TITLE
FIRST FLOOR PLAN - PART A - CONDENSATE PIPING

REVISIONS

NO	DATE

DRAWN BY MEA
CHECKED BY RWD
APPROVED BY JRW
DATE 10/31/2024
PROJECT NO 23809

DRAWING NO.
P2.1



FIRST FLOOR PLAN – PART B – CONDENSATE PIPING
1/8"=1'-0"

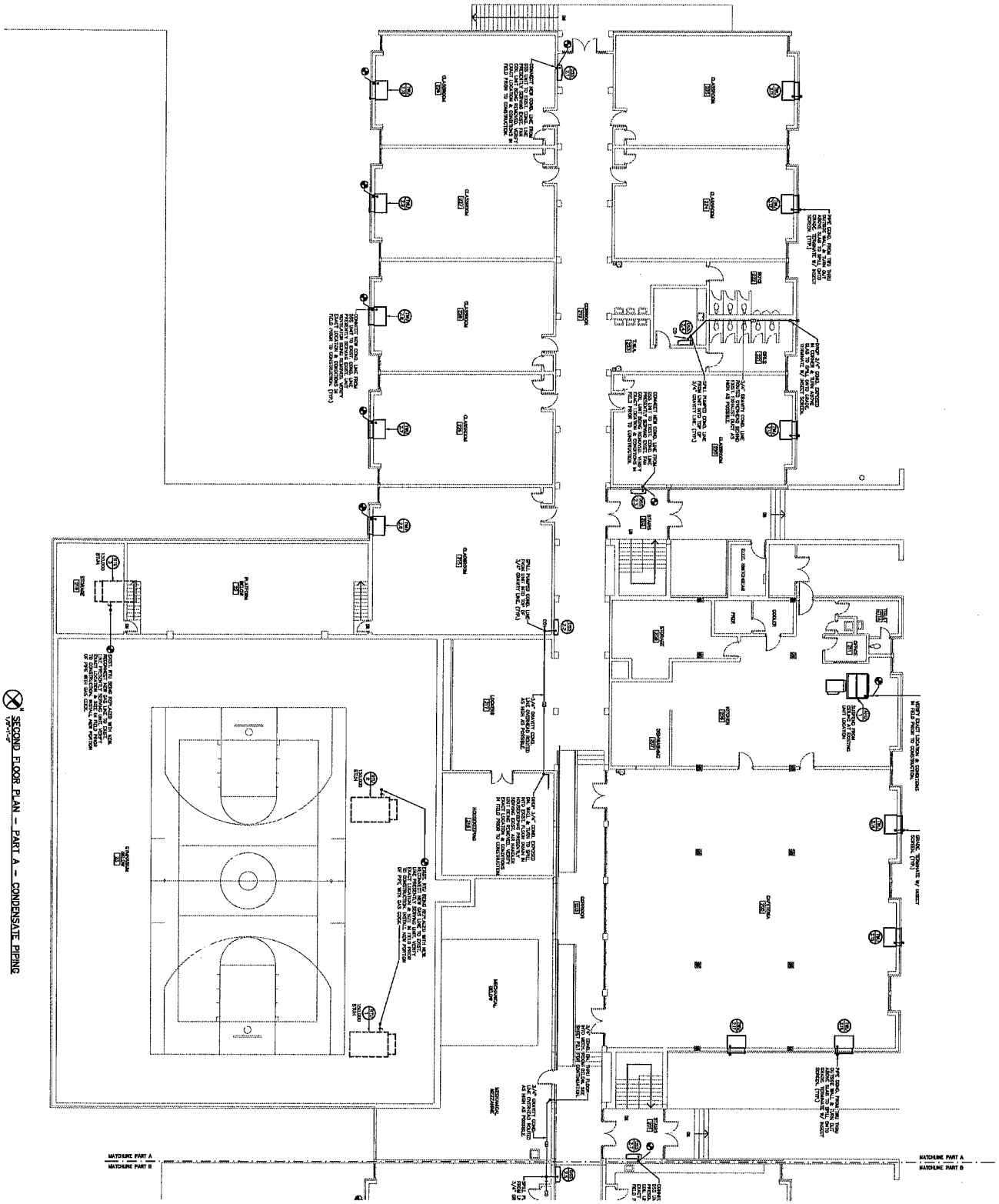
PROJECT
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd, Knoxville, Tennessee

DRAWING TITLE
FIRST FLOOR PLAN - PART B - CONDENSATE PIPING

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0393
PROJECT NO. 23809

REVISIONS	
NO	DATE

DRAWN BY	MEA
CHECKED BY	RWD
APPROVED BY	JRW
DATE	10/31/2023
PROJECT NO	23809
DRAWING NO.	P2.2



KEYPLAN

DRAWING NO.	P2.3
PROJECT NO.	23809
DATE	10/31/2023
DRAWN BY	MEA
CHECKED BY	RWD
APPROVED BY	JRW

REVISIONS

NO.	DATE

DRAWING TITLE

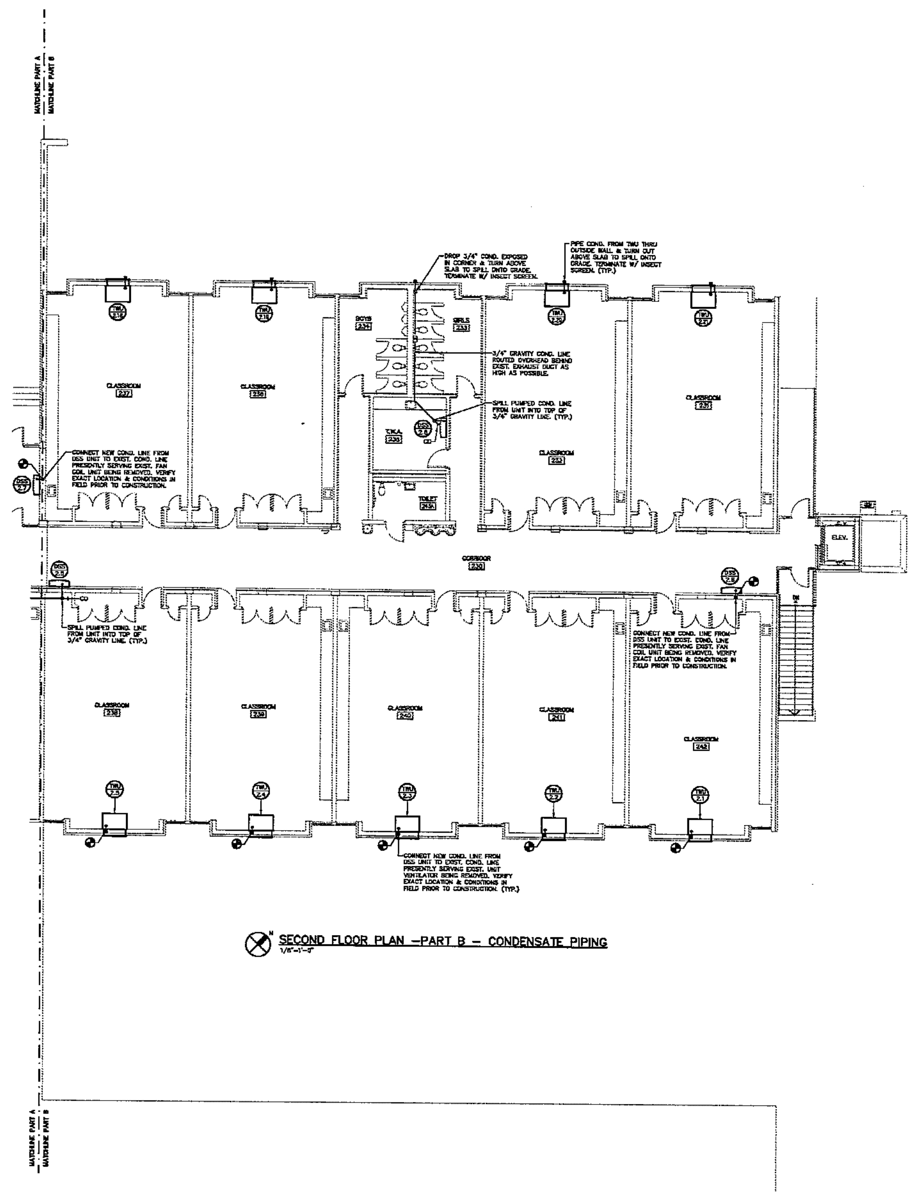
SECOND FLOOR PLAN - PART A - CONDENSATE PIPING

PROJECT

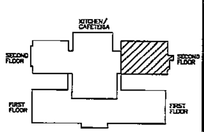
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
600 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0303
PROJECT NO. 23809

REGISTERED ENGINEER
RUSSELL D. WILLIAMS



SECOND FLOOR PLAN –PART B – CONDENSATE PIPING
1/8"=1'-0"



KEYPLAN

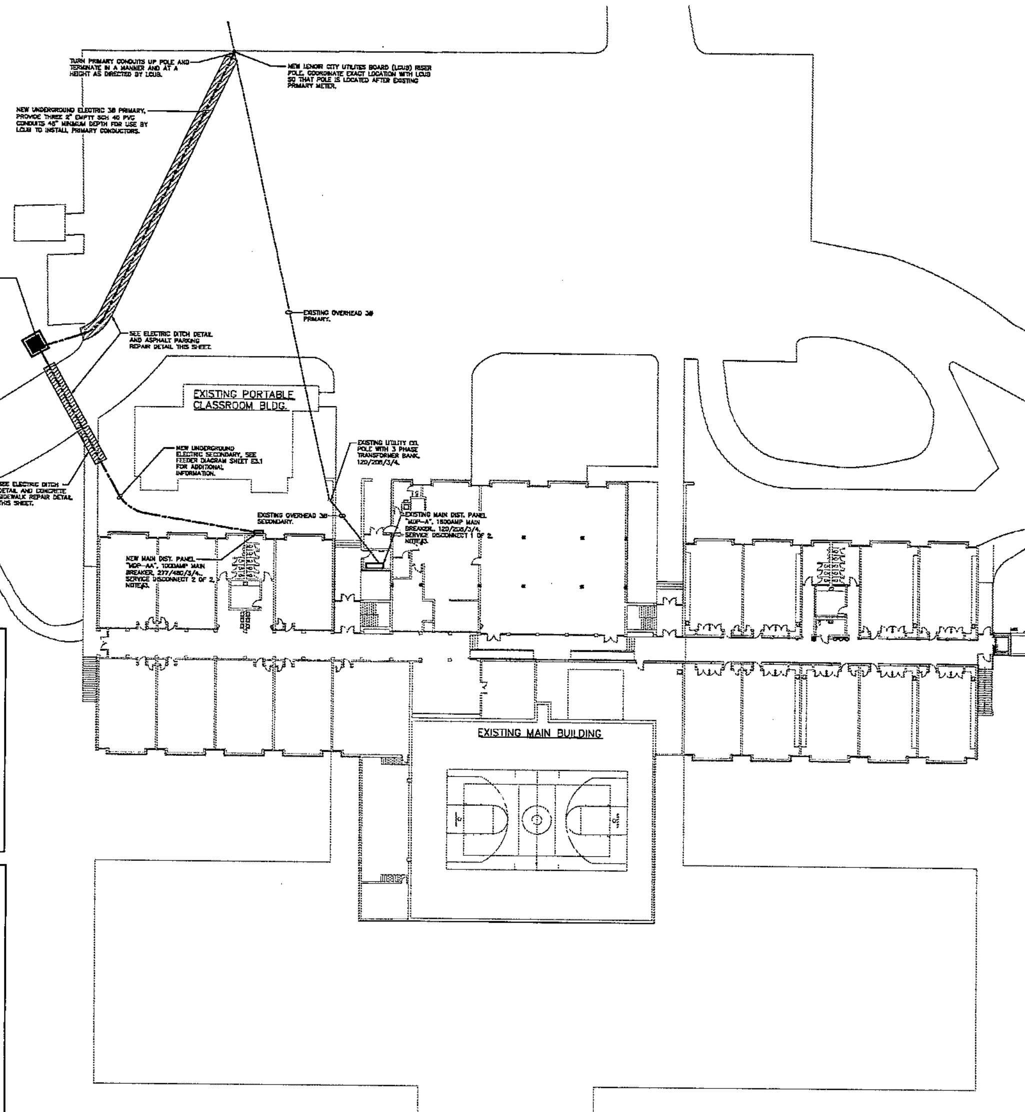
ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0393
PROJECT NO. 23809

PROJECT
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd, Knoxville, Tennessee

DRAWING TITLE
SECOND FLOOR PLAN - PART B - CONDENSATE PIPING

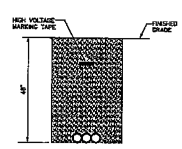
REVISIONS	
NO.	DATE

DRAWN BY MEA
CHECKED BY RWD
APPROVED BY JRW
DATE 10/31/2023
PROJECT NO 23809
DRAWING NO.
P2.4

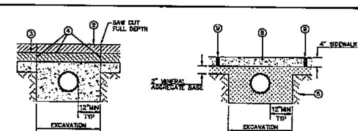


NOTES:

1. ALL BURIED CONDUIT SHALL MEET THE MINIMUM REQUIREMENTS OF NEC 300.5. COORDINATE CONDUIT INSTALLATION DEPTH WITH OTHER TRADES.
2. THE ELECTRICAL CONTRACTOR SHALL INCLUDE IN BID PRICE ALL UTILITY COMPANY COSTS RELATIVE TO THE TYPE OF SERVICES PLANNED. THE SERVICES ILLUSTRATED ON THE DRAWINGS ARE BASED ON INFORMATION WHICH WAS AVAILABLE AT THE TIME OF RELEASING PROJECT FOR BIDDING. PRIOR TO BIDDING THE ELECTRICAL CONTRACTOR SHALL CONTACT POWER COMPANY TO VERIFY FINAL SERVICE ARRANGEMENT AND ALL UTILITY COMPANY COST INVOLVED WHICH ARE TO BE INCLUDED IN BID PRICE.
LENOIR CITY UTILITIES BOARD (LCUB)
MR. JAY HINES (844) 667-5282.
3. PROVIDE SIGNAGE AT EACH SERVICE DISCONNECT CLEARLY INDICATING THE LOCATION OF THE OTHER SERVICE DISCONNECT.
4. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL CHARTED AND UNCHARTED UTILITIES. TAKE CARE TO PROTECT UTILITIES THAT ARE TO REMAIN. REPAIR ANY DAMAGE ACCORDING TO LOCAL STANDARDS AND AT THE CONTRACTOR'S EXPENSE. COORDINATE ALL CONSTRUCTION WITH THE APPROPRIATE UTILITY COMPANY.
5. IN AREAS WHERE EXISTING PAVEMENT, WALKS, OR CURBS ARE TO BE REMOVED, SAW CUT TO PROVIDE A CLEAN EDGE. COORDINATE EXTENT OF PAVEMENT DEMOLITION WITH THE LIMIT OF NEW IMPROVEMENTS ON THE SITE LAYOUT PLAN & UTILITY INSTALLATION.
6. THE CONTRACTOR IS RESPONSIBLE FOR ALL DEMOLITION AND REMOVAL NECESSARY TO ACCOMPLISH THE PROPOSED IMPROVEMENTS SHOWN ON THESE PLANS.
7. ALL TRENCHES CUT IN EXISTING ROADS OR DRIVES SHALL UTILIZE A CLEAN SAW CUT AND SHALL BE BACKFIELD (100%) TO FINAL SUBGRADE WITH #57 STONE. REPAIR ROADS PER DETAILS.
8. REPAIR EXISTING PAVEMENT, CURBS, WALKS, LANDSCAPING, ETC. THAT ARE DAMAGED BY CONSTRUCTION ACTIVITIES TO A LIKE NEW CONDITION. INCLUDE ALL ASSOCIATED COSTS IN THE BID.



ELECTRIC DITCH PROFILE
N.T.S.



ASPHALT PARKING REPAIR
N.T.S.

CONCRETE SIDEWALK REPAIR
N.T.S.

NOTES:

1. ALL SECTIONS NOTED BELOW REFERENCE THE CITY OF KNOXVILLE STANDARD SPECIFICATIONS UNLESS OTHERWISE SPECIFIED.
2. ASPHALTIC CONCRETE SURFACE, GRADING D, SECTION 10.0. MATCH EXISTING DEPTH OR MINIMUM THICKNESS OF ONE AND ONE-HALF(1.5) INCHES.
3. BITUMINOUS PLAN MIX BASE, GRADING B, B-M, OR C SECTION 9.0. MATCH EXISTING DEPTH OR MINIMUM THICKNESS OF TWO AND ONE-HALF (2.5) INCHES. THE ENTIRE FOUR (4) INCH MINIMUM DEPTH MAY BE ASPHALTIC CONCRETE OR SURFACE GRADING D, BUT SHALL BE COMPACTED IN TWO LIFTS.
4. TACK COAT, SECTION 7.0.
5. PORTLAND CEMENT CONCRETE PAVEMENT, SECTION 11.0. JOINTS SHALL BE DOWELED AS DETAILED IN SECTION 11.0.
6. MINERAL AGGREGATE BASE, CLASS A AGGREGATE GRADING D, SECTION 5.0. COMPACT IN SIX (6) INCH LIFTS TO 100% OF THE STANDARD PROCTOR DENSITY AT 2% LESS THAN OPTIMUM MOISTURE CONTENT AS DETERMINED BY AASHTO T99, METHOD D, APPROXIMATELY 140 PCF FOR LIMESTONE.
7. WHEN A TEMPORARY ASPHALT PATCH IS USED, IT SHALL BE PLACED IMMEDIATELY AFTER THE MINERAL AGGREGATE BACKFILL. ALL TEMPORARY REPAIRS MUST BE REPLACED PERMANENTLY WITHIN 90 DAYS.
8. CONCRETE SIDEWALKS, DRIVEWAYS AND MEDIAN STRIP SECTION 13.0.
9. LIMITS OF REMOVAL SHALL BE FROM THE NEAREST EXPANSION OR CONTRACTION JOINT.
10. EXISTING CONCRETE AREAS THAT HAVE BEEN OVERLAID WITH ASPHALT SHALL BE REPAIRED WITH ASPHALT. THE DEPTH OF THE ASPHALT REPLACING THE CONCRETE SHALL BE INCREASED 50% (PLUS ANY OVERLAY). THUS, THE TOTAL DEPTH SHALL BE 1.5 TIMES THE CONCRETE THICKNESS THUS THE ASPHALT OVERLAY THICKNESS.

SITE PLAN – ELECTRICAL
1"=20'-0"

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0395
PROJECT No. 23809

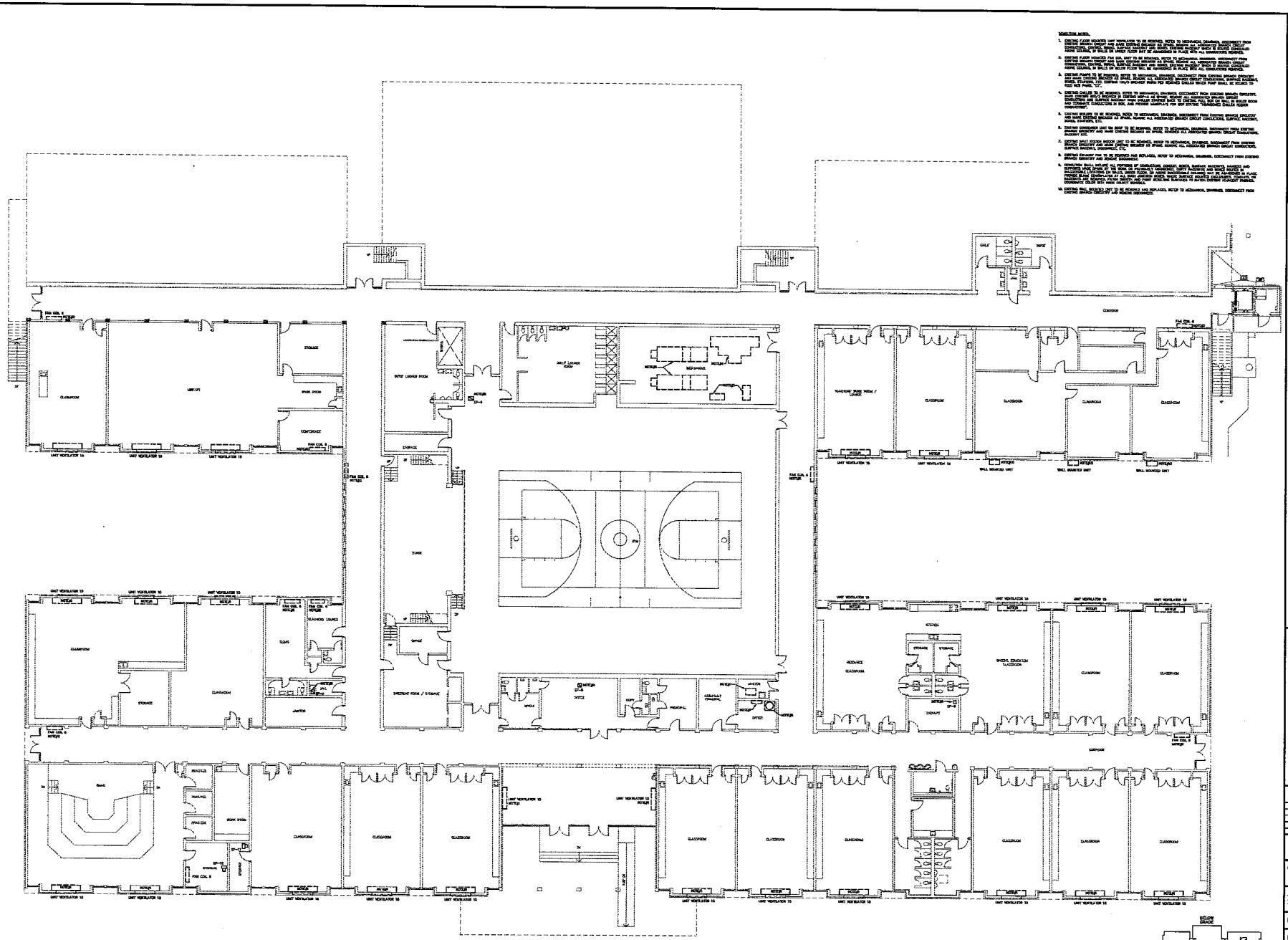
PROJECT:
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE
SITE PLAN - ELECTRICAL

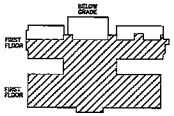
REVISIONS

NO	DATE

DRAWN BY: WRM
CHECKED BY: ECH
APPROVED BY: ECH
DATE 10/31/2023
PROJECT NO 23809
DRAWING NO.
ES1.1



FIRST FLOOR PLAN
ELECTRICAL DEMOLITION
3/32"=1'-0"



KEYPLAN

ENGINEERING SERVICES GROUP, INC.
500 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
865.522.0383
PROJECT NO. 23809

PROJECT

CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd, Knoxville, Tennessee

DRAWING TITLE

FIRST FLOOR PLAN -
ELECTRICAL DEMOLITION

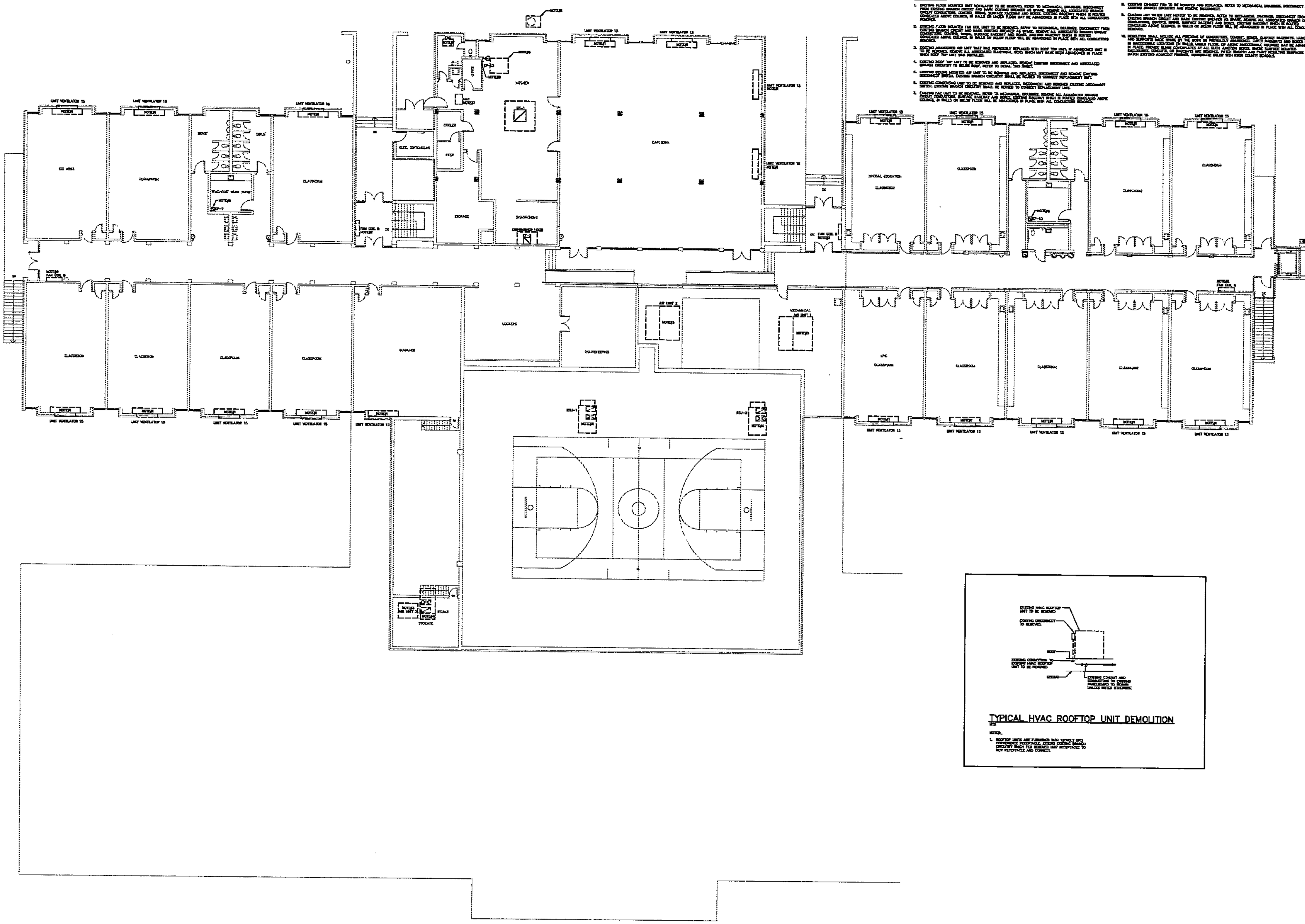
REVISIONS

NO.	DATE

DRAWN BY: WRM
CHECKED BY: ECH
APPROVED BY: ECH
DATE: 10/31/2023
PROJECT NO: 23809

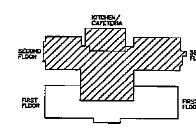
DRAWING NO.

E1.1



SECOND FLOOR PLAN
ELECTRICAL DEMOLITION
3/32"=1'-0"

TYPICAL HVAC ROOFTOP UNIT DEMOLITION



KEYPLAN

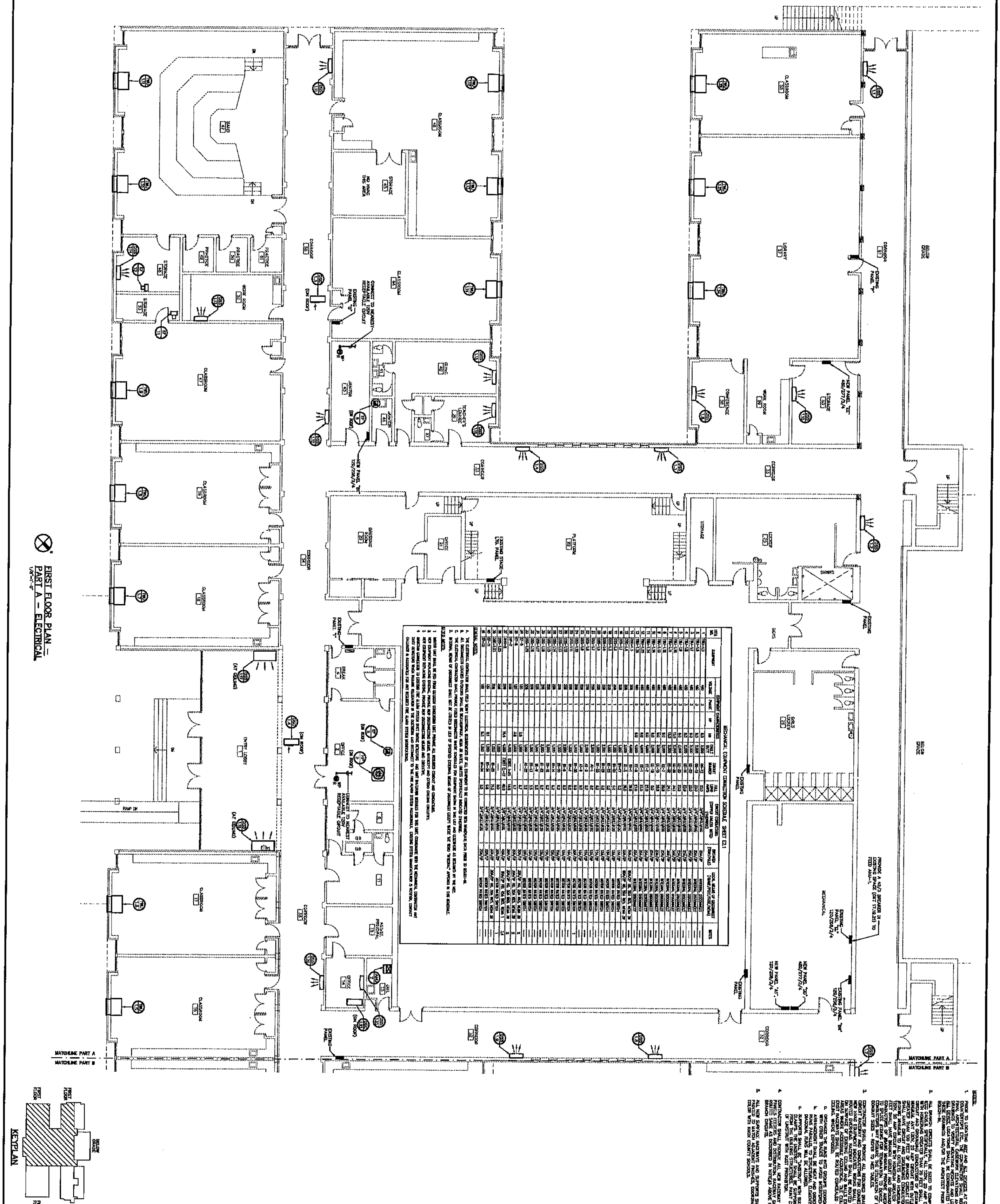
ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
500 EAST HILL AVE SUITE 250
KNOXVILLE, TENNESSEE 37915
(865) 522-0253
PROJECT NO. 23809

PROJECT:
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd. Knoxville, Tennessee

DRAWING TITLE
SECOND FLOOR PLAN - ELECTRICAL DEMOLITION

REVISIONS	
NO.	DATE

DRAWN BY: WRM
CHECKED BY: ECH
APPROVED BY: ECH
DATE: 10/31/2023
PROJECT No: 23809
DRAWING NO.
E1.2



REVISIONS

NO.	DATE

DRAWN BY: WRM

CHECKED BY: ECH

APPROVED BY: ECH

DATE: 10/31/2023

PROJECT NO: 23809

DRAWING NO. E2.1

DRAWING TITLE: FIRST FLOOR PLAN - PART A - ELECTRICAL

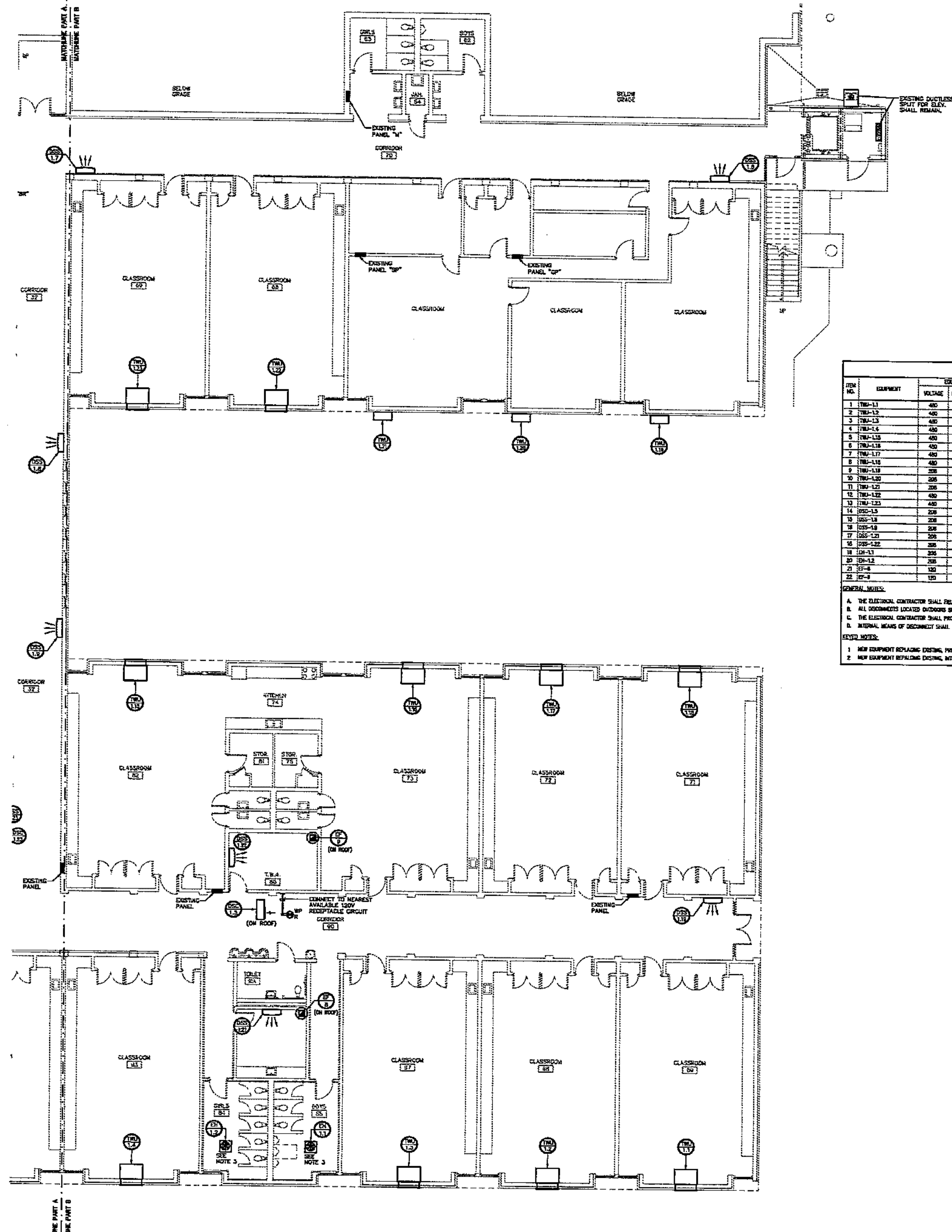
PROJECT

CEDAR BLUFF MIDDLE SCHOOL HVAC RENOVATIONS

for Knox County Schools

707 N. Cedar Bluff Rd, Knoxville, Tennessee

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0353
PROJECT No. 23809



FIRST FLOOR PLAN – PART B – ELECTRICAL
1/8"=1'-0"

NOTES:

1. PRIOR TO LOCATING ANY AND ALL DEVICES AT CASEWORK, COUNTERTOPS ETC., THE CONTRACTOR SHALL REFER TO FINAL ARCHITECTURAL CASEWORK ELEVATIONS AND SHOP DRAWINGS TO VERIFY MOUNTING HEIGHTS AND LOCATIONS. ALL DEVICE LOCATIONS SHALL BE COORDINATED WITH THESE DRAWINGS AND/OR THE ARCHITECT PRIOR TO ROUGH-IN.
2. ALL BRANCH CIRCUITS SHALL BE SIZED TO COMPLY WITH IECC C405.9. SPECIFICALLY, ALL 120V, 20 AMP CIRCUITS WITH HOMERUNS GREATER THAN 70 FEET SHALL HAVE CIRCUIT AND GROUNDING CONDUCTORS OF #10AWG AS MINIMUM. ANY 120V, 20 AMP CIRCUIT WITH OUTLETS GREATER THAN 100 FEET OF BRANCH CIRCUIT LENGTH SHALL HAVE CIRCUIT AND GROUNDING CONDUCTORS OF #10AWG MINIMUM TO ALL OUTLETS AND HOMERUN. ANY 120V, 20 AMP CIRCUIT WITH HOMERUN GREATER THAN 140 FEET SHALL HAVE BRANCH CIRCUIT AND GROUNDING CONDUCTORS OF #8AWG MINIMUM, PROVIDE ADEQUATE BOX TO SPLICE #12AWG FOR TERMINATION TO DEVICE. LARGER CONDUCTORS MAY REQUIRE THE UTILIZATION OF LARGER CONDUIT SIZES – REFER TO NEC TABLES.
3. CONTRACTOR SHALL PROVIDE ALL REQUIRED BRANCH CIRCUIT RACEWAY AND CONDUCTORS FOR CONNECTION OF NEW HVAC EQUIPMENT INDICATED. WIRING SHALL BE ROUTED OVERHEAD. RACEWAY SHALL BE ROUTED EXPOSED ON SURFACE OF EXISTING CEILING AND WALLS EXCEPT IN AREAS WHERE ACCESSIBLE ACOUSTICAL TILE CEILINGS EXIST RACEWAYS SHALL BE ROUTED CONCEALED ABOVE CEILING. WHERE EXPOSED:
   a. ORGANIZE THE RUNS INTO GROUPS COORDINATING WITH OTHER TRADES TO AVOID INTERFERENCE.
   b. ARRANGEMENT SHALL BE NEAT AND ORDERLY WITH RUNS PARALLEL TO STRUCTURAL ELEMENTS. NO DIAGONAL RUNS WILL BE ALLOWED.
   c. SUPPORTS SHALL BE "UNISTRUT" WITH SUITABLE CLAMPS. THE UNISTRUT SHALL BE SUPPORTED FROM THE BUILDING STRUCTURES. PAINT CUT ENDS OF UNISTRUT WITH RUST PROHIBITOR.
4. CONTRACTOR SHALL PROVIDE ALL NEW RACEWAY FOR NEW PANELS FEEDERS AND DISTRIBUTION. RACEWAY SHALL BE ROUTED SAME AS DESCRIBED IN NOTE#3 ABOVE FOR BRANCH CIRCUITS.
5. REFER TO SHEET E3.1 FOR MECHANICAL EQUIPMENT CONNECTION SCHEDULE.
6. ALL NEW SURFACE RACEWAYS AND SUPPORTS SHALL BE PAINTED TO MATCH ADJACENT FINISHES, COORDINATE COLOR WITH KNOX COUNTY SCHOOLS.

MECHANICAL EQUIPMENT CONNECTION SCHEDULE SHEET E2.2

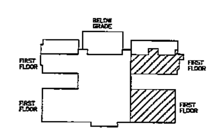
ITEM NO.	EQUIPMENT	EQUIPMENT CHARACTERISTICS: VOLTAGE	PHASE	HP	kW	FAULT DUTY	CIRCUIT NUMBER	FULL LOAD AMPS	CIRCUIT CONDUCTORS (COPPER UNLESS NOTED OTHERWISE)	BREAKER (TRIP/POLE)	LOCAL MEANS OF DISCONNECT (FRAME/POLE/FUSE/NEMA)	NOTES
1	TWU-1.1	480	3		9.0	1,000	DD-2	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
2	TWU-1.2	480	3		9.0	1,000	DD-8	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
3	TWU-1.3	480	3		9.0	2,000	DD-14	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
4	TWU-1.4	480	3		9.0	2,000	DD-20	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
5	TWU-1.15	480	3		9.0	3,000	DD-25	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
6	TWU-1.16	480	3		9.0	2,000	DD-26	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
7	TWU-1.17	480	3		9.0	2,000	DD-31	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
8	TWU-1.18	480	3		9.0	2,000	DD-32	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
9	TWU-1.19	208	3		9.0	2,000	—	37.8	3/4",3#8,1#10G	50A/3P	INTEGRAL DISCONNECT	2
10	TWU-1.20	208	3		9.0	2,000	—	37.8	3/4",3#8,1#10G	50A/3P	INTEGRAL DISCONNECT	2
11	TWU-1.21	208	3		9.0	2,000	—	37.8	3/4",3#8,1#10G	50A/3P	INTEGRAL DISCONNECT	2
12	TWU-1.22	480	3		9.0	4,000	DD-7	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
13	TWU-1.23	480	3		9.0	5,000	DD-1	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
14	DSC-1.5	208	1			1,000	A1-17	28.0	3/4",2#8,1#10G	40A/2P	60A/2P HD, 40A RKS, NEMA 3R	—
15	DSS-1.8	208	1			1,000	A1-13	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
16	DSS-1.9	208	1			1,000	A1-10	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
17	DSS-1.21	208	1			1,000	A1-14	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
18	DSS-1.22	208	1			1,000	A1-18	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
19	EH-1.1	208	1		2.0	1,000	A1-2	9.6	3/4",2#12,1#12G	20A/2P	INTEGRAL DISCONNECT	—
20	EH-1.2	208	1		2.0	1,000	A1-6	9.6	3/4",2#12,1#12G	20A/2P	INTEGRAL DISCONNECT	—
21	EF-8	120	1	1/2		1,000	—	9.8	3/4",2#12,1#12G	20A/1P	30A/1P HD, 20A RKS, NEMA 3R	1
22	EF-9	120	1		0.2	1,000	—	1.7	3/4",2#12,1#12G	20A/1P	30A/1P HD, 20A RKS, NEMA 3R	1

GENERAL NOTES:

A. THE ELECTRICAL CONTRACTOR SHALL FIELD VERIFY ELECTRICAL REQUIREMENTS OF ALL EQUIPMENT TO BE CONNECTED WITH NAMEPLATE DATA PRIOR TO ROUGH-IN.
B. ALL DISCONNECTS LOCATED OUTDOORS SHALL BE WEATHERPROOF, NEMA 3R RATED, UNLESS SPECIFICALLY INDICATED OTHERWISE.
C. THE ELECTRICAL CONTRACTOR SHALL PROVIDE FUSED DISCONNECTS WHERE SCHEDULED FOR EQUIPMENT SHOWN IN THIS LIST AND ELSEWHERE AS REQUIRED BY THE NEC.
D. INTERNAL MEANS OF DISCONNECT SHALL NOT BE UTILIZED IN LIEU OF SPECIFIED EXTERNAL MEANS OF DISCONNECT EXCEPT WHERE THE WORD "INTEGRAL" APPEARS IN THIS SCHEDULE.

KEYED NOTES:

1. NEW EQUIPMENT REPLACING EXISTING, PROVIDE NEW DISCONNECTING MEANS, INTERCEPT AND EXTEND EXISTING CIRCUITRY.
2. NEW EQUIPMENT REPLACING EXISTING, INTERCEPT AND EXTEND EXISTING CIRCUITRY.



KEYPLAN

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
500 EAST HILL AVE, SUITE 300
KNOXVILLE, TENNESSEE 37915
(865) 522-0383
PROJECT NO. 23809

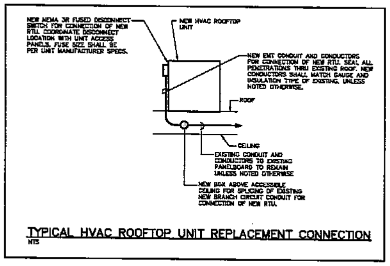
PROJECT
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd, Knoxville, Tennessee

DRAWING TITLE
FIRST FLOOR PLAN - PART B - ELECTRICAL

REVISIONS

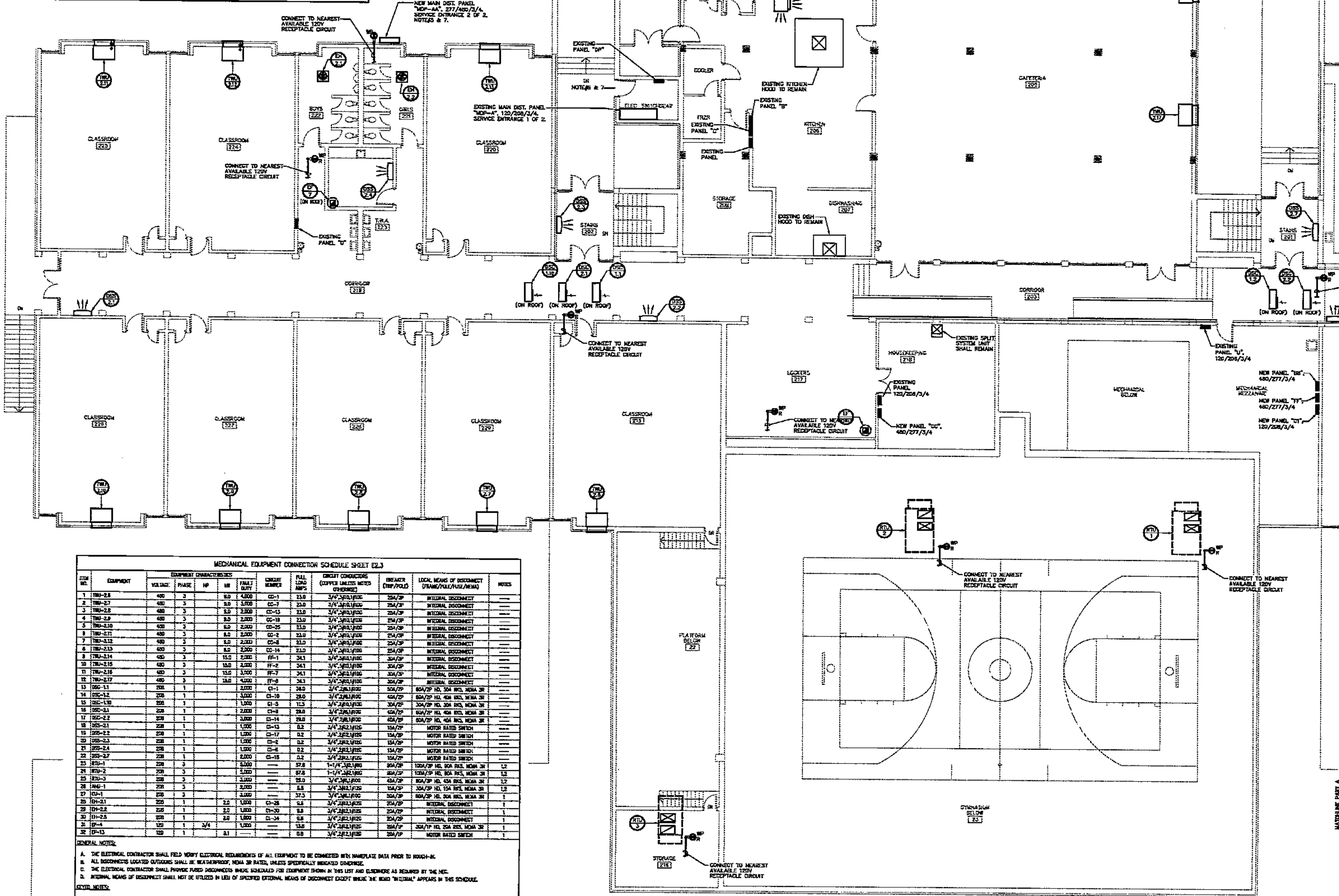
NO.	DATE

DRAWN BY WRM
CHECKED BY ECH
APPROVED BY ECH
DATE 10/31/2023
PROJECT NO. 23809
DRAWING NO.
E2.2



TYPICAL HVAC ROOFTOP UNIT REPLACEMENT CONNECTION

NTS



ITEM NO.	EQUIPMENT	EQUIPMENT CHARACTERISTICS					CIRCUIT NUMBER	FULL LOAD AMPS	CIRCUIT CONDUCTORS (COPPER UNLESS NOTED OTHERWISE)	BREAKER (TRIP/POLE)	LOCAL MEANS OF DISCONNECT (FRAME/POLE/FUSE/NEMA)	NOTES
		VOLTAGE	PHASE	HP	MB	FAULT DUTY						
1	TMU-2.6	480	3		9.0	4,000	CC-1	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
2	TMU-2.7	480	3		9.0	3,000	CC-7	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
3	TMU-2.8	480	3		9.0	2,000	CC-13	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
4	TMU-2.9	480	3		9.0	2,000	CC-19	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
5	TMU-2.10	480	3		8.0	2,000	CC-25	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
6	TMU-2.11	480	3		8.0	2,000	CC-2	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
7	TMU-2.12	480	3		9.0	2,000	CC-8	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
8	TMU-2.13	480	3		8.0	2,000	CC-14	23.0	3/4",3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
9	TMU-2.14	480	3		15.0	2,000	FF-1	34.1	3/4",3#10,1#10G	30A/3P	INTEGRAL DISCONNECT	—
10	TMU-2.15	480	3		15.0	2,000	FF-2	34.1	3/4",3#10,1#10G	30A/3P	INTEGRAL DISCONNECT	—
11	TMU-2.16	480	3		15.0	3,000	FF-7	34.1	3/4",3#10,1#10G	30A/3P	INTEGRAL DISCONNECT	—
12	TMU-2.17	480	3		18.0	4,000	FF-8	34.1	3/4",3#10,1#10G	30A/3P	INTEGRAL DISCONNECT	—
13	DSC-1.1	208	1			2,000	CI-1	38.0	3/4",2#6,1#10G	50A/2P	60A/2P HD, 50A RK5, NEMA 3R	—
14	DSC-1.2	208	1			3,000	CI-10	28.0	3/4",2#8,1#10G	40A/2P	60A/2P HD, 40A RK5, NEMA 3R	—
15	DSC-1.10	208	1			1,000	CI-5	11.5	3/4",2#10,1#10G	30A/2P	30A/2P HD, 30A RK5, NEMA 3R	—
16	DSC-2.1	208	1			2,000	CI-9	28.0	3/4",2#6,1#10G	40A/2P	60A/2P HD, 40A RK5, NEMA 3R	—
17	DSC-2.2	208	1			3,000	CI-14	28.0	3/4",2#8,1#10G	40A/2P	60A/2P HD, 40A RK5, NEMA 3R	—
18	DSS-2.1	208	1			1,000	CI-13	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
19	DSS-2.2	208	1			1,000	CI-17	0.2	3/4",2#12,1#12G	15A/3P	MOTOR RATED SWITCH	—
20	DSS-2.3	208	1			1,000	CI-2	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
21	DSS-2.4	208	1			1,000	CI-6	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
22	DSS-2.7	208	1			2,000	CI-15	0.2	3/4",2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
23	RTU-1	208	3			5,000	—	57.6	1-1/4",3#2,1#8G	80A/3P	100A/3P HD, 80A RK5, NEMA 3R	1,2
24	RTU-2	208	3			5,000	—	57.6	1-1/4",3#2,1#8G	80A/3P	100A/3P HD, 80A RK5, NEMA 3R	1,2
25	RTU-3	208	3			3,000	—	28.0	3/4",3#8,1#10G	45A/3P	60A/3P HD, 45A RK5, NEMA 3R	1,2
26	AHU-1	208	3			2,000	—	5.8	3/4",3#12,1#12G	15A/3P	30A/3P HD, 15A RK5, NEMA 3R	1,2
27	CU-1	208	3			3,000	—	37.5	3/4",3#6,1#10G	50A/3P	60A/3P HD, 50A RK5, NEMA 3R	1
28	EH-2.1	208	1		2.0	1,000	CI-28	9.6	3/4",2#12,1#12G	20A/2P	INTEGRAL DISCONNECT	1
29	EH-2.2	208	1		2.0	1,000	CI-30	9.6	3/4",2#12,1#12G	20A/2P	INTEGRAL DISCONNECT	1
30	EH-2.5	208	1		2.0	1,000	CI-34	9.6	3/4",2#12,1#12G	20A/2P	INTEGRAL DISCONNECT	1
31	EF-4	120	1	3/4		1,000	—	13.8	3/4",2#12,1#12G	20A/1P	30A/1P HD, 20A RK5, NEMA 3R	1
32	EF-13	120	1		0.1	—	—	0.8	3/4",2#12,1#12G	20A/1P	MOTOR RATED SWITCH	1

MECHANICAL EQUIPMENT CONNECTION SCHEDULE SHEET E2.3

GENERAL NOTES:

A. THE ELECTRICAL CONTRACTOR SHALL FIELD VERIFY ELECTRICAL REQUIREMENTS OF ALL EQUIPMENT TO BE CONNECTED WITH NAMEPLATE DATA PRIOR TO ROUGH-IN.
B. ALL DISCONNECTS LOCATED OUTDOORS SHALL BE WEATHERPROOF, NEMA 3R RATED, UNLESS SPECIFICALLY INDICATED OTHERWISE.
C. THE ELECTRICAL CONTRACTOR SHALL PROVIDE FUSED DISCONNECTS WHERE SCHEDULED FOR EQUIPMENT SHOWN IN THIS LIST AND ELSEWHERE AS REQUIRED BY THE NEC.
D. INTERNAL MEANS OF DISCONNECT SHALL NOT BE UTILIZED IN LIEU OF SPECIFIED EXTERNAL MEANS OF DISCONNECT EXCEPT WHERE THE WORD "INTEGRAL" APPEARS IN THIS SCHEDULE.

KEYED NOTES:

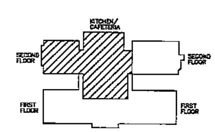
1. NEW EQUIPMENT REPLACING EXISTING. PROVIDE NEW DISCONNECTING MEANS, INTERCEPT AND EXTEND EXISTING CIRCUITRY.
2. MAINTAIN CONNECTION TO EXISTING FIRE ALARM SYSTEM DUCT SMOKE DETECTORS AND UNIT SHUTDOWN MODULES FOR THIS UNIT. COORDINATE WITH THE MECHANICAL CONTRACTOR ANY DUCT DETECTORS WHICH REQUIRE RELOCATION IN THE DUCTWORK AND RECONNECT TO THE FIRE ALARM SYSTEM ACCORDINGLY. EXISTING SYSTEM MANUFACTURER IS NOTIFIER, CONTACT GALLAHER & ASSOCIATES FOR ANY REQUIRED FIRE ALARM SYSTEM MODIFICATIONS.

SECOND FLOOR PLAN – PART A – ELECTRICAL

1/8"=1'-0"

NOTES:

1. PRIOR TO LOCATING ANY AND ALL DEVICES AT CASEWORK, COUNTERTOPS ETC., THE CONTRACTOR SHALL REFER TO FINAL ARCHITECTURAL CASEWORK ELEVATIONS AND SHOP DRAWINGS TO VERIFY MOUNTING HEIGHTS AND LOCATIONS. ALL DEVICE LOCATIONS SHALL BE COORDINATED WITH THESE DRAWINGS AND/OR THE ARCHITECT PRIOR TO ROUGH-IN.
2. ALL BRANCH CIRCUITS SHALL BE SIZED TO COMPLY WITH IECC C405.9. SPECIFICALLY, ALL 120V, 20 AMP CIRCUITS WITH HOMERUNS GREATER THAN 70 FEET SHALL HAVE CIRCUIT AND GROUNDING CONDUCTORS OF #10AWG AS MINIMUM. ANY 120V, 20 AMP CIRCUIT WITH OUTLETS GREATER THAN 100 FEET OF BRANCH CIRCUIT LENGTH SHALL HAVE CIRCUIT AND GROUNDING CONDUCTORS OF #10AWG MINIMUM TO ALL OUTLETS AND HOMERUN. ANY 120V, 20 AMP CIRCUIT WITH HOMERUN GREATER THAN 140 FEET SHALL HAVE BRANCH CIRCUIT AND GROUNDING CONDUCTORS OF #8AWG MINIMUM. PROVIDE ADEQUATE BOX TO SPLICE #12AWG FOR TERMINATION TO DEVICE. LARGER CONDUCTORS MAY REQUIRE THE UTILIZATION OF LARGER CONDUIT SIZES – REFER TO NEC TABLES.
3. CONTRACTOR SHALL PROVIDE ALL REQUIRED BRANCH CIRCUIT RACEWAY AND CONDUCTORS FOR CONNECTION OF NEW HVAC EQUIPMENT INDICATED. WIRING SHALL BE ROUTED OVERHEAD. RACEWAY SHALL BE ROUTED EXPOSED ON SURFACE OF EXISTING CEILING AND WALLS EXCEPT IN AREAS WHERE ACCESSIBLE ACOUSTICAL TILE CEILINGS EXIST RACEWAYS SHALL BE ROUTED CONCEALED ABOVE CEILING. WHERE EXPOSED:
   a. ORGANIZE THE RUNS INTO GROUPS COORDINATING WITH OTHER TRADES TO AVOID INTERFERENCE.
   b. ARRANGEMENT SHALL BE NEAT AND ORDERLY WITH RUNS PARALLEL TO STRUCTURAL ELEMENTS. NO DIAGONAL RUNS WILL BE ALLOWED.
   c. SUPPORTS SHALL BE "UNISTRUT" WITH SUITABLE CLAMPS. THE UNISTRUT SHALL BE SUPPORTED FROM THE BUILDING STRUCTURES. PAINT CUT ENDS OF UNISTRUT WITH RUST PROHIBITOR.
4. CONTRACTOR SHALL PROVIDE ALL NEW RACEWAY FOR NEW PANELS FEEDERS AND DISTRIBUTION. RACEWAY SHALL BE ROUTED SAME AS DESCRIBED IN NOTE #3 ABOVE FOR BRANCH CIRCUITS.
5. PROVIDE ENGRAVED NAMEPLATE ON FRONT OF PANEL "MDP- AA, 480/277VOLT, 3PHASE, SERVICE DISCONNECT 2 OF 2". COORDINATE EXACT WORDING WITH AUTHORITY HAVING JURISDICTION.
6. PROVIDE ENGRAVED NAMEPLATE ON DOOR OF ELECT. RM., "MDP-A, 120/208VOLT, 3PHASE, SERVICE DISCONNECT 1 OF 2". COORDINATE EXACT WORDING WITH AUTHORITY HAVING JURISDICTION.
7. PROVIDE SIGNAGE AT EACH SERVICE DISCONNECT CLEARLY INDICATING THE LOCATION OF THE OTHER SERVICE DISCONNECT.
8. ALL NEW SURFACE RACEWAYS AND SUPPORTS SHALL BE PAINTED TO MATCH ADJACENT FINISHES. COORDINATE COLOR WITH KNOX COUNTY SCHOOLS.



KEYPLAN

ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
500 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0393
PROJECT NO. 23809

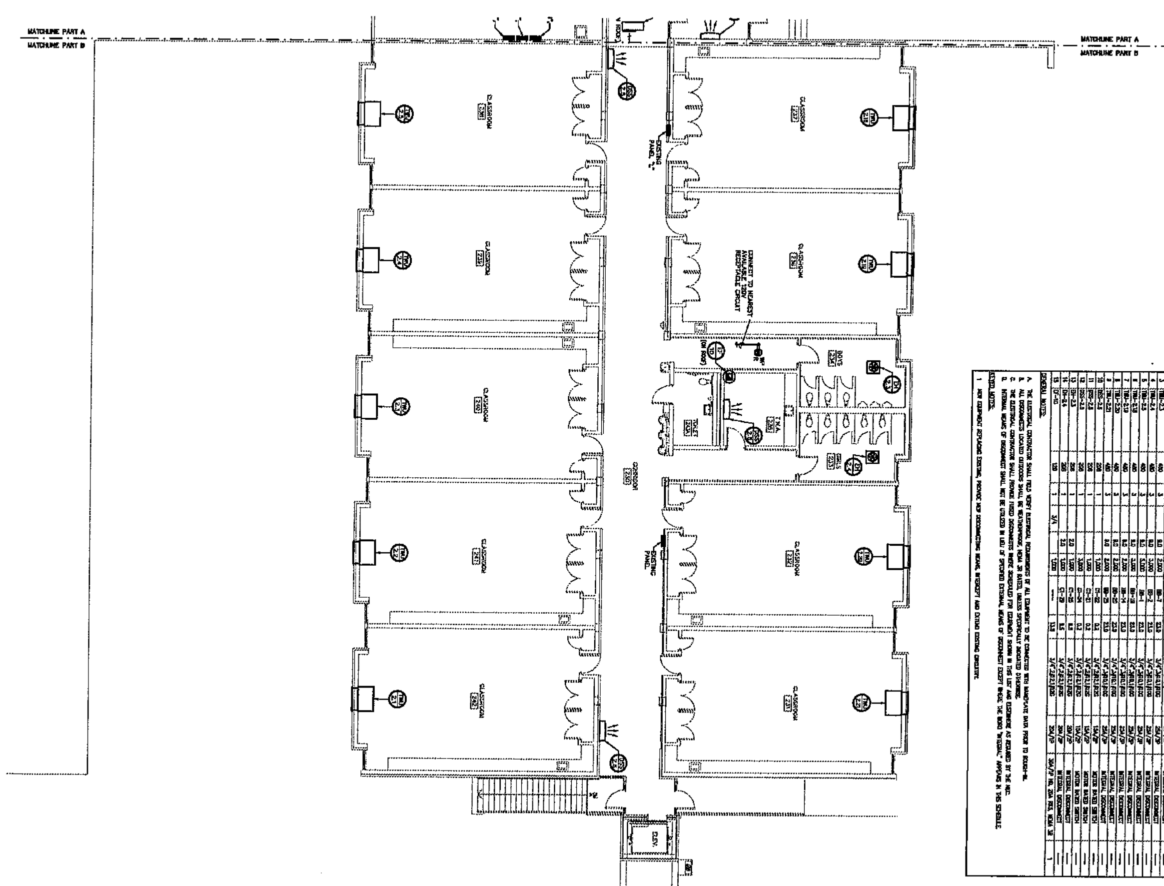
PROJECT:

CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd, Knoxville, Tennessee

DRAWING TITLE: SECOND FLOOR PLAN - PART A - ELECTRICAL

REVISIONS	
NO.	DATE

DRAWN BY: WRM
CHECKED BY: ECH
APPROVED BY: ECH
DATE: 10/31/2023
PROJECT NO: 23809
DRAWING NO. E2.3



SECOND FLOOR PLAN – PART B – ELECTRICAL

1/8"=1'-0"

MECHANICAL EQUIPMENT CONNECTION SCHEDULE SHEET E2.4

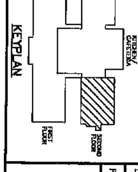
ITEM NO.	EQUIPMENT	VOLTAGE	PHASE	HP	KW	FAULT DUTY	CIRCUIT NUMBER	FULL LOAD AMPS	CIRCUIT CONDUCTORS (COPPER UNLESS NOTED OTHERWISE)	BREAKER (TRIP/POLE)	LOCAL MEANS OF DISCONNECT (FRAME/POLE/FUSE/NEMA)	NOTES
1	TBU-2.1	480	3		3.0	2,000	BB-13	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
2	TBU-2.2	480	3		3.0	2,000	BB-8	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
3	TBU-2.3	480	3		9.0	2,000	BB-7	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
4	TBU-2.4	480	3		9.0	3,000	BB-2	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
5	TBU-2.5	480	3		9.0	3,000	BB-1	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
6	TBU-2.18	480	3		9.0	3,000	BB-19	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
7	TBU-2.19	480	3		9.0	2,000	BB-14	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
8	TBU-2.20	480	3		9.0	2,000	BB-20	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
9	TBU-2.21	480	3		9.0	2,000	BB-25	23.0	3/4"-3#10,1#10G	25A/3P	INTEGRAL DISCONNECT	—
10	EDS-2.5	208	1			1,000	C1-22	0.2	3/4"-2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
11	EDS-2.8	208	1			1,000	C1-21	0.2	3/4"-2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
12	EDS-2.9	208	1			3,000	C1-24	0.2	3/4"-2#12,1#12G	15A/2P	MOTOR RATED SWITCH	—
13	EH-2.3	208	1		2.0	1,000	C1-26	9.6	3/4"-2#12,1#12G	20A/2P	INTEGRAL DISCONNECT	—
14	EH-2.4	208	1		2.0	1,000	C1-28	9.6	3/4"-2#12,1#12G	20A/2P	INTEGRAL DISCONNECT	—
15	EF-10	120	1	3/4		1,000	---	13.8	3/4"-2#12,1#12G	20A/1P	30A/1P NS, 20A FUS, NEMA 1R	1

GENERAL NOTES:

A. THE ELECTRICAL CONTRACTOR SHALL FIELD VERIFY ELECTRICAL REQUIREMENTS OF ALL EQUIPMENT TO BE CONNECTED WITH NAMEPLATE DATA PRIOR TO ROUGH-IN.
B. ALL DISCONNECTS LOCATED OUTDOORS SHALL BE WEATHERPROOF, NEMA 3R RATED, UNLESS SPECIFICALLY INDICATED OTHERWISE.
C. THE ELECTRICAL CONTRACTOR SHALL PROVIDE FUSED DISCONNECTS WHERE SCHEDULED FOR EQUIPMENT SHOWN IN THIS LIST AND ELSEWHERE AS REQUIRED BY THE NEC.
D. INTERNAL MEANS OF DISCONNECT SHALL NOT BE UTILIZED IN LIEU OF SPECIFIED EXTERNAL MEANS OF DISCONNECT EXCEPT WHERE THE WORD "INTEGRAL" APPEARS IN THIS SCHEDULE.

KEYED NOTES:

1. NEW EQUIPMENT REPLACING EXISTING, PROVIDE NEW DISCONNECTING MEANS, INTERCEPT AND EXTEND EXISTING CIRCUITS.



DRAWING NO. E2.4

PROJECT NO. 23809

DATE 10/31/2023

APPROVED BY ECH

CHECKED BY ECH

DRAWN BY WRM

REVISIONS

DRAWING TITLE: SECOND FLOOR PLAN - PART B - ELECTRICAL

PROJECT:

CEDAR BLUFF MIDDLE SCHOOL HVAC RENOVATIONS

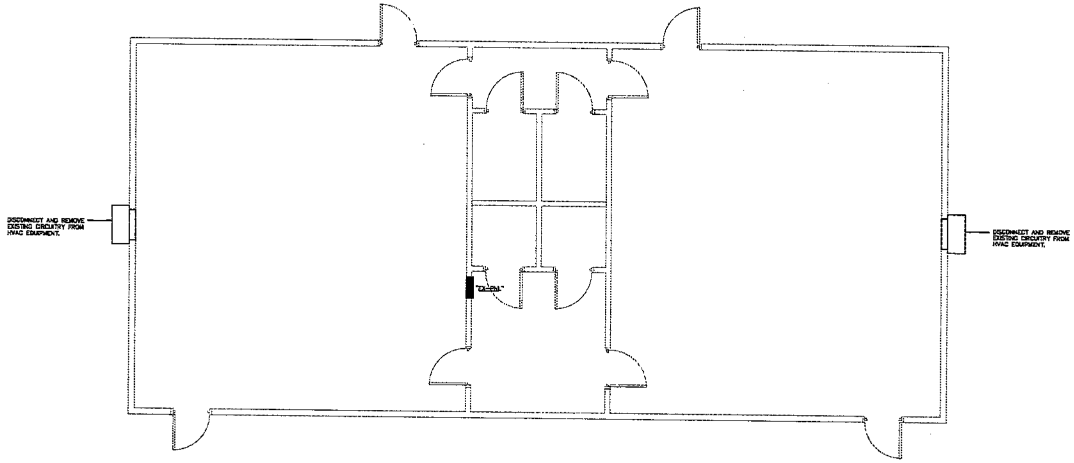
for Knox County Schools

707 N. Cedar Bluff Rd. Knoxville, Tennessee

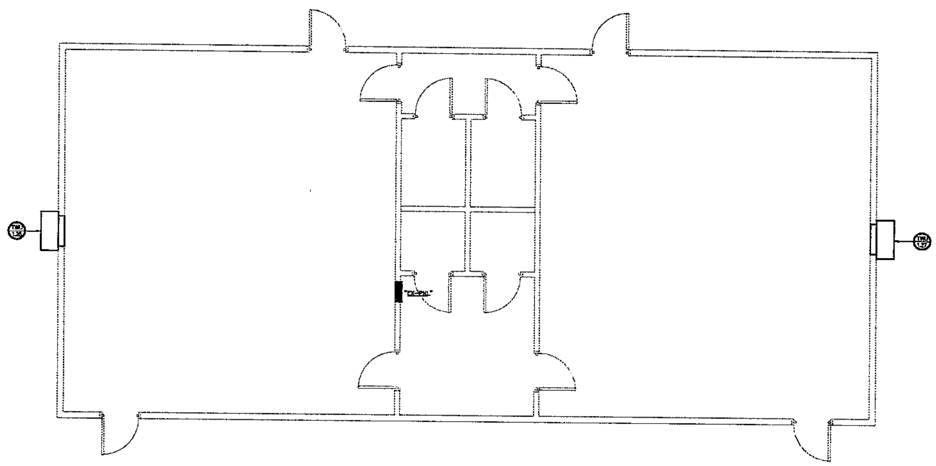
ESG
ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
900 EAST HILL AVE SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0353
PROJECT NO. 23809

DEMOLITION NOTES:

1. DEMOLITION SHALL INCLUDE ALL PORTIONS OF CONDUCTORS, CONDUIT, BOXES, SURFACE RACEWAYS, HANGERS AND SUPPORTS MADE SPARE BY THE WORK OR PREVIOUSLY ABANDONED. EMPTY RACEWAYS AND BOXES ROUTED IN INACCESSIBLE LOCATIONS (IN WALLS, UNDER FLOOR, OR ABOVE INACCESSIBLE CEILINGS) MAY BE ABANDONED IN PLACE. PROVIDE BLANK COVERPLATES AT ALL SUCH JUNCTION BOXES. WHERE SURFACE MOUNTED ENCLOSURES, CONDUITS, OR RACEWAYS ARE REMOVED, PATCH SMOOTH AND PAINT RESULTING SURFACES TO MATCH EXISTING ADJACENT FINISHES. COORDINATE COLOR WITH KNOX COUNTY SCHOOLS.



PORTABLE CLASSROOM – ELECTRICAL DEMOLITIONS
1/4"=1'-0" (ESTIMATED)



PORTABLE CLASSROOM – ELECTRICAL
1/4"=1'-0" (ESTIMATED)

NEW CONSTRUCTION NOTES:

1. PRIOR TO LOCATING ANY AND ALL DEVICES AT CASEWORK, COUNTERTOPS ETC., THE CONTRACTOR SHALL REFER TO FINAL ARCHITECTURAL CASEWORK ELEVATIONS AND SHOP DRAWINGS TO VERIFY MOUNTING HEIGHTS AND LOCATIONS. ALL DEVICE LOCATIONS SHALL BE COORDINATED WITH THESE DRAWINGS AND/OR THE ARCHITECT PRIOR TO ROUGH-IN.
2. ALL BRANCH CIRCUITS SHALL BE SIZED TO COMPLY WITH IECC C405.8. SPECIFICALLY, ALL 120V, 20 AMP CIRCUITS WITH HOMERUNS GREATER THAN 70 FEET SHALL HAVE CIRCUIT AND GROUNDING CONDUCTORS OF #10AWG AS MINIMUM. ANY 120V, 20 AMP CIRCUIT WITH OUTLETS GREATER THAN 100 FEET OF BRANCH CIRCUIT LENGTH SHALL HAVE CIRCUIT AND GROUNDING CONDUCTORS OF #10AWG MINIMUM TO ALL OUTLETS AND HOMERUN. ANY 120V, 20 AMP CIRCUIT WITH HOMERUN GREATER THAN 140 FEET SHALL HAVE BRANCH CIRCUIT AND GROUNDING CONDUCTORS OF #8AWG MINIMUM. PROVIDE ADEQUATE BOX TO SPLICE #12AWG FOR TERMINATION TO DEVICE. LARGER CONDUCTORS MAY REQUIRE THE UTILIZATION OF LARGER CONDUIT SIZES – REFER TO NEC TABLES.
3. CONTRACTOR SHALL PROVIDE ALL REQUIRED BRANCH CIRCUIT RACEWAY AND CONDUCTORS FOR CONNECTION OF NEW HVAC EQUIPMENT INDICATED. WIRING SHALL BE ROUTED OVERHEAD. RACEWAY SHALL BE ROUTED EXPOSED ON SURFACE OF EXISTING CEILING AND WALLS EXCEPT IN AREAS WHERE ACCESSIBLE ACOUSTICAL TILE CEILINGS EXIST RACEWAYS SHALL BE ROUTED CONCEALED ABOVE CEILING. WHERE EXPOSED:
   a. ORGANIZE THE RUNS INTO GROUPS COORDINATING WITH OTHER TRADES TO AVOID INTERFERENCE.
   b. ARRANGEMENT SHALL BE NEAT AND ORDERLY WITH RUNS PARALLEL TO STRUCTURAL ELEMENTS. NO DIAGONAL RUNS WILL BE ALLOWED.
   c. SUPPORTS SHALL BE "UNISTRUT" WITH SUITABLE CLAMPS. THE UNISTRUT SHALL BE SUPPORTED FROM THE BUILDING STRUCTURES. PAINT CUT ENDS OF UNISTRUT WITH RUST PROHIBITOR.
4. CONTRACTOR SHALL PROVIDE ALL NEW RACEWAY FOR NEW PANELS FEEDERS AND DISTRIBUTION. RACEWAY SHALL BE ROUTED SAME AS DESCRIBED IN NOTE#3 ABOVE FOR BRANCH CIRCUITS.
5. ALL NEW SURFACE RACEWAYS AND SUPPORTS SHALL BE PAINTED TO MATCH ADJACENT FINISHES, COORDINATE COLOR WITH KNOX COUNTY SCHOOLS.

MECHANICAL EQUIPMENT CONNECTION SCHEDULE

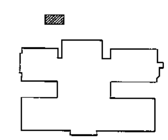
ITEM NO.	EQUIPMENT	EQUIPMENT CHARACTERISTICS: VOLTAGE	PHASE	HP	kW	FAULT DUTY	CIRCUIT NUMBER	FULL LOAD AMPS	CIRCUIT CONDUCTORS (COPPER UNLESS NOTED OTHERWISE)	BREAKER (TRIP/POLE)	LOCAL MEANS OF DISCONNECT (FRAME/POLE/FUSE/NEMA)	NOTES
1	TMU-1.27 CKT. 1 OF 2	240	1		15.0	1,000	EX-PNL-0	62.5	1",2#4,1#10G	80A/2P	INTEGRAL DISCONNECT	1
2	TMU-1.27 CKT. 2 OF 2	240	1	1/2		1,000	EX-PNL-1	30.0	3/4",2#8,1#10G	40A/2P	INTEGRAL DISCONNECT	2
3	TMU-1.28 CKT. 1 OF 2	240	1		15.0	1,000	EX-PNL-13	62.5	1",2#4,1#10G	80A/2P	INTEGRAL DISCONNECT	1
4	TMU-1.28 CKT. 2 OF 2	240	1	1/2		1,000	EX-PNL-5	30.0	3/4",2#8,1#10G	40A/2P	INTEGRAL DISCONNECT	3

GENERAL NOTES:

1. THE ELECTRICAL CONTRACTOR SHALL FIELD VERIFY ELECTRICAL REQUIREMENTS OF ALL MECHANICAL EQUIPMENT TO BE CONNECTED WITH NAMEPLATE DATA PRIOR TO ROUGH-IN.
2. ALL DISCONNECTS LOCATED OUTDOORS SHALL BE WEATHERPROOF, NEMA 3R RATED, UNLESS SPECIFICALLY INDICATED OTHERWISE.
3. THE ELECTRICAL CONTRACTOR SHALL PROVIDE FUSED DISCONNECTS WHERE SCHEDULED FOR EQUIPMENT SHOWN IN THIS LIST AND AS REQUIRED BY THE NEC.
4. INTERNAL MEANS OF DISCONNECT SHALL NOT BE UTILIZED IN LIEU OF SPECIFIED EXTERNAL MEANS OF DISCONNECT EXCEPT WHERE THE WORD "INTEGRAL" APPEARS IN THIS SCHEDULE.

KEYED NOTES:

1. CONNECT TO EXISTING 80/2 BREAKER MADE SPARE FROM DEMOLITION.
2. REPLACE EXISTING 30/2 CIRCUIT BREAKER WITH NEW 40/2 BREAKER.



ENGINEERING SERVICES GROUP, INC.
CONSULTING ENGINEERS
500 EAST HILL AVE. SUITE 350
KNOXVILLE, TENNESSEE 37915
(865) 522-0393
PROJECT NO. 23809

PROJECT:
CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
for Knox County Schools
707 N. Cedar Bluff Rd, Knoxville, Tennessee

DRAWING TITLE:
PORTABLE CLASSROOM -ELECTRICAL

REVISIONS	
NO.	DATE

DRAWN BY MWE
CHECKED BY ECH
APPROVED BY ECH
DATE 10/31/2023
PROJECT NO 23809
DRAWING NO.
E2.5

CEDAR BLUFF MIDDLE SCHOOL
HVAC RENOVATIONS
KNOXVILLE, TN

ESG ENGINEERING SERVICES GROUP, INC. CONSULTING ENGINEERS, 900 EAST HILL AVE. SUITE 350, KNOXVILLE, TENNESSEE 37915, (865) 522-0333, PROJECT NO. 23697

DRAWING TITLE: PANEL SCHEDULES AND FEEDER DIAGRAM

REVISIONS

NO.	DATE

DRAWN BY: WRM
CHECKED BY: ECH
APPROVED BY: ECH
DATE: 8/31/2023
PROJECT NO: 23697
DRAWING NO. E3.1

PANELBOARD 'MDP-AA' SCHEDULE

VOLTAGE: 480Y/277V, 3 PHASE, 4 WIRE | MAIN: 1000 A MAIN BKR | MOUNTING: SURFACE 10"x42" | NEMA TYPE 3R
BUS SIZE: 1000 AMPERES | LOAD: 681.0 kVA TOTAL | FAULT DUTY: 42,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	PANEL BB (DD)			102.40			200.5							98.10	PANEL CC (EE)	2
3				102.30	400/3			200.3			400/3			98.00		4
5				102.20					200.2					98.00		6
7	PANEL FF			30.00			30.0								SPARE	8
9				30.00	225/3			30.0			225/3					10
11				30.00					30.0							12
13	SURGE PROTECTOR														SPACE	14
15					30/3						100/3					16
17																18

PHASE TOTALS: A 230.5 | B 230.3 | C 230.2

PANELBOARD NOTES:
1. U.L. SERVICE ENTRANCE LABELED. EQUIPPED WITH LINE-SIDE TERMINAL GUARDS AND BARRIERS INSTALLED PER NEC 408.3(A)(2)
2. INTEGRAL SURGE PROTECTIVE DEVICE CONNECTED VIA BREAKER.
3. PROVIDE ALL BREAKERS (EXCEPT SPD BREAKER) WITH GROUND FAULT PROTECTION. PROVIDE COORDINATION STUDY.

TOTAL CONNECTED LOAD: 681.0 kVA AT 480Y/277V = 831.1 AMPERES

4. PROVIDE ENERGY-REDUCING MAINTENANCE SWITCH PER NEC 240.87.

PANELBOARD 'BB' SCHEDULE

VOLTAGE: 480Y/277V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 400 AMPERES | LOAD: 306.9 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	TRU-2.5			4.90			9.8							4.90	TRU-2.4	2
3				4.90	25/3			9.8			25/3			4.90		4
5				4.90					9.8					4.90		6
7	TRU-2.3			4.90			9.8							4.90	TRU-2.2	8
9				4.90	25/3			9.8			25/3			4.90		10
11				4.90					9.8					4.90		12
13	TRU-2.1			4.90			9.8							4.90	TRU-2.19	14
15				4.90	25/3			9.8			25/3			4.90		16
17				4.90					9.8					4.90		18
19	TRU-2.18			4.90			9.8							4.90	TRU-2.20	20
21				4.90	25/3			9.8			25/3			4.90		22
23				4.90					9.8					4.90		24
25	TRU-2.21			4.90			4.9								SPARE	26
27				4.90	25/3			4.9			25/3					28
29				4.90					4.9							30
31	SPACE				20/1						20/1				SPACE	32
33	SPACE				20/1						20/1				SPACE	34
35	SPACE				20/1						20/1				SPACE	36
37	SPACE				20/1						20/1				SPACE	38
39	SPACE				20/1						20/1				SPACE	40
41	SPACE				20/1						20/1				SPACE	42

PHASE TOTALS: A 102.4 | B 102.3 | C 102.2

PANELBOARD NOTES:
1. PROVIDE WITH FEED THRU LUGS.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 306.9 kVA AT 480Y/277V = 369.1 AMPERES

PANELBOARD 'CC' SCHEDULE

VOLTAGE: 480Y/277V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 400 AMPERES | LOAD: 294.1 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	TRU-2.6			4.90			9.8							4.90	TRU-2.11	2
3				4.90	25/3			9.7			25/3			4.80		4
5				4.90					9.7					4.80		6
7	TRU-2.7			4.90			9.7							4.80	TRU-2.12	8
9				4.90	25/3			9.7			25/3			4.80		10
11				4.90					9.7					4.80		12
13	TRU-2.8			4.90			9.7							4.80	TRU-2.13	14
15				4.90	25/3			9.7			25/3			4.80		16
17				4.90					9.7					4.80		18
19	TRU-2.9			4.90			4.9								SPARE	20
21				4.90	25/3			4.9			25/3					22
23				4.90					4.9							24
25	TRU-2.10			4.90			4.9				20/1				SPACE	26
27				4.90	25/3			4.9			20/1				SPACE	28
29				4.90					4.9		20/1				SPACE	30
31	SPACE				20/1						20/1				SPACE	32
33	SPACE				20/1						20/1				SPACE	34
35	SPACE				20/1						20/1				SPACE	36
37	SPACE				20/1						20/1				SPACE	38
39	SPACE				20/1						20/1				SPACE	40
41	SPACE				20/1						20/1				SPACE	42

PHASE TOTALS: A 98.1 | B 98.0 | C 98.0

PANELBOARD NOTES:
1. PROVIDE WITH FEED THRU LUGS.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 294.1 kVA AT 480Y/277V = 353.7 AMPERES

PANELBOARD 'DD' SCHEDULE

VOLTAGE: 480Y/277V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 400 AMPERES | LOAD: 174.7 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	TRU-1.23			4.90			9.8							4.90	TRU-1.1	2
3				4.90	25/3			9.7			25/3			4.80		4
5				4.90					9.7					4.80		6
7	TRU-1.22			4.90			9.7							4.80	TRU-1.2	8
9				4.90	25/3			9.7			25/3			4.80		10
11				4.90					9.7					4.80		12
13	TRU-1.5			4.90			9.7							4.80	TRU-1.3	14
15				4.90	25/3			9.7			25/3			4.80		16
17				4.90					9.7					4.80		18
19	TRU-1.6			4.90			9.7							4.80	TRU-1.4	20
21				4.90	25/3			9.7			25/3			4.80		22
23				4.90					9.7					4.80		24
25	TRU-1.15			4.90			9.7							4.80	TRU-1.16	26
27				4.90	25/3			9.7			25/3			4.80		28
29				4.90					9.7					4.80		30
31	TRU-1.17			4.90			9.7							4.80	TRU-1.18	32
33				4.90	25/3			9.7			25/3			4.80		34
35				4.90					9.7					4.80		36
37	SPARE														SPARE	38
39					25/3						25/3					40
41																42

PHASE TOTALS: A 58.3 | B 58.2 | C 58.2

PANELBOARD NOTES:
1.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 174.7 kVA AT 480Y/277V = 210.1 AMPERES

PANELBOARD 'EE' SCHEDULE

VOLTAGE: 480Y/277V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 400 AMPERES | LOAD: 177.3 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	TRU-1.25			4.90			9.8							4.90	TRU-1.24	2
3				4.90	25/3			9.8			25/3			4.90		4
5				4.90					9.8					4.90		6
7	TRU-1.12			4.90			9.8							4.90	TRU-1.26	8
9				4.90	25/3			9.8			25/3			4.90		10
11				4.90					9.8					4.90		12
13	TRU-1.13			4.90			9.8							4.90	TRU-1.8	14
15				4.90	25/3			9.8			25/3			4.90		16
17				4.90					9.8					4.90		18
19	TRU-1.14			4.90			9.8							4.90	TRU-1.7	20
21				4.90	25/3			9.8			25/3			4.90		22
23				4.90					9.8					4.90		24
25	TRU-1.9			4.90			12.4							7.50	TRU-1.10	26
27				4.90	25/3			12.4			30/3			7.50		28
29				4.90					12.4					7.50		30
31	SPACE				20/1		7.5							7.50	TRU-1.11	32
33	SPACE				20/1			7.5			30/3			7.50		34
35	SPACE				20/1				7.5					7.50		36
37	SPACE				20/1						20/1				SPACE	38
39	SPACE				20/1						20/1				SPACE	40
41	SPACE				20/1						20/1				SPACE	42

PHASE TOTALS: A 59.1 | B 59.1 | C 59.1

PANELBOARD NOTES:
1.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 177.3 kVA AT 480Y/277V = 213.3 AMPERES

PANELBOARD 'FF' SCHEDULE

VOLTAGE: 480Y/277V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 225 AMPERES | LOAD: 90.0 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	TRU-2.14			7.50			15.0							7.50	TRU-2.15	2
3				7.50	30/3			15.0			30/3			7.50		4
5				7.50					15.0					7.50		6
7	TRU-2.16			7.50			15.0							7.50	TRU-2.17	8
9				7.50	30/3			15.0			30/3			7.50		10
11				7.50					15.0					7.50		12
13	SPARE														SPARE	14
15					30/3						30/3					16
17																18
19	SPACE				20/1						20/1				SPACE	20
21	SPACE				20/1						20/1				SPACE	22
23	SPACE				20/1						20/1				SPACE	24
25	SPACE				20/1						20/1				SPACE	26
27	SPACE				20/1						20/1				SPACE	28
29	SPACE				20/1						20/1				SPACE	30
31	SPACE				20/1						20/1				SPACE	32
33	SPACE				20/1						20/1				SPACE	34
35	SPACE				20/1						20/1				SPACE	36
37	SPACE				20/1						20/1				SPACE	38
39	SPACE				20/1						20/1				SPACE	40
41	SPACE				20/1						20/1				SPACE	42

PHASE TOTALS: A 30.0 | B 30.0 | C 30.0

PANELBOARD NOTES:
1.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 90.0 kVA AT 480Y/277V = 108.3 AMPERES

PANELBOARD 'A1' SCHEDULE

VOLTAGE: 208Y/120V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 100 AMPERES | LOAD: 11.6 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	DSS-1.7			0.10	15/2		1.1				20/2			1.00	EH-1.1	2
3				0.10				1.1						1.00		4
5	DSS-1.8			0.10	15/2				1.1		20/2			1.00	EH-1.2	6
7				0.10			1.1							1.00		8
9	DSS-1.9			0.10	15/2			0.2			15/2			0.10	DSS-1.10	10
11				0.10					0.2					0.10		12
13	DSS-1.11			0.10	15/2		0.2				15/2			0.10	DSS-1.6	14
15				0.10				0.2						0.10		16
17	DSC-1.5			3.00	40/2				3.1		15/2			0.10	DSS-1.5	18
19				3.00			3.1							0.10		20
21	SPARE				15/2			0.1			15/2			0.10	DSS-1.20	22
23									0.1					0.10		24
25	SPACE				20/1						20/1				SPACE	26
27	SPACE				20/1						20/1				SPACE	28
29	SPACE				20/1						20/1				SPACE	30
31	SPACE				20/1						20/1				SPACE	32
33	SPACE				20/1						20/1				SPACE	34
35	SPACE				20/1						20/1				SPACE	36
37	SPACE				20/1						20/1				SPACE	38
39	SPACE				20/1						20/1				SPACE	40
41	SPACE				20/1						20/1				SPACE	42

PHASE TOTALS: A 5.5 | B 1.6 | C 4.5

PANELBOARD NOTES:
1.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 11.6 kVA AT 208Y/120V = 32.2 AMPERES

PANELBOARD 'B1' SCHEDULE

VOLTAGE: 208Y/120V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 100 AMPERES | LOAD: 20.9 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	DSC-1.3			3.70	50/2		3.8				15/2			0.10	DSS-1.11	2
3				3.70				3.8						0.10		4
5	DSC-1.4			3.70	50/2				3.8		15/2			0.10	DSS-1.12	6
7				3.70			3.8							0.10		8
9	DSS-1.17			0.25	15/2			0.4			15/2			0.10	DSS-1.13	10
11				0.25					0.4					0.10		12
13	DSS-1.18			0.25	15/2		0.4				15/2			0.10	DSS-1.14	14
15				0.25				0.4						0.10		16
17	DSS-1.1			0.10	15/2				0.2		15/2			0.10	DSS-1.15	18
19				0.10			0.2							0.10		20
21	DSS-1.2			0.10	15/2			0.2			15/2			0.10	DSS-1.16	22
23				0.10					0.2					0.10		24
25	DSS-1.3			0.10	15/2		1.3				30/2			1.20	DSC-1.2	26
27				0.10				1.3						1.20		28
29	DSS-1.4			0.10	15/2				0.2		15/2			0.10	DSS-1.10	30
31				0.10			0.2							0.10		32
33	DSS-1.5			0.10	15/2			0.4			20/1			0.30	EF-11 & EF-12	34
35				0.10					0.1		20/1				SPARE	36
37	SPACE				20/1						20/1				SPACE	38
39	SPACE				20/1						20/1				SPACE	40
41	SPACE				20/1						20/1				SPACE	42

PHASE TOTALS: A 8.7 | B 6.4 | C 4.8

PANELBOARD NOTES:
1.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 20.9 kVA AT 208Y/120V = 58.0 AMPERES

PANELBOARD 'C1' SCHEDULE

VOLTAGE: 208Y/120V, 3 PHASE, 4 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 150 AMPERES | LOAD: 39.4 kVA TOTAL | FAULT DUTY: 22,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	C	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	DSC-1.1			3.70	40/2		3.8				15/2			0.10	DSS-2.3	2
3				3.70				3.8						0.10		4
5	DSC-1.10			1.20	30/2				1.3		15/2			0.10	DSS-2.4	6
7				1.20			1.3							0.10		8
9	DSC-2.1			3.00	40/2			6.0			40/2			3.00	DSC-1.2	10
11				3.00					6.0					3.00		12
13	DSS-2.1			0.10	15/2		3.1				40/2			3.00	DSC-2.2	14
15				0.10				3.1						3.00		16
17	DSS-2.2			0.10	15/2				0.2		15/2			0.10	DSS-2.7	18
19				0.10			0.2							0.10		20
21	DSS-2.8			0.10	15/2			0.2			15/2			0.10	DSS-2.6	22
23				0.10					0.2					0.10		24
25	EH-2.3			1.00	20/2		2.0				20/2			1.00	EH-2.1	26
27				1.00				2.0						1.00		28
29	EH-2.4			1.00	20/2				2.0		20/2			1.00	EH-2.2	30
31				1.00			2.0							1.00		32
33	EH-2.5			1.00	20/2			1.1			15/2			0.10	DSS-2.5	34
35				1.00					1.1					0.10		36
37	SPACE				20/1						20/1				SPACE	38
39	SPACE				20/1						20/1				SPACE	40
41	SPACE				20/1						20/1				SPACE	42

PHASE TOTALS: A 12.4 | B 16.2 | C 10.8

PANELBOARD NOTES:
1.
2.
3.
4.
5.

TOTAL CONNECTED LOAD: 39.4 kVA AT 208Y/120V = 109.4 AMPERES

EXISTING PANELBOARD 'EX-PNL' SCHEDULE

VOLTAGE: 240/120V, 1 PHASE, 3 WIRE | MAIN: LUG ONLY | MOUNTING: SURFACE 6"x20" | NEMA TYPE 1
BUS SIZE: 200 AMPERES | LOAD: 52.9 kVA TOTAL | FAULT DUTY: 10,000 AIC | LOCATION & FEEDER: SEE DRAWINGS

CKT NO	SERVICE TO:	LTG	RECPT	OTHER	O.C./POLE	TRIP TYPE	A	B	TRIP TYPE	O.C./POLE	LTG	RECPT	OTHER	SERVICE TO:	CKT NO
1	NEW TRU-1.27			3.60	40/2		5.1			20/1			1.50	EXISTING WATER HEATER	2
3				3.60				4.6		20/1	0.50	0.50		EXISTING REC/LTG	4
5	NEW TRU-1.28			3.60	40/2		4.6			20/1	0.50	0.50		EXISTING REC/LTG	6
7				3.60				4.6		20/1	0.50	0.50		EXISTING REC/LTG	8
9	NEW TRU-1.27(EX BKR)			7.50	60/2		8.5			20/1	0.50	0.50		EXISTING REC/LTG	10
11				7.50				8.5		20/1	0.50	0.50		EXISTING REC/LTG	12
13	NEW TRU-1.28(EX BKR)			7.50	80/2		8.5			20/1	0.50	0.50		EXISTING REC/LTG	14
15				7.50				8.5		20/1	0.50	0.50		EXISTING REC/LTG	16

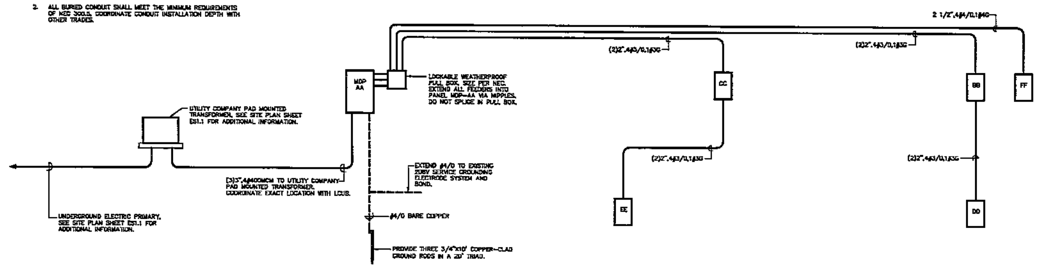
PHASE TOTALS: A 26.7 | B 26.2

PANELBOARD NOTES:
1.
2.
3.
4.
5.

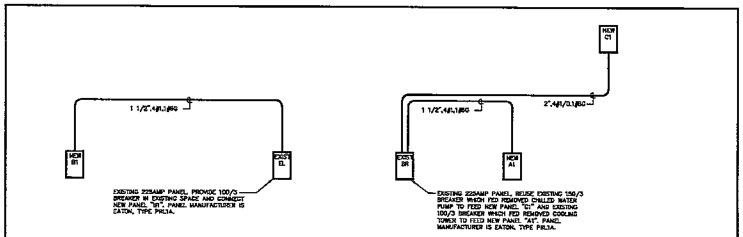
TOTAL CONNECTED LOAD: 52.9 kVA AT 240/120V = 220.4 AMPERES

NOTES:

1. NEW PANEL FEEDERS INSIDE THE BUILDING SHALL BE ROUTED EXPOSED ON SURFACE OF EXISTING CEILING AND WALLS EXCEPT IN AREAS WHERE ACCESSIBLE ACOUSTICAL TILE CEILINGS EXIST RACEWAYS SHALL BE ROUTED CONCEALED ABOVE CEILING. WHERE EXPOSED:
   a. ORGANIZE THE RUNS INTO GROUPS COORDINATING WITH OTHER TRADES TO AVOID INTERFERENCE.
   b. ARRANGEMENT SHALL BE NEAT AND ORDERLY WITH RUNS PARALLEL TO STRUCTURAL ELEMENTS. NO DIAGONAL RUNS WILL BE ALLOWED.
   c. SUPPORTS SHALL BE "UNISTRUT" WITH SUITABLE CLAMPS. THE UNISTRUT SHALL BE SUPPORTED FROM THE BUILDING STRUCTURES. PAINT CUT ENDS OF UNISTRUT WITH RUST PROHIBITOR.
2. ALL BURIED CONDUIT SHALL MEET THE MINIMUM REQUIREMENTS OF NEC 300.5. COORDINATE CONDUIT INSTALLATION DEPTH WITH OTHER TRADES.



FEEDER DIAGRAM – NEW 480VOLT, 3Ø SERVICE
N.T.S.



PARTIAL FEEDER DIAGRAM – EXISTING 208VOLT, 3Ø SERVICE
N.T.S.

ELECTRICAL SYMBOL LEGEND

SYMBOL	DESCRIPTION
(duplex receptacle symbol)	DUPLEX PLUG RECEPTACLE: 18" AFF TO CENTER OF ROUGH-IN, 20A, 120V, TAMPER RESISTANT TYPE. PROVIDE WHITE TAPE LABEL WITH 1/4" HIGH TYPED BLACK LETTERING ON COVERPLATE OF RECEPTACLE INDICATING PANELBOARD AND CIRCUIT NUMBER.
(GFCI receptacle symbol)	COLORED CENTER WITH BUILT-IN GROUND FAULT PROTECTION, 44" AFF TO CENTER OF ROUGH-IN AT CASEWORK, 18" OUT OF DOORS "WP" WEATHERPROOF IN-USE "EXTRA-DUTY" (UL 514D) METAL COVER AND WEATHER-RESISTANT (UL 498) TYPE GFCI DEVICE. "R" INDICATES MOUNTED ON THE ROOF PROVIDE DEDICATED NEUTRAL FOR EACH CIRCUIT SERVING AN OUTLET.
(homerun symbol)	BRANCH CIRCUIT HOMERUN: CONDUIT WITH CONDUCTORS EXTENDED AND CONNECTED TO OVERCURRENT DEVICE(S) NOTED. CROSSLINES INDICATE QUANTITY OF #12 AWG CONDUCTORS WHEN MORE THAN TWO. PROVIDE A DEDICATED NEUTRAL FOR EACH LINE-TO-NEUTRAL CIRCUIT IN A HOMERUN. WHERE ONE NEUTRAL IS PROVIDED FOR A MULTI-CIRCUIT HOMERUN THE CONTRACTOR SHALL PROVIDE DISCONNECTING MEANS FOR EACH CONDUCTOR AS REQUIRED BY THE NEC. GROUNDING CONDUCTOR IS NOT ILLUSTRATED.
(solid line)	CONDUIT: SOLID LINE AND CLOSED DOT INDICATE INSTALLED IN WALL OR CEILING SHOWN TURNING DOWN. ALL CONDUITS SHALL CONTAIN AN EQUIPMENT GROUNDING CONDUCTOR WHICH IS NOT ILLUSTRATED.
(broken line)	BROKEN LINE AND OPEN DOT INDICATE INSTALLED IN FLOOR CONSTRUCTION OR UNDERGROUND SHOWN TURNING UP. ALL CONDUITS SHALL CONTAIN AN EQUIPMENT GROUNDING CONDUCTOR WHICH IS NOT ILLUSTRATED.
(panelboard symbol)	POWER PANELBOARD: FLUSH OR SURFACE MOUNTED, TOP 6'-0" AFF. SEE PANELBOARD SCHEDULE FOR SUPPORT INFORMATION.

NOTES:
1. ALL CONDUITS SHALL CONTAIN AN EQUIPMENT GROUNDING CONDUCTOR WHICH IS NOT ILLUSTRATED.
2. PROVIDE A DEDICATED NEUTRAL FOR EACH LINE-TO-NEUTRAL CIRCUIT IN A MULTI-CIRCUIT HOMERUN.
3. DEVICE ACCESSIBILITY: DEVICES INTENDED FOR NORMAL USE OR OPERATION BY BUILDING OCCUPANTS SHALL BE LOCATED AT AN ACCESSIBLE MOUNTING HEIGHT AS DEFINED BY THE AMERICANS WITH DISABILITIES ACT (ADA). AT UNOBSTRUCTED APPROACH LOCATIONS, OPERABLE PARTS SHALL NOT BE GREATER THAN 48" AFF AND NOT LESS THAN 15" AFF. COORDINATE OBSTRUCTED APPROACHES WITH ADA.