

COPY NO. _____

**EVERGREEN AVENUE & BLUE HILLS PUMP STATION
HVAC IMPROVEMENTS
BID # 21-100**

**WATERFORD UTILITY COMMISSION
WATERFORD, CONNECTICUT**

**BIDDING AND CONTRACT REQUIREMENTS
AND SPECIFICATIONS**

JANUARY 2021

20483

**WATERFORD UTILITY COMMISSION
WATERFORD, CT**

**BIDDING AND CONTRACT REQUIREMENTS
AND SPECIFICATIONS**

FOR

**EVERGREEN AVENUE & BLUE HILLS
PUMP STATIONS HVAC IMPOROVEMENTS**

BID # 21-100

JANUARY 2021

Prepared By:

**Wright-Pierce
169 Main Street., 3rd Floor
Middletown, CT 06457**

Phone: (860) 343-8297

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Invitation to Bid
Evergreen Avenue and Blue Hills
Pump Stations HVAC Improvements
Bid # 21-100

The Purchasing Agent will accept sealed bids for the Evergreen Avenue and Blue Hills Pump Stations HVAC Improvements until **11:00 A.M. on Thursday March 11th, 2021** at the Waterford Town Hall, 15 Rope Ferry Road Waterford, CT 06385 in the Louis Appleby Room. Please see the Town of Waterford website at <http://www.waterfordct.org> for packets and all information regarding this Bid. Electronic Bids can be submitted by the deadline stated above at sealedbids@waterfordct.org. All emailed bids shall have the Bid number in the subject line. Copies of bonding information shall accompany electronic submissions. Zoom instructions will be posted to the Town's website. **The Town Hall is currently closed to the public, and as a result, bids shall be placed in the Dropbox at the rear of the building.** Late bids will not be accepted and it is the responsibility of the bidders to ensure that bids (including signed addenda) arrive in the Town's purchasing office by the date and time listed above. Complete bid packets can be downloaded from the Town website <https://www.waterfordct.org/purchasing> *Bids and Vendors*. Vendors are asked to register on our Web Site through the vendor link. Any questions regarding this proposal are to be directed to the Purchasing Agent at rdummett@waterfordct.org. Telephone Number 860-444-5842.

A **mandatory walk-through** of the two pump stations is scheduled for **10:00 A.M on Thursday February 4th, 2021** beginning at the Blue Hills Pump Station located on Harvey Avenue (off of Route 85) in Waterford, CT.

The Board of Selectmen reserves the right to reject any or all bids, in whole or in part, and to waive any informality in any bid when such action is deemed in the best interest of the Town; their decision is final.

Rawle Dummett
Purchasing Agent
Town of Waterford

SCOPE OF WORK

This Contract consists of the removal, replacement and/or rehabilitation of HVAC and electrical systems at the Evergreen Avenue and Blue Hills Sewer Pump Stations in the Town of Waterford. The project involves demolition and modification to existing piping, fans, boilers, ductwork and electrical conduit and wiring as well as the installation of new HVAC and plumbing items and equipment.

The requirements for bidders under this contract, including all applicable permit and insurance requirements of the Town of Waterford, are explained in the bidding documents. A completed Bid Form must be submitted with the Bid. The Town will enter into a purchase order agreement with the selected bidder.

The work shall be substantially completed within sixty (60) days after the Contract Time commences to run.

TOWN OF WATERFORD
INFORMATION AND GENERAL REQUIREMENTS TO BIDDERS

1. Sealed bids (**one ORIGINAL & TWO copies**) on the attached Bid Forms will be received at the Office of the Purchasing Agent, Town Hall, 15 Rope Ferry Rd Waterford, Connecticut 06385. At the designated time of opening, they will be publicly opened, read, recorded and placed on file. Bids may be mailed or hand-delivered by the specified time. **Packets received after designated time will not be accepted. Time clock in the Finance office is the official time clock.** A mailed Bid shall be addressed to the above address and must arrive in the Purchasing Office and be stamped prior to the date and time of Bid Opening.
2. The envelope enclosing your bid should be clearly marked on its front by bid number, time of bid opening and date.
3. Whenever it is deemed to be in the best interest of the Town, The Town of Waterford reserves the right to reject any or all bids, in whole or in part, and to waive technical defects, irregularities or any informality in any bid when such action is deemed in the best interest of the Town; their decision is final.
4. The contract will be generally awarded to the most qualified, lowest and responsive bidder to meet specifications unless otherwise specified.
5. Bids will be carefully evaluated as to conformance with stated specifications.
6. Specifications must be submitted complete in every detail, and when requested, samples shall be provided. If a bid involves any exception from stated specifications, they must be clearly noted as exceptions, underlined, and attached to the bid.
7. The Bid Documents contain the provisions required for the requested item. Information obtained from an officer, agent, or employee of the Town or any other person shall not affect the risks or obligations assumed by the Bidder or relieve him/her from fulfilling any of the conditions of the Bid.
8. Each bidder is held responsible for the examination and/or to have acquainted themselves with any conditions at the job site which would affect their work before submitting a bid. Failure to meet these criteria shall not relieve the Bidder of the responsibility of completing the Bid without extra cost to the Town of Waterford.
9. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No bidder may withdraw a bid within ninety (90) days after the actual date of the opening thereof. Should there be reasons why a Bid cannot be awarded within the specified period; the time may be extended by mutual agreement between the Town and the bidder.

10. Each bid must be accompanied by a bid bond payable to the Town for five percent (5%) of the total amount of the bid. The bid bond of the successful bidder will be retained until the payment bond and performance bond have been executed and approved, after which it will be returned. A certified check may be used in lieu of a bid bond. The Town of Waterford will not be liable for the accrual of any interest on any certified check submitted.
11. A 100% Performance and Payment bonds are required of the successful bidder. This bond shall cover all aspects of the specification and shall be delivered to the Purchasing Agent prior to the issuance of a purchase order. This submission must be received within fifteen days of contract award. Bonds must meet the following requirements: Corporation - must be signed by an official of the corporation above their official title and the corporate seal must be affixed over the signature; Firm or Partnership - must be signed by all the partners and indicate they are “doing business as”; Individual - must be signed by the owner and indicated as “Owner”. The surety company executing the bond or countersigning **must be licensed in Connecticut and an official of the surety company** must sign the bond with the corporate seal affixed over their signature. Signatures of two witnesses for both the principal and the surety must appear on the bond. Power of attorney for the official signing the bond for the surety company must be submitted with the bond. The Performance and Payment Bonds will be returned upon completion and acceptance of the job.
12. The bidder agrees and warrants that in the submission of this sealed bid, they will uphold the Town of Waterford’s commitment to following Connecticut State and Federal law ensuring full compliance with Title VI of the Civil Rights Act of 1964 which affirms that no person or group of persons is excluded from participation, denied benefits, or otherwise subjected to discrimination or permits discrimination under any program or activity or any service rendered to the public, on the grounds of race, color, creed, religion, national origin, sex, age or disability. Unless it is shown by such bidder that such disability prevents performance of that which must be done to successfully fulfill the terms of this sealed bid or in any manner which is prohibited by the laws of the United States or the State of Connecticut. The bidder further agrees to provide the Connecticut Commission on Human Rights and Opportunities with such information requested by the Commission concerning the employment practices and procedures of the bidder. An Affirmative Action Statement will be required by the successful bidder.
13. Bidder agrees to comply with all of the latest Federal, State and OSHA Safety Standards and Regulations and certifies that all work required in this bid will conform to and comply with said standards and regulations. Bidder further agrees to indemnify and hold harmless the Town for all damages assessed against the Town as a result of Bidder's failure to comply with said standards and/or regulations.
14. The Town of Waterford is exempt from Excise, Transportation and Sales taxes imposed by the Federal Government and/or State of Connecticut. Such taxes

must not be included in proposal prices. Exemption certificates will be provided upon request.

15. By submitting a proposal, Vendors/Bidders certify that the proposal is made independently and without collusion, agreement, understanding, or planned course of action with any other Vendor/Bidder and that the contents of the proposal shall not be disclosed to anyone other than their employees, agents, or sureties prior to the official opening. Non-Collusion Statement to be filled out.
16. The Bidder, when applicable, agrees to pay its labor force Prevailing Wage Rates and to comply with all Laws, Regulations and Ordinances regarding these wage rates and the recording of them set forth by the Connecticut Department of Labor. Where the total cost of the project, including all current and future change orders and addenda, exceeds \$100,000.00 then prevailing wage rates shall apply. All current wage information may be accessed online from the CT Dept. of Labor website at www.ctdol.state.ct.us.
The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.
Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.
It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.
Contracting Agency (Town of Waterford) is under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.
17. **Under all circumstances, contractor shall be responsible for any increases in prevailing wage during the duration of the project, and the town will not agree to any change order request based solely on an increase in prevailing wages by the state during the pendency of the contract between the successful bidder and the town.**
18. Vendors shall observe and comply with all Federal, State and local laws, ordinances and regulations. Vendors shall indemnify and save harmless the Town, all of its officers, agents and servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation or negligence whether by the bidder, his employees, his consultant and/or their employees.
19. Bidders are responsible for checking the Town of Waterford website at <http://www.waterfordct.org/depts/finance/purchasing.htm> for any addenda and updates to the Bid.
20. All correspondence regarding any purchase made by the Town of Waterford shall reference the Town's purchase order number. Each shipping container shall clearly indicate both Town purchase order number and item number.
21. **Non Resident Contractors (IF APPLICABLE)** Upon award Non Resident Contractors are required to follow all requirements for the State of Connecticut,

Department of Revenue Services (DRS) for Non-Resident Contractors, to ensure that Employment Taxes and other applicable taxes are being paid by Contractors. See State of Connecticut **Notice SN 2012 (2)**.

22. Bidder shall include on a sheet(s) attached to its proposal a complete disclosure of all past and pending mediation, arbitration and litigation cases that the bidder or its principals (regardless of their place of employment) have been involved in for the most recent five years. Please include a statement of the issues in dispute and their resolution. Acceptability of Bidder based upon this disclosure shall lie solely with the Town.
23. The Town of Waterford is dedicated to waste reduction and the practice of using and promoting the use of recycled and environmentally preferable products. Bidders are encouraged to submit bids responses that are printed double-sided (except for the signed proposal page) on recycled paper, and to use paper dividers to organize the bid for review. All bid pages should be secured with a binder clip, staple or elastic band. We appreciate your efforts towards a greener environment.
24. Catalogue Reference - Unless expressly stated otherwise, any and all reference to commercial types, sales, trade names and catalogues are intended to be descriptive only and not restrictive; the intent is to indicate the kind and quality of the articles that will be acceptable. Bids on other equivalent makes, or with reference to other catalogue items will be considered. The bidder is to clearly state exactly what will be furnished. Where possible and feasible, submit an illustration, descriptive material, and/or product sample.
25. Property Damage - The Contractor shall be responsible for repair of any damage to Town of Waterford and Board of Education's property and restoration of any facility damage beyond normal wear and tear, caused by Contractor's activities. Repair and restoration shall be to the satisfaction of the Town of Waterford and Board of Education. Any repair or restoration of these damages shall be performed at no cost to the Town of Waterford and Board of Education.
26. A statement may be requested of the successful Bidder's financial resources, his experience and his organization and equipment available to complete the work. The Town of Waterford shall have the right to take such steps as deems necessary to determine the ability of the Bidder to perform the work. The Bidder shall furnish all information and data for this purpose as requested. No awarded shall be made to any bidder that is in default of payment to the Town for any reason.
27. The successful Bidder agrees to be bound by its bid, unless specifically excepted. The bid will be incorporated into the contract to be negotiated between the Town of Waterford and the Bidder. A contract will be entered into with contractor. Bids to be considered must be submitted on the Bid Sheets contained in this packet.

28. Bidders should be advised that should budgetary constraints dictate part and/or all of the items listed in this proposal might be rejected. The decision shall be final and not subject to recourse by the Bidder.
29. Bidder or its principals, regardless of their place of employment, shall not have been convicted of, nor entered any plea of guilty, or nolo contendere, or otherwise have been found civilly liable or criminally responsible for any criminal offense or civil action. Bidder shall not be in violation of any State or local ethics standards or other offenses arising out of the submission of bids or proposals, or performance of work on public works projects or contracts.
30. **Vendors are asked to register on our Web Site through the vendor link**
31. All Questions must be submitted in writing to the purchasing agent via email at rdummett@waterfordct.org.
32. **Bid Pricing** - If applicable Unit prices are to be written in both words and figures. In case of discrepancy, the unit price shown in words will govern.
33. If at any time of the scheduled Bid opening, Town Hall or the Office of Procurement is closed due to uncontrolled events such as fire, snow, ice, wind or building evacuation, the Bid opening will be postponed until 2:00 p.m. the next business day. Bidders are reminded to check the web site for updates and information or email the purchasing agent at rdummett@waterfordct.org. Proposals will be accepted until that date and time.
34. **Security and Identification** - The vendor shall take all measures necessary to comply and to ensure the employees of Contractor comply with the security rules and regulations of the Town of Waterford and all Federal, State and local rules, laws and regulations. ***IT IS A REQUIREMENT OF THIS CONTRACT THAT ALL EMPLOYEES OF THE CONTRACTOR BE DULY AUTHORIZED TO WORK IN THE UNITED STATES.***
35. Employees serving hereunder shall not use controlled substances not prescribed for them, or illegal substances on or off the Town of Waterford premises, and shall not use alcohol on the Town of Waterford premises nor preceding their work shift, when to do so would in any way affect the performance of the services. Contractor's employees shall not have any criminal record of misdemeanors or felony, and are not permitted to carry weapons into the Town of Waterford premises. The Contractor shall attest in writing, before a Notary, that a background check, to the full extent allowed by law, of employment history and references has been conducted on each employee within four (4) weeks of initial employment and prior to commencing work on Town of Waterford premises. Failure to submit said documentation shall result in rejection of bid.
36. The Town of Waterford shall have the right to request any additional investigative background information including, but not limited to, the employment record of any

personnel assigned to perform the services. The Contractor shall furnish, in writing, such information to the extent allowed by law within (30) calendar days after receipt of written request from the Town Purchasing Agent. The Town of Waterford reserves the right to conduct its own investigation of any employee of the vendor, who, in the opinion of the Town of Waterford is not performing the services in a proper manner, or who is incompetent, disorderly, abusive, dangerous, or disruptive or does not comply with the rules and regulations of the Town of Waterford. Such removal shall in no way be interpreted to require dismissal or other disciplinary action of the employee by Contractor.

37. The Contractor shall establish, implement and maintain procedures and controls to ensure that each employee of the Contractor complies with all applicable provisions of the contract and all site rules and practices of the Town of Waterford.

38. Rights Reserved To the Town - The Town reserves the right to award in part, to reject any and all, in whole or in part, for misrepresentation or if the respondent is in default of any prior Town contract, or if the Respondent limits or modifies any of the terms and conditions and/or specifications of the Request The Town also reserves the right to waive technical defects, irregularities and omissions if, in its judgment, the best interest of the Town will be served.

INSURANCE REQUIREMENTS - Within five days of contract award, the awarded vendor shall provide a Certificate of Insurance in accordance with the following requirements: Contractor/Vendor will agree to maintain in force at all times during which work/services are to be performed, the following minimum limits of insurance coverage. Coverage will include the bidder and all of its agents, employees and sub-contractors and other providers of services and shall name the **Town of Waterford, its employees and agents as an Additional Insured** on a primary and non-contributory basis to all policies, except Workers Compensation. **All policies shall also include a Waiver of Subrogation.** The insurance company(ies) must be licensed with the State of Connecticut and have a Financial Strength Rating of “A-” or higher and a Financial Size Rating of VIII or higher from A.M. Best Company.

		Minimum Limits
General Liability	Each Occurrence	\$1,000,000
	General Aggregate	\$2,000,000
	Products/Completed Operations Aggregate	\$2,000,000
Auto Liability	Combined Single Limit Each Accident	\$1,000,000
Umbrella (Excess Liability)	Each Occurrence	\$1,000,000
	Aggregate	\$1,000,000
Workers' Compensation & Employers' Liability	Work Comp	Statutory Limits
	EL Each Accident	\$1,000,000
	EL Disease Each Employee	\$1,000,000
	EL Disease Policy Limit	\$1,000,000

A Certificates of Insurance documenting the coverage listed above must be presented to The Town of Waterford prior to the commencing of any work/service. The Contractor/Vendor also agrees to provide replacement and/or renewal certificates at least 30 days prior to the expiration of each policy.

If any policy is written on a “Claims Made” basis, the policy must be continually renewed for a minimum of two (2) years following the completion date of the work/service. If the claims-made policy is replaced and/or the retroactive date is changed, then the expiring policy must be endorsed to extend the reporting period for claims for two (2) years from the completion date.

FIFTEEN ROPE FERRY ROAD



WATERFORD, CT 06385-2886

**TOWN OF WATERFORD
NON-COLLUSION STATEMENT**

“The undersigned affirms that they are duly authorized to execute this contract, that this company, corporation, firm, partnership or individual has not prepared this bid in collusion with any other bidder, and that the contents of this bid as to prices, terms or conditions of said bid have not been communicated by the undersigned nor by any employee or agent to any other person engaged in this type of business prior to the official opening of this bid.”

We understand that this proposal must be signed by an authorized agent of our company to constitute a valid proposal.

Date: _____

Name of Company: _____

Name and Title of Agent: _____

By (SIGNATURE): _____

Address: _____

Telephone Number: _____

AFFIRMATIVE ACTION STATEMENT

NOTE: IF YOUR COMPANY HAS LESS THAN 10 EMPLOYEES, OR HAS COMPLETED THIS SAME FORM WITHIN 1 YEAR, YOU MAY DISREGARD THE FOLLOWING EQUAL EMPLOYMENT/AFFIRMATIVE ACTION SECTION, EXCEPT AS NOTED.

- OR: (1) The number of employees _____
- (2) Completed this form within one year _____ Yes _____ No

FOR SEALED BIDS: If your company has completed this form within one year Please forward a photocopy of the initial form with your bid. If significant Changes have taken place within the past year, please update the information on this form.

REQUIREMENT – Any vendor/bidder seeking to do business with the Town of Waterford must, upon request, supply the Town and/or the Waterford Human Resources with any information concerning the Affirmative Action/Equal Employment practices of the vendor/bidder, which the Town and/or Commission deems necessary in fulfilling its charge. Failure to supply such information, when requested, will result in the termination of any further transactions between the vendor/bidder and the Town of Waterford.

COMPANY NAME AND ADDRESS

TYPE OF BUSINESS

TYPE OF ORGANIZATION

_____ Corporation _____ Partnership _____ Individual

If unit filing this application is not the above-named company, give the name, address, and telephone number of reporting unit. (Branch, agent, representative).

FIFTEEN ROPE FERRY ROAD



WATERFORD, CT 06385-2886

**BID FORM
Evergreen Avenue and Blue Hill
Pump Stations HVAC Improvements
BID # 21-100**

VENDOR NAME AND ADDRESS

PRINTED NAME AND TITLE OF VENDOR'S AGENT

PHONE AND FACSIMILE NUMBERS, E-MAIL ADDRESS

I _____, _____ of the
Name Position

above named firm hereby submit the following bid in accordance with Town of Waterford specifications.

SIGNATURE

DATE

PROJECT IDENTIFICATION:	Evergreen Avenue and Blue Hills Pump Stations HVAC Improvements
THIS BID IS SUBMITTED TO:	Town of Waterford Connecticut 15 Rope Ferry Road Waterford, Connecticut 06385

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a purchase order agreement with the Town of Waterford at the stipulated price indicated in this bid.
2. Bidder accepts all of the terms and conditions of the Advertisement or Invitation to Bid. This Bid will remain subject to acceptance for 90 days after the day of Bid opening.

3. BIDDER has familiarized itself with the nature and extent of the Bid Documents including any Addenda (acknowledge receipt of any and all Addenda by listing the date and Addenda Number where indicated below), Work, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

Addenda
Date

Addenda
Number

4. BIDDER has given ENGINEER written notice of all conflicts, errors or discrepancies that it has discovered in the Bid Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER.
5. BIDDER certifies that the Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.
6. BIDDER understands that the OWNER reserves the right to reject any or all bids.
7. Bidder will complete the Work described in the Contract Documents for the following price(s):

BID SCHEDULE

Item No.	Quantity	Brief Description of Item with Unit Bid Price in Words	Unit Bid In Figures	Amount In Figures
1	1 L.S.	Evergreen Avenue Pump Station HVAC/Electrical Improvements all-inclusive The Sum of \$ _____	\$ _____	\$ _____
		Per Lump Sum		
2	1 L.S.	Blue Hills Pump Station HVAC/Electrical Improvements all-inclusive less Item #3 The Sum of \$ _____	\$ _____	\$ _____
		Per Lump Sum		
3	1 L.S.	Blue Hills Pump Station HVAC-Provide and install ductwork modifications to HV-1 The Sum of \$ _____	\$ _____	\$ _____
		Per Lump Sum		
4	Allowance	Owners System Integrator Allowance The Sum of \$ <u>five thousand dollars</u>	\$ <u>5,000</u>	\$ <u>5,000</u>
		Amount in Words		

TOTAL BID: Total of Items 1 through 4 above.

_____ (\$ _____)
 _____ (use figures)
 _____ (use words)

8. Communications concerning this Bid shall be addressed to:
 Rawle Dummett, Purchasing Agent
 Finance Office, 15 Rope Ferry Road
 Waterford, Connecticut 06385
 Phone: (860) 444-5842
 Fax: (860) 440-0579
rdummett@waterfordct.org

CONTRACTOR INFORMATION SHEETS

(These sheets must be completed and included with Bid)

COMPANY NAME: _____

ADDRESS: _____

ESTABLISHED: _____

(Month) (Year)

TYPE OF ORGANIZATION: (Circle One)

- A) Individual
- B) Partnership
- C) Corporation
- D) Joint Venture
- E) Other _____

(Specify)

(If Applicable)

FORMER FIRM NAME(S) YEARS IN BUSINESS

YEARS OF WORK IN A RELATED FIELD: _____

(Described Any Related Work)

EQUIPMENT AND EMPLOYEES:

Provide a list (attached to this sheet) of equipment and employees anticipated to be utilized for this work.

USE OF SUBCONTRACTORS:

To provide all the services listed in the specifications, would any services be handled by subcontractors? _____ Yes/No If "Yes", please explain:

Subcontractor Name(s): _____

PROJECT MANAGER: _____

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Minimum Rates and Classifications for Building Construction

ID# 21-19027

**Connecticut Department of Labor
Wage and Workplace Standards**

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay

Project Number: Waterford

Project Town: Waterford

State#: Waterford

FAP#: Waterford

Project: Pump Station HVAC Upgrades (Waterford)

CLASSIFICATION	Hourly	Benefits
1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters.**See Laborers Group 7**		
1c) Asbestos Worker/Heat and Frost Insulator	42.07	30.99
2) Boilermaker	38.34	26.01
3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	35.71	33.31 + a
3b) Tile Setter	34.9	25.87
3c) Terrazzo Mechanics and Marble Setters	31.69	22.35
3d) Tile, Marble & Terrazzo Finishers	26.7	21.75
3e) Plasterer	33.48	32.06
-----LABORERS-----		
4) Group 1: Laborers (common or general), acetylene burners, concrete specialists, wrecking laborers, fire watchers.	31.0	22.15
4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofers/mixer/nozzleman (Person running mixer and spraying fireproof only).	31.25	22.15

Project: Pump Station HVAC Upgrades (Waterford)

4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	31.5	22.15
4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew who primary task is to actually perform the mating of pipe sections) P6 and P7 rate is \$26.80.	32.0	22.15
4d) Group 5: Air track operator, sand blaster and hydraulic drills.	31.75	22.15
4e) Group 6: Blasters, nuclear and toxic waste removal.	34.0	22.15
4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	32.0	22.15
4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	29.28	22.15
4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	28.74	22.15
4i) Group 10: Traffic Control Signalman	18.0	22.15
5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	34.53	25.64
5a) Millwrights	34.94	26.19
6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	39.0	29.91+3% of gross wage
7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	55.12	34.765+a+b
-----LINE CONSTRUCTION-----		
Groundman	26.5	6.5% + 9.00
Linemen/Cable Splicer	48.19	6.5% + 22.00
8) Glazier (Trade License required: FG-1,2)	39.18	22.55 + a

As of: January 12, 2021

9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	36.67	37.62 + a
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----OPERATORS----

Group 1: Crane handling or erecting structural steel or stone, hoisting engineer 2 drums or over, front end loader (7 cubic yards or over), work boat 26 ft. and over and Tunnel Boring Machines. (Trade License Required)	42.45	25.30 + a
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Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver (\$3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required)	42.11	25.30 + a
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Group 3: Excavator; Backhoe/Excavator under 2 cubic yards; Cranes (under 100 ton rated capacity), Grader/Blade; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar); Grader Operator; Bulldozer Fine Grade. (slopes, shaping, laser or GPS, etc.). (Trade License Required)	41.32	25.30 + a
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Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper).	40.91	25.30 + a
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Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24	40.28	25.30 + a
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Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller; Pile Testing Machine.	40.28	25.30 + a
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Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	39.95	25.30 + a
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Group 7: Asphalt roller, concrete saws and cutters (ride on types), vermeer concrete cutter, Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24	39.59	25.30 + a
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Group 8: Mechanic, grease truck operator, hydroblaster; barrier mover; power stone spreader; welding; work boat under 26 ft.; transfer machine.	39.17	25.30 + a
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Group 9: Front end loader (under 3 cubic yards), skid steer loader regardless of attachments, (Bobcat or Similar): forklift, power chipper; landscape equipment (including Hydroseeder).	38.71	25.30 + a
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Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	36.54	25.30 + a
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Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	36.54	25.30 + a
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Project: Pump Station HVAC Upgrades (Waterford)

Group 12: Wellpoint operator.	36.48	25.30 + a
Group 13: Compressor battery operator.	35.86	25.30 + a
Group 14: Elevator operator; tow motor operator (solid tire no rough terrain).	34.66	25.30 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	34.23	25.30 + a
Group 16: Maintenance Engineer/Oiler.	33.54	25.30 + a
Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	38.11	25.30 + a
Group 18: Power safety boat; vacuum truck; zim mixer; sweeper; (Minimum for any job requiring a CDL license).	35.53	25.30 + a
-----PAINTERS (Including Drywall Finishing)-----		
10a) Brush and Roller	35.62	22.55
10b) Taping Only/Drywall Finishing	36.37	22.55
10c) Paperhanger and Red Label	36.12	22.55
10e) Blast and Spray	38.62	22.55
11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	44.63	32.95
12) Well Digger, Pile Testing Machine	37.26	24.05 + a
13) Roofer (composition)	38.4	21.89
14) Roofer (slate & tile)	38.9	21.89
15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	38.9	39.46
16) Pipefitter (Including HVAC work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	44.63	32.95

As of: January 12, 2021

-----TRUCK DRIVERS-----

17a) 2 Axle	29.86	25.79 + a
17b) 3 Axle, 2 Axle Ready Mix	29.97	25.79 + a
17c) 3 Axle Ready Mix	30.03	25.79 + a
17d) 4 Axle, Heavy Duty Trailer up to 40 tons	30.08	25.79 + a
17e) 4 Axle Ready Mix	30.13	25.79 + a
17f) Heavy Duty Trailer (40 Tons and Over)	30.35	25.79 + a
17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	30.13	25.79 + a
18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	45.92	26.08 + a
19) Theatrical Stage Journeyman	25.76	7.34

Project: Pump Station HVAC Upgrades (Waterford)

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional \$1.25 per hour for truck drivers.*

***Note: Hazardous waste premium \$3.00 per hour over classified rate*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra \$4.00 premium in addition to the hourly wage rate and benefit contributions:

- 1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)***
- 2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson***
- 3) Cranes (under 100 ton rated capacity)***

Crane with 150 ft. boom (including jib) - \$1.50 extra

Crane with 200 ft. boom (including jib) - \$2.50 extra

Crane with 250 ft. boom (including jib) - \$5.00 extra

Crane with 300 ft. boom (including jib) - \$7.00 extra

Crane with 400 ft. boom (including jib) - \$10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

As of: January 12, 2021

Project: Pump Station HVAC Upgrades (Waterford)

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: January 12, 2021

Important Information:

For use with Building, Heavy/Highway, and Residential

Welders: Rate for craft to which welding is incidental.

*Note: Hazardous waste removal work receives additional \$1.25 per hour for truck drivers.

**Note: Hazardous waste premium \$3.00 per hour over classified rate.

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra \$4.00 premium in addition to the hourly wage rate and benefit contributions:

- 1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)
- 2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson
- 3) Cranes (under 100 ton rated capacity)

Crane with boom including jib, 150 feet - \$1.50 extra.

Crane with boom including jib, 200 feet - \$2.50 extra.

Crane with boom including jib, 250 feet - \$5.00 extra.

Crane with boom including jib, 300 feet - \$7.00 extra.

Crane with boom including jib, 400 feet - \$10.00 extra.

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

- Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyman instructing and supervising the work of one apprentice in a specific trade.

Connecticut General Statute Section 31-55a: Annual Adjustments to wage rates by contractors doing state work

- The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.
- Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.
- It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.
- The annual adjustments will be posted on the Department of Labor's Web page: www.ctdol.state.ct.us.
- The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.
- All subsequent annual adjustments will be posted on our Web Site for contractor access.

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage.

- All Persons who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.
- All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)
- Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.



Opportunity * Guidance * Support



THIS IS A PUBLIC WORKS PROJECT

Covered by the

PREVAILING WAGE LAW

CT General Statutes Section 31-53

**If you have QUESTIONS regarding your wages
CALL (860) 263-6790**

Section 31-55 of the CT State Statutes requires every contractor or subcontractor performing work for the state to post in a prominent place the prevailing wages as determined by the Labor Commissioner.

Sec. 31-53b. Construction safety and health course. New miner training program. Proof of completion required for mechanics, laborers and workers on public works projects. Enforcement. Regulations. Exceptions. (a) Each contract for a public works project entered into on or after July 1, 2009, by the state or any of its agents, or by any political subdivision of the state or any of its agents, described in subsection (g) of section 31-53, shall contain a provision requiring that each contractor furnish proof with the weekly certified payroll form for the first week each employee begins work on such project that any person performing the work of a mechanic, laborer or worker pursuant to the classifications of labor under section 31-53 on such public works project, pursuant to such contract, has completed a course of at least ten hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration or, has completed a new miner training program approved by the Federal Mine Safety and Health Administration in accordance with 30 CFR 48 or, in the case of telecommunications employees, has completed at least ten hours of training in accordance with 29 CFR 1910.268.

(b) Any person required to complete a course or program under subsection (a) of this section who has not completed the course or program shall be subject to removal from the worksite if the person does not provide documentation of having completed such course or program by the fifteenth day after the date the person is found to be in noncompliance. The Labor Commissioner or said commissioner's designee shall enforce this section.

(c) Not later than January 1, 2009, the Labor Commissioner shall adopt regulations, in accordance with the provisions of chapter 54, to implement the provisions of subsections (a) and (b) of this section. Such regulations shall require that the ten-hour construction safety and health courses required under subsection (a) of this section be conducted in accordance with federal Occupational Safety and Health Administration Training Institute standards, or in accordance with Federal Mine Safety and Health Administration Standards or in accordance with 29 CFR 1910.268, as appropriate. The Labor Commissioner shall accept as sufficient proof of compliance with the provisions of subsection (a) or (b) of this section a student course completion card issued by the federal Occupational Safety and Health Administration Training Institute, or such other proof of compliance said commissioner deems appropriate, dated no earlier than five years before the commencement date of such public works project.

(d) This section shall not apply to employees of public service companies, as defined in section 16-1, or drivers of commercial motor vehicles driving the vehicle on the public works project and delivering or picking up cargo from public works projects provided they perform no labor relating to the project other than the loading and unloading of their cargo.

(P.A. 06-175, S. 1; P.A. 08-83, S. 1.)

History: P.A. 08-83 amended Subsec. (a) by making provisions applicable to public works project contracts entered into on or after July 1, 2009, replacing provision re total cost of work with reference to Sec. 31-53(g), requiring proof in certified payroll form that new mechanic, laborer or worker has completed a 10-hour or more construction safety course and adding provision re new miner training program, amended Subsec. (b) by substituting "person" for "employee" and adding "or program", amended Subsec. (c) by adding "or in accordance with Federal Mine Safety and Health Administration Standards" and setting new deadline of January 1, 2009, deleted former Subsec. (d) re "public building", added new Subsec. (d) re exemptions for public service company employees and delivery drivers who perform no labor other than delivery and made conforming and technical changes, effective January 1, 2009.

Informational Bulletin

THE 10-HOUR OSHA CONSTRUCTION SAFETY AND HEALTH COURSE

(applicable to public building contracts entered into *on or after July 1, 2007*, where the total cost of all work to be performed is at least \$100,000)

- (1) This requirement was created by Public Act No. 06-175, which is codified in Section 31-53b of the Connecticut General Statutes (pertaining to the prevailing wage statutes);
- (2) The course is required for public building construction contracts (projects funded in whole or in part by the state or any political subdivision of the state) entered into on or after July 1, 2007;
- (3) It is required of private employees (not state or municipal employees) and apprentices who perform manual labor for a general contractor or subcontractor on a public building project where the total cost of all work to be performed is at least \$100,000;
- (4) The ten-hour construction course pertains to the ten-hour Outreach Course conducted in accordance with federal OSHA Training Institute standards, and, for telecommunications workers, a ten-hour training course conducted in accordance with federal OSHA standard, 29 CFR 1910.268;
- (5) The internet website for the federal OSHA Training Institute is http://www.osha.gov/fso/ote/training/edcenters/fact_sheet.html;
- (6) The statutory language leaves it to the contractor and its employees to determine who pays for the cost of the ten-hour Outreach Course;
- (7) Within 30 days of receiving a contract award, a general contractor must furnish proof to the Labor Commissioner that all employees and apprentices performing manual labor on the project will have completed such a course;
- (8) Proof of completion may be demonstrated through either: (a) the presentation of a *bona fide* student course completion card issued by the federal OSHA Training Institute; *or* (2) the presentation of documentation provided to an employee by a trainer certified by the Institute pending the actual issuance of the completion card;
- (9) Any card with an issuance date more than 5 years prior to the commencement date of the construction project shall not constitute proof of compliance;

- (10) Each employer shall affix a copy of the construction safety course completion card to the certified payroll submitted to the contracting agency in accordance with Conn. Gen. Stat. § 31-53(f) on which such employee's name first appears;
- (11) Any employee found to be in non-compliance shall be subject to removal from the worksite if such employee does not provide satisfactory proof of course completion to the Labor Commissioner by the fifteenth day after the date the employee is determined to be in noncompliance;
- (12) Any such employee who is determined to be in noncompliance may continue to work on a public building construction project for a maximum of fourteen consecutive calendar days while bringing his or her status into compliance;
- (13) The Labor Commissioner may make complaint to the prosecuting authorities regarding any employer or agent of the employer, or officer or agent of the corporation who files a false certified payroll with respect to the status of an employee who is performing manual labor on a public building construction project;
- (14) The statute provides the minimum standards required for the completion of a safety course by manual laborers on public construction contracts; any contractor can exceed these minimum requirements; and
- (15) Regulations clarifying the statute are currently in the regulatory process, and shall be posted on the CTDOL website as soon as they are adopted in final form.
- (16) Any questions regarding this statute may be directed to the Wage and Workplace Standards Division of the Connecticut Labor Department via the internet website of <http://www.ctdol.state.ct.us/wgwkstnd/wgemenu.htm>; or by telephone at (860)263-6790.

THE ABOVE INFORMATION IS PROVIDED EXCLUSIVELY AS AN EDUCATIONAL RESOURCE, AND IS NOT INTENDED AS A SUBSTITUTE FOR LEGAL INTERPRETATIONS WHICH MAY ULTIMATELY ARISE CONCERNING THE CONSTRUCTION OF THE STATUTE OR THE REGULATIONS.

November 29, 2006

Notice
To All Mason Contractors and Interested Parties
Regarding Construction Pursuant to Section 31-53 of the
Connecticut General Statutes (Prevailing Wage)

The Connecticut Labor Department Wage and Workplace Standards Division is empowered to enforce the prevailing wage rates on projects covered by the above referenced statute.

Over the past few years the Division has withheld enforcement of the rate in effect for workers who operate a forklift on a prevailing wage rate project due to a potential jurisdictional dispute.

The rate listed in the schedules and in our Occupational Bulletin (see enclosed) has been as follows:

Forklift Operator:

- **Laborers (Group 4) Mason Tenders** - operates forklift solely to assist a mason to a maximum height of nine feet only.
- **Power Equipment Operator (Group 9)** - operates forklift to assist any trade and to assist a mason to a height over nine feet.

The U.S. Labor Department conducted a survey of rates in Connecticut but it has not been published and the rate in effect remains as outlined in the above Occupational Bulletin.

Since this is a classification matter and not one of jurisdiction, effective January 1, 2007 the Connecticut Labor Department will enforce the rate on each schedule in accordance with our statutory authority.

Your cooperation in filing appropriate and accurate certified payrolls is appreciated.

STATUTE 31-55a

- SPECIAL NOTICE -

To: All State and Political Subdivisions, Their Agents, and Contractors

Connecticut General Statute 31-55a - Annual adjustments to wage rates by contractors doing state work.

Each contractor that is awarded a contract on or after October 1, 2002, for (1) the construction of a state highway or bridge that falls under the provisions of section 31-54 of the general statutes, or (2) the construction, remodeling, refinishing, refurbishing, rehabilitation, alteration or repair of any public works project that falls under the provisions of section 31-53 of the general statutes shall contact the Labor Commissioner on or before July first of each year, for the duration of such contract, to ascertain the prevailing rate of wages on an hourly basis and the amount of payment or contributions paid or payable on behalf of each mechanic, laborer or worker employed upon the work contracted to be done, and shall make any necessary adjustments to such prevailing rate of wages and such payment or contributions paid or payable on behalf of each such employee, effective each July first.

- The prevailing wage rates applicable to any contract or subcontract awarded on or after October 1, 2002 are subject to annual adjustments each July 1st for the duration of any project which was originally advertised for bids on or after October 1, 2002.
- Each contractor affected by the above requirement shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.
- It is the **contractor's** responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's Web Site. The annual adjustments will be posted on the Department of Labor Web page: www.ctdol.state.ct.us. For those without internet access, please contact the division listed below.
- The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project. All subsequent annual adjustments will be posted on our Web Site for contractor access.

Any questions should be directed to the Contract Compliance Unit, Wage and Workplace Standards Division, Connecticut Department of Labor, 200 Folly Brook Blvd., Wethersfield, CT 06109 at (860)263-6790.

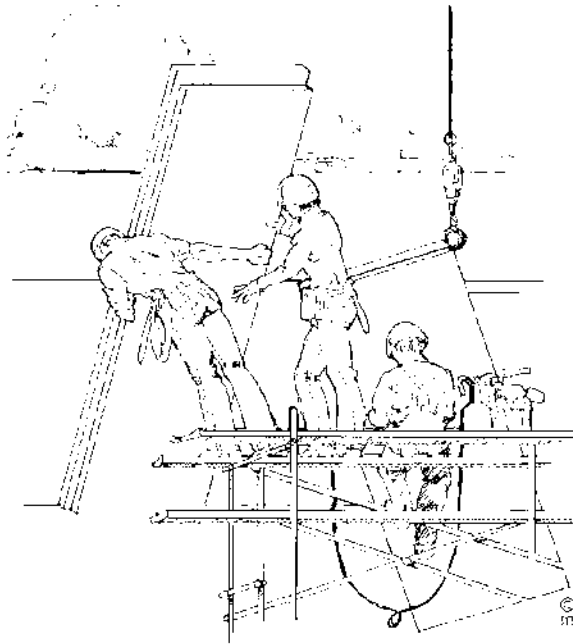
~NOTICE~

TO ALL CONTRACTING AGENCIES

Please be advised that Connecticut General Statutes Section 31-53, requires the contracting agency to certify to the Department of Labor, the total dollar amount of work to be done in connection with such public works project, regardless of whether such project consists of one or more contracts.

Please find the attached “Contracting Agency Certification Form” to be completed and returned to the Department of Labor, Wage and Workplace Standards Division, Public Contract Compliance Unit.

 Inquiries can be directed to (860)263-6543.



CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION
CONTRACT COMPLIANCE UNIT

CONTRACTING AGENCY CERTIFICATION FORM

I, _____, acting in my official capacity as _____,
authorized representative title

for _____, located at _____,
contracting agency address

do hereby certify that the total dollar amount of work to be done in connection with
_____, located at _____,
project name and number address

shall be \$_____, which includes all work, regardless of whether such project
consists of one or more contracts.

CONTRACTOR INFORMATION

Name: _____

Address: _____

Authorized Representative: _____

Approximate Starting Date: _____

Approximate Completion Date: _____

Signature

Date

Return To: Connecticut Department of Labor
Wage & Workplace Standards Division
Contract Compliance Unit
200 Folly Brook Blvd.
Wethersfield, CT 06109

Date Issued: _____

CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION

CONTRACTORS WAGE CERTIFICATION FORM
Construction Manager at Risk/General Contractor/Prime Contractor

I, _____ of _____
Officer, Owner, Authorized Rep. Company Name

do hereby certify that the _____
Company Name

Street

City

and all of its subcontractors will pay all workers on the

Project Name and Number

Street and City

the wages as listed in the schedule of prevailing rates required for such project (a copy of which is attached hereto).

Signed

Subscribed and sworn to before me this _____ day of _____, _____.

Notary Public

Return to:
Connecticut Department of Labor
Wage & Workplace Standards Division
200 Folly Brook Blvd.
Wethersfield, CT 06109

Rate Schedule Issued (Date): _____

[New] In accordance with Section 31-53b(a) of the C.G.S. each contractor shall provide a copy of the OSHA 10 Hour Construction Safety and Health Card for each employee, to be attached to the first certified payroll on the project.

In accordance with Connecticut General Statutes, 31-53 Certified Payrolls with a statement of compliance shall be submitted monthly to the contracting agency.											PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS					Connecticut Department of Labor Wage and Workplace Standards Division 200 Folly Brook Blvd. Wethersfield, CT 06109					
WEEKLY PAYROLL											SUBCONTRACTOR NAME & ADDRESS					WORKER'S COMPENSATION INSURANCE CARRIER					
CONTRACTOR NAME AND ADDRESS:																					
PAYROLL NUMBER	Week-Ending Date	PROJECT NAME & ADDRESS									POLICY #					EFFECTIVE DATE: EXPIRATION DATE:					
PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/FEMALE AND RACE*	WORK CLASSIFICATION	DAY AND DATE						Total ST Hours											BASE HOURLY RATE
				S	M	T	W	TH	F	S		TOTAL FRINGE BENEFIT PLAN CASH			FICA	FEDERAL WITH-HOLDING	STATE WITH-HOLDING	LIST OTHER			
			Trade License Type & Number - OSHA 10 Certification Number	HOURS WORKED EACH DAY						Total O/T Hours											
												\$	1. \$								
												Base Rate	2. \$								
												3. \$									
												4. \$									
												\$	5. \$								
												Cash Fringe	6. \$								
												\$	1. \$								
												Base Rate	2. \$								
												3. \$									
												4. \$									
												\$	5. \$								
												Cash Fringe	6. \$								
												\$	1. \$								
												Base Rate	2. \$								
												3. \$									
												4. \$									
												\$	5. \$								
												Cash Fringe	6. \$								

***FRINGE BENEFITS EXPLANATION (P):**

Bona fide benefits paid to approved plans, funds or programs, except those required by Federal or State Law (unemployment tax, worker’s compensation, income taxes, etc.).

Please specify the type of benefits provided:

- 1) Medical or hospital care _____ 4) Disability _____
- 2) Pension or retirement _____ 5) Vacation, holiday _____
- 3) Life Insurance _____ 6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

For the week ending date of _____,

I, _____ of _____, (hereafter known as Employer) in my capacity as _____ (title) do hereby certify and state:

Section A:

1. All persons employed on said project have been paid the full weekly wages earned by them during the week in accordance with Connecticut General Statutes, section 31-53, as amended. Further, I hereby certify and state the following:

- a) The records submitted are true and accurate;
- b) The rate of wages paid to each mechanic, laborer or workman and the amount of payment or contributions paid or payable on behalf of each such person to any employee welfare fund, as defined in Connecticut General Statutes, section 31-53 (h), are not less than the prevailing rate of wages and the amount of payment or contributions paid or payable on behalf of each such person to any employee welfare fund, as determined by the Labor Commissioner pursuant to subsection Connecticut General Statutes, section 31-53 (d), and said wages and benefits are not less than those which may also be required by contract;
- c) The Employer has complied with all of the provisions in Connecticut General Statutes, section 31-53 (and Section 31-54 if applicable for state highway construction);
- d) Each such person is covered by a worker’s compensation insurance policy for the duration of his employment which proof of coverage has been provided to the contracting agency;
- e) The Employer does not receive kickbacks, which means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided directly or indirectly, to any prime contractor, prime contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a prime contractor in connection with a subcontractor relating to a prime contractor; and
- f) The Employer is aware that filing a certified payroll which he knows to be false is a class D felony for which the employer may be fined up to five thousand dollars, imprisoned for up to five years or both.

2. OSHA~The employer shall affix a copy of the construction safety course, program or training completion document to the certified payroll required to be submitted to the contracting agency for this project on which such persons name first appears.

_____ (Signature) _____ (Title) _____ Submitted on (Date)

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

WEEKLY PAYROLL

PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/ FEMALE AND RACE*	WORK CLASSIFICATION Trade License Type & Number - OSHA 10 Certification Number	DAY AND DATE							Total ST Hours Total O/T Hours	BASE HOURLY RATE TOTAL FRINGE BENEFIT PLAN CASH	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY
				S	M	T	W	TH	F	S					FICA	FEDERAL WITH- HOLDING	STATE WITH- HOLDING	OTHER		
				HOURS WORKED EACH DAY																
											\$	1. \$								
											Base Rate	2. \$								
												3. \$								
											\$	4. \$								
											Cash Fringe	5. \$								
												6. \$								
											\$	1. \$								
											Base Rate	2. \$								
												3. \$								
											\$	4. \$								
											Cash Fringe	5. \$								
												6. \$								
											\$	1. \$								
											Base Rate	2. \$								
												3. \$								
											\$	4. \$								
											Cash Fringe	5. \$								
												6. \$								

*IF REQUIRED

[New] In accordance with Section 31-53b(a) of the C.G.S. each contractor shall provide a copy of the OSHA 10 Hour Construction Safety and Health Card for each employee, to be attached to the first certified payroll on the project.

PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS											Connecticut Department of Labor Wage and Workplace Standards Division 200 Folly Brook Blvd. Wethersfield, CT 06109											
In accordance with Connecticut General Statutes, 31-53 Certified Payrolls with a statement of compliance shall be submitted monthly to the contracting agency.											WEEKLY PAYROLL											
CONTRACTOR NAME AND ADDRESS: Landon Corporation, 15 Connecticut Avenue, Northford, CT 06472						SUBCONTRACTOR NAME & ADDRESS XYZ Corporation 2 Main Street Yantic, CT 06389					WORKER'S COMPENSATION INSURANCE CARRIER Travelers Insurance Company POLICY # #BAC8888928 EFFECTIVE DATE: 1/1/09 EXPIRATION DATE: 12/31/09											
PAYROLL NUMBER	Week-Ending Date	PROJECT NAME & ADDRESS									Total ST Hours	BASE HOURLY RATE	TYPE OF FRINGE BENEFITS Per Hour 1 through 6 (see back)	GROSS PAY FOR ALL WORK PERFORMED THIS WEEK	TOTAL DEDUCTIONS				GROSS PAY FOR THIS PREVAILING RATE JOB	CHECK # AND NET PAY		
		DAY AND DATE							Total O/T Hours	TOTAL FRINGE BENEFIT PLAN CASH					FICA	FEDERAL WITH-HOLDING	STATE WITH-HOLDING	LIST OTHER				
PERSON/WORKER, ADDRESS and SECTION	APPR RATE %	MALE/FEMALE AND RACE*	WORK CLASSIFICATION	S	M	T	W	TH			F	S										
			Trade License Type & Number - OSHA 10 Certification Number	20	21	22	23	24	25	26												
				HOURS WORKED EACH DAY																		
Robert Craft 81 Maple Street Willimantic, CT 06226		M/C	Electrical Lineman E-1 1234567 Owner OSHA 123456		8	8	8	8	8			S-TIME 40	\$ 30.75 Base Rate	1. \$ 5.80 2. \$ 3. \$ 2.01	\$1,582.80				P-xxxx	\$1,582.80	#123 \$ xxx.xx	
Ronald Jones 212 Elm Street Norwich, CT 06360	65%	M/B	Electrical Apprentice OSHA 234567		8	8	8	8	8			S-TIME 40	\$ 19.99 Base Rate	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$	\$1,464.80	xx.xx	xxx.xx	xx.xx	G-xxx	\$1,464.80	#124 \$xxx.xx	
Franklin T. Smith 234 Washington Rd. New London, CT 06320 SECTION B		M/H	Project Manager			8						S-TIME 8	\$ Base Rate	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$	\$1,500.00	xx.xx	xx.xx	xx.xx	M-xx.x		xxx.xx #125	
												S-TIME	\$ Base Rate	1. \$ 2. \$ 3. \$ 4. \$ 5. \$ 6. \$								
												O-TIME	\$ Cash Fringe									

7/13/2009 *IF REQUIRED
WWS-CP1

*SEE REVERSE SIDE

PAGE NUMBER 1 OF 2

OSHA 10 ~ATTACH CARD TO 1ST CERTIFIED PAYROLL

***FRINGE BENEFITS EXPLANATION (P):**

Bona fide benefits paid to approved plans, funds or programs, except those required by Federal or State Law (unemployment tax, worker's compensation, income taxes, etc.).

Please specify the type of benefits provided:

- 1) Medical or hospital care Blue Cross 4) Disability _____
- 2) Pension or retirement _____ 5) Vacation, holiday _____
- 3) Life Insurance Utopia 6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

For the week ending date of 9/26/09,

I, Robert Craft of XYZ Corporation, (hereafter known as

Employer) in my capacity as Owner (title) do hereby certify and state:

Section A:

1. All persons employed on said project have been paid the full weekly wages earned by them during the week in accordance with Connecticut General Statutes, section 31-53, as amended. Further, I hereby certify and state the following:

- a) The records submitted are true and accurate;
- b) The rate of wages paid to each mechanic, laborer or workman and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as defined in Connecticut General Statutes, section 31-53 (h), are not less than the prevailing rate of wages and the amount of payment or contributions paid or payable on behalf of each such employee to any employee welfare fund, as determined by the Labor Commissioner pursuant to subsection Connecticut General Statutes, section 31-53 (d), and said wages and benefits are not less than those which may also be required by contract;
- c) The Employer has complied with all of the provisions in Connecticut General Statutes, section 31-53 (and Section 31-54 if applicable for state highway construction);
- d) Each such employee of the Employer is covered by a worker's compensation insurance policy for the duration of his employment which proof of coverage has been provided to the contracting agency;
- e) The Employer does not receive kickbacks, which means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided directly or indirectly, to any prime contractor, prime contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a prime contractor in connection with a subcontractor relating to a prime contractor; and
- f) The Employer is aware that filing a certified payroll which he knows to be false is a class D felony for which the employer may be fined up to five thousand dollars, imprisoned for up to five years or both.

2. OSHA~The employer shall affix a copy of the construction safety course, program or training completion document to the certified payroll required to be submitted to the contracting agency for this project on which such employee's name first appears.

Robert Craft owner 10/2/09
 (Signature) (Title) Submitted on (Date)

Section B: Applies to CONNDOT Projects ONLY

That pursuant to CONNDOT contract requirements for reporting purposes only, all employees listed under Section B who performed work on this project are not covered under the prevailing wage requirements defined in Connecticut General Statutes Section 31-53.

Robert Craft owner 10/2/09
 (Signature) (Title) Submitted on (Date)

Note: CTDOL will assume all hours worked were performed under Section A unless clearly delineated as Section B WWS-CP1 as such. Should an employee perform work under both Section A and Section B, the hours worked and wages paid must be segregated for reporting purposes.

*****THIS IS A PUBLIC DOCUMENT***
DO NOT INCLUDE SOCIAL SECURITY NUMBERS**

Information Bulletin ***Occupational Classifications***

The Connecticut Department of Labor has the responsibility to properly determine "job classification" on prevailing wage projects covered under C.G.S. Section 31-53(d).

Note: This information is intended to provide a sample of some occupational classifications for guidance purposes only. It is not an all-inclusive list of each occupation's duties. This list is being provided only to highlight some areas where a contractor may be unclear regarding the proper classification. If unsure, the employer should seek guidelines for CTDOL.

Below are additional clarifications of specific job duties performed for certain classifications:

- **ASBESTOS WORKERS**

Applies all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems.

- **ASBESTOS INSULATOR**

Handle, install apply, fabricate, distribute, prepare, alter, repair, dismantle, heat and frost insulation, including penetration and fire stopping work on all penetration fire stop systems.

- **BOILERMAKERS**

Erects hydro plants, incomplete vessels, steel stacks, storage tanks for water, fuel, etc. Builds incomplete boilers, repairs heat exchanges and steam generators.

- **BRICKLAYERS, CEMENT MASONS, CEMENT FINISHERS, MARBLE MASONS, PLASTERERS, STONE MASONS, PLASTERERS. STONE MASONS, TERRAZZO WORKERS, TILE SETTERS**

Lays building materials such as brick, structural tile and concrete cinder, glass, gypsum, terra cotta block. Cuts, tools and sets marble, sets stone, finishes concrete, applies decorative steel, aluminum and plastic tile, applies cements, sand, pigment and marble chips to floors, stairways, etc.

- **CARPENTERS, MILLWRIGHTS. PILEDRIVERMEN. LATHERS. RESILEINT FLOOR LAYERS, DOCK BUILDERS, DIKERS, DIVER TENDERS**

Constructs, erects, installs and repairs structures and fixtures of wood, plywood and wallboard. Installs, assembles, dismantles, moves industrial machinery. Drives piling into ground to provide foundations for structures such as buildings and bridges, retaining walls for earth embankments, such as cofferdams. Fastens wooden, metal or rockboard lath to walls, ceilings and partitions of buildings, acoustical tile layer, concrete form builder. Applies firestopping materials on fire resistive joint systems only. Installation of curtain/window walls only where attached to wood or metal studs. Installation of insulated material of all types whether blown, nailed or attached in other ways to walls, ceilings and floors of buildings. Assembly and installation of modular furniture/furniture systems. Free-standing furniture is not covered. This includes free standing: student chairs, study top desks, book box desks, computer furniture, dictionary stand, atlas stand, wood shelving, two-position information access station, file cabinets, storage cabinets, tables, etc.

- **LABORER, CLEANING**

- The clean up of any construction debris and the general (heavy/light) cleaning, including sweeping, wash down, mopping, wiping of the construction facility and its furniture, washing, polishing, and dusting.

- **DELIVERY PERSONNEL**

- If delivery of supplies/building materials is to one common point and stockpiled there, prevailing wages are not required. If the delivery personnel are involved in the distribution of the material to multiple locations within the construction site then they would have to be paid prevailing wages for the type of work performed: laborer, equipment operator, electrician, ironworker, plumber, etc.

- An example of this would be where delivery of drywall is made to a building and the delivery personnel distribute the drywall from one "stockpile" location to further sub-locations on each floor. Distribution of material around a construction site is the job of a laborer or tradesman, and not a delivery personnel.

- **ELECTRICIANS**

Install, erect, maintenance, alteration or repair of any wire, cable, conduit, etc., which generates, transforms, transmits or uses electrical energy for light, heat, power or other purposes, including the Installation or maintenance of telecommunication, LAN wiring or computer equipment, and low voltage wiring. ****License required per Connecticut General Statutes: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9.***

- **ELEVATOR CONSTRUCTORS**

Install, erect, maintenance and repair of all types of elevators, escalators, dumb waiters and moving walks. **License required by Connecticut General Statutes: R-1,2,5,6.*

- **FORK LIFT OPERATOR**

Laborers Group 4) Mason Tenders - operates forklift solely to assist a mason to a maximum height of nine (9) feet only.

Power Equipment Operator Group 9 - operates forklift to assist any trade, and to assist a mason to a height over nine (9) feet.

- **GLAZIERS**

Glazing wood and metal sash, doors, partitions, and 2 story aluminum storefronts. Installs glass windows, skylights, store fronts and display cases or surfaces such as building fronts, interior walls, ceilings and table tops and metal store fronts. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers, which require equal composite workforce.

- **IRONWORKERS**

Erection, installation and placement of structural steel, precast concrete, miscellaneous iron, ornamental iron, metal curtain wall, rigging and reinforcing steel. Handling, sorting, and installation of reinforcing steel (rebar). Metal bridge rail (traffic), metal bridge handrail, and decorative security fence installation. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers which require equal composite workforce.

- **INSULATOR**

- Installing fire stopping systems/materials for "Penetration Firestop Systems": transit to cables, electrical conduits, insulated pipes, sprinkler pipe penetrations, ductwork behind radiation, electrical cable trays, fire rated pipe penetrations, natural polypropylene, HVAC ducts, plumbing bare metal, telephone and communication wires, and boiler room ceilings.

- **LABORERS**

Acetylene burners, asphalt rakers, chain saw operators, concrete and power buggy operator, concrete saw operator, fence and guard rail erector (except metal bridge rail (traffic), decorative security fence (non-metal)).

installation.), hand operated concrete vibrator operator, mason tenders, pipelayers (installation of storm drainage or sewage lines on the street only), pneumatic drill operator, pneumatic gas and electric drill operator, powermen and wagon drill operator, air track operator, block paver, curb setters, blasters, concrete spreaders.

- **PAINTERS**

Maintenance, preparation, cleaning, blasting (water and sand, etc.), painting or application of any protective coatings of every description on all bridges and appurtenances of highways, roadways, and railroads. Painting, decorating, hardwood finishing, paper hanging, sign writing, scenic art work and drywall hhg for any and all types of building and residential work.

- **LEAD PAINT REMOVAL**

- Painter's Rate

1. Removal of lead paint from bridges.
2. Removal of lead paint as preparation of any surface to be repainted.
3. Where removal is on a Demolition project prior to reconstruction.

- Laborer's Rate

1. Removal of lead paint from any surface NOT to be repainted.
2. Where removal is on a *TOTAL* Demolition project only.

- **PLUMBERS AND PIPEFITTERS**

Installation, repair, replacement, alteration or maintenance of all plumbing, heating, cooling and piping. ****License required per Connecticut General Statutes: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2 S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4.***

- **POWER EQUIPMENT OPERATORS**

Operates several types of power construction equipment such as compressors, pumps, hoists, derricks, cranes, shovels, tractors, scrapers or motor graders, etc. Repairs and maintains equipment. ****License required, crane operators only, per Connecticut General Statutes.***

- **ROOFERS**

Covers roofs with composition shingles or sheets, wood shingles, slate or asphalt and gravel to waterproof roofs, including preparation of surface. (demolition or removal of any type of roofing and or clean-up of any and all areas where a roof is to be relaid.)

- **SHEETMETAL WORKERS**

Fabricate, assembles, installs and repairs sheetmetal products and equipment in such areas as ventilation, air-conditioning, warm air heating, restaurant equipment, architectural sheet metal work, sheetmetal roofing, and aluminum gutters. Fabrication, handling, assembling, erecting, altering, repairing, etc. of coated metal material panels and composite metal material panels when used on building exteriors and interiors as soffits, fascia, louvers, partitions, canopies, cornice, column covers, awnings, beam covers, cladding, sun shades, lighting troughs, spires, ornamental roofing, metal ceilings, mansards, copings, ornamental and ventilation hoods, vertical and horizontal siding panels, trim, etc. The sheet metal classification also applies to the vast variety of coated metal material panels and composite metal material panels that have evolved over the years as an alternative to conventional ferrous and non-ferrous metals like steel, iron, tin, copper, brass, bronze, aluminum, etc. Fabrication, handling, assembling, erecting, altering, repairing, etc. of architectural metal roof, standing seam roof, composite metal roof, metal and composite bathroom/toilet partitions, aluminum gutters, metal and composite lockers and shelving, kitchen equipment, and walk-in coolers. To include testing and air –balancing ancillary to installation and construction.

- **SPRINKLER FITTERS**

Installation, alteration, maintenance and repair of fire protection sprinkler systems.

****License required per Connecticut General Statutes: F-1,2,3,4.***

- **TILE MARBLE AND TERRAZZO FINISHERS**

Assists and tends the tile setter, marble mason and terrazzo worker in the performance of their duties.

- **TRUCK DRIVERS**

~How to pay truck drivers delivering asphalt is under REVISION~

Truck Drivers are requires to be paid prevailing wage for time spent "working" directly on the site. These drivers remain covered by the prevailing wage for any time spent transporting between the actual construction location and facilities (such as fabrication, plants, mobile factories, batch plant, borrow pits, job headquarters, tool yards, etc.) dedicated exclusively, or nearly so, to performance of the contract or project, which are so located in proximity to the actual construction location that it is reasonable to include them. ****License required, drivers only, per Connecticut General Statutes.***

For example:

- Material men and deliverymen are not covered under prevailing wage as long as they are not directly involved in the construction process. If, they unload the material, they would then be covered by prevailing wage for the classification they are performing work in: laborer, equipment operator, etc.
- Hauling material off site is not covered provided they are not dumping it at a location outlined above.
- Driving a truck on site and moving equipment or materials on site would be considered covered work, as this is part of the construction process.

➤ *Any questions regarding the proper classification should be directed to:*
Public Contract Compliance Unit
Wage and Workplace Standards Division
Connecticut Department of Labor
200 Folly Brook Blvd, Wethersfield, CT 06109
(860) 263-6543.

**Connecticut Department of Labor
Wage and Workplace Standards Division
FOOTNOTES**

⇒ Please Note: If the “Benefits” listed on the schedule for the following occupations includes a letter(s) (+ a or + a+b for instance), refer to the information below.

Benefits to be paid at the appropriate prevailing wage rate for the listed occupation.

If the “Benefits” section for the occupation lists only a dollar amount, disregard the information below.

Bricklayers, Cement Masons, Cement Finishers, Concrete Finishers, Stone Masons
(Building Construction) and
(Residential- Hartford, Middlesex, New Haven, New London and Tolland Counties)

- a. Paid Holiday: Employees shall receive 4 hours for Christmas Eve holiday provided the employee works the regularly scheduled day before and after the holiday. Employers may schedule work on Christmas Eve and employees shall receive pay for actual hours worked in addition to holiday pay.

Elevator Constructors: Mechanics

- a. Paid Holidays: New Year’s Day, Memorial Day, Independence Day, Labor Day, Veterans’ Day, Thanksgiving Day, Christmas Day, plus the Friday after Thanksgiving.
- b. Vacation: Employer contributes 8% of basic hourly rate for 5 years or more of service or 6% of basic hourly rate for 6 months to 5 years of service as vacation pay credit.

Glaziers

- a. Paid Holidays: Labor Day and Christmas Day.

Power Equipment Operators
(Heavy and Highway Construction & Building Construction)

- a. Paid Holidays: New Year’s Day, Good Friday, Memorial day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day, provided the employee works 3 days during the week in which the holiday falls, if scheduled, and if scheduled, the working day before and the working day after the holiday. Holidays falling on Saturday may be observed on Saturday, or if the employer so elects, on the preceding Friday.

Ironworkers

- a. Paid Holiday: Labor Day provided employee has been on the payroll for the 5 consecutive work days prior to Labor Day.

Laborers (Tunnel Construction)

- a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. No employee shall be eligible for holiday pay when he fails, without cause, to work the regular work day preceding the holiday or the regular work day following the holiday.

Roofers

- a. Paid Holidays: July 4th, Labor Day, and Christmas Day provided the employee is employed 15 days prior to the holiday.

Sprinkler Fitters

- a. Paid Holidays: Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day, provided the employee has been in the employment of a contractor 20 working days prior to any such paid holiday.

Truck Drivers

(Heavy and Highway Construction & Building Construction)

- a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas day, and Good Friday, provided the employee has at least 31 calendar days of service and works the last scheduled day before and the first scheduled day after the holiday, unless excused.

SECTION 00839

WAIVER OF LIEN - MATERIALS AND LABOR

STATE OF _____

COUNTY OF _____

TO WHOM IT MAY CONCERN:

WHEREAS, _____ the undersigned
_____ have been employed by _____
_____ to furnish labor and materials for the project known as
_____.

NOW THEREFORE, KNOW YE, THAT WE, the undersigned, for good and valuable considerations do hereby waive and release any and all lien or right of lien on said above project and premises under the Law, in relation to Mechanics' Liens Law, on account of labor and materials, or both, furnished by the undersigned to or on account of the said contract for the said project and premises only so far as that portion of work which has been included in our requisition dated _____ and all prior requisitions.

THIS WAIVER AND RELEASE is being made to the undersigned in the amount of \$_____ which sum the undersigned certifies to be the balance due the undersigned for all labor, materials or both, furnished by the undersigned to or on account of the said contract as included on his requisition dated _____.

GIVEN UNDER _____ hand and seal, the _____ day
of _____, 20 ____.

By: _____

END OF SECTION

SECTION 00840
WORK CHANGE DIRECTIVE

Work Change Directive No. _____

Date of Issuance: _____ Effective Date: _____
 Owner: **Waterford Utility Commission** Owner's Contract No.: _____
 Contractor: _____ Contractor's Project No.: _____
 Engineer: **Wright-Pierce** Engineer's Project No.: _____
 Project: **Pump Station HVAC Improvements** Contract Name: _____

Contractor is directed to proceed promptly with the following change(s):
 Description:

Attachments: *[List documents supporting change]*

Purpose for Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: *[check one or both of the following]*

- Non-agreement on pricing of proposed change.
 Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price \$ _____ [increase] [decrease].
 Contract Time _____ days [increase] [decrease].

Basis of estimated change in Contract Price:

- Lump Sum Unit Price
 Cost of the Work Other

RECOMMENDED:

AUTHORIZED BY:

RECEIVED:

By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
 Title: _____

**SECTION 00842
CHANGE ORDER**

Change Order No. _____

Date of Issuance:
 Owner: **Waterford Utility Commission**
 Contractor:
 Engineer: **Wright-Pierce**
 Project: **Sewer Pump Station HVAC Improvements**

Effective Date:
 Owner's Contract No.:
 Contractor's Project No.:
 Engineer's Project No.:
 Contract Name:

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:		ACCEPTED:		ACCEPTED:	
By: _____	By: _____	By: _____	By: _____	By: _____	By: _____
Engineer (if required)	Owner (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)	Contractor (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____	Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____	Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
 Title: _____

Contractor's Application for Payment No. _____

Application Period:		Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

**Application For Payment
Change Order Summary**

Approved Change Orders			1. ORIGINAL CONTRACT PRICE.....	\$ _____
Number	Additions	Deductions	2. Net change by Change Orders.....	\$ _____
			3. Current Contract Price (Line 1 ± 2).....	\$ _____
			4. TOTAL COMPLETED AND STORED TO DATE (Column F total on Progress Estimates).....	\$ _____
			5. RETAINAGE:	
			a. X _____ Work Completed.....	\$ _____
			b. X _____ Stored Material.....	\$ _____
			c. Total Retainage (Line 5.a + Line 5.b).....	\$ _____
			6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c).....	\$ _____
			7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application).....	\$ _____
			8. AMOUNT DUE THIS APPLICATION.....	\$ _____
			9. BALANCE TO FINISH, PLUS RETAINAGE (Column G total on Progress Estimates + Line 5.c above).....	\$ _____
TOTALS				
NET CHANGE BY CHANGE ORDERS				

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By: _____ Date: _____

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ (Engineer) _____ (Date)

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ (Owner) _____ (Date)

Approved by: _____
Funding or Financing Entity (if applicable) _____ (Date)

Progress Estimate - Lump Sum Work

Contractor's Application

For (Contract):					Application Number:				
Application Period:					Application Date:				
			Work Completed		E	F		G	
A			B	C	D	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F / B)	Balance to Finish (B - F)
Specification Section No.	Description		Scheduled Value (\$)	From Previous Application (C+D)	This Period				
Totals									

Stored Material Summary

Contractor's Application

For (Contract):								Application Number:				
Application Period:								Application Date:				
Bid Item No.	A		B		C	D		E	Subtotal Amount Completed and Stored to Date (D + E)	F		G
	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored		Stored Previously		Amount Stored this Month (\$)		Date (Month/Year)	Amount (\$)	Materials Remaining in Storage (\$) (D + E - F)
						Date Placed into Storage (Month/Year)	Amount (\$)					
					Totals							

SECTION 01045CUTTING, CORING AND PATCHINGPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included - This section establishes general requirements pertaining to cutting, excavating, coring, fitting, and patching of the Work required to:
 - 1. Make alterations to existing structures.
 - 2. Make the parts fit properly.
 - 3. Replace work not conforming to requirements of the Contract Documents.
 - 4. Contractor is responsible for all cutting, coring, and rough and finish patching. Contractor shall coordinate the work of any and all subcontracting trades performing the work.
 - 5. Contractor is responsible for reviewing with the Owner and Engineer and receiving permission to proceed prior to cutting and coring and patching.
- B. Quality Assurance:
 - 1. Perform all cutting, coring and patching in strict accordance with pertinent requirements of these Specifications, and in the event no such requirements are determined, in conformance with the Engineer's written direction.
- C. Submittals:
 - 1. Provide a shop drawing submittal to include the following information:
 - a. Identification of coring and cutting subcontractor including: Company name, business address contact information, or if by Contractor indicated as such.
 - b. List of type of coring and cutting equipment proposed to be used with equipment cuts of the equipment.
 - c. Schedule indicating the: location of the core or cut, size and any potential obstructions or embedded conduits and wiring.
 - d. Key plan indicating the location of anticipated cores and cuts.
 - 2. Request for the Engineer's consent:
 - a. Prior to cutting which affects structural safety, submit written request to the Engineer for permission to proceed with cutting.
 - b. Should conditions of the work, or schedule, indicate a required change of materials or methods for cutting and patching, so notify the Engineer and secure his written permission prior to proceeding.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Materials for replacement of work shall be equal to those of adjacent construction and shall comply with the pertinent sections of these Specifications.
- B. Concrete and grout for rough patching shall be as specified in Division 3.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Inspection:

1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, coring, backfilling, and patching.
2. After uncovering the work, inspect conditions affecting installation of new work.

B. Discrepancies:

1. If uncovered conditions are not as anticipated, immediately notify the Engineer and secure needed directions.
2. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION PRIOR TO CUTTING AND CORING

- A. Provide all required protection including, but not necessarily limited to, shoring, bracing and support to maintain structural integrity of the work.
- B. All cutting and coring shall be performed in such a manner as to limit the extent of patching.
- C. All holes cut through concrete and masonry walls or slabs shall be core drilled unless otherwise approved. No structural members shall be cut without approval of the Engineer and all such cutting shall be done in a manner directed by him. No holes may be drilled in beams or other structural members without obtaining prior approval. All work shall be performed by mechanics skilled in this type of work.
- D. If holes are cored through floor slabs they shall be drilled from below.
- E. The Contractor shall determine from Owner's information, logical deduction and field testing if there are embedded electrical conduits, wiring or piping in the coring locations and shall readjust locations if possible to avoid coring through them. If concealed embedded conduit and piping are damaged, or severed, the coring contractor shall immediately notify the Contractor, Owner and RPR to determine impact of the damage and develop and implement a plan to repair the damage and reactive the lines.
- F. If embedded concealed conduit, wiring or pipe is damaged or severed and all reasonable steps were taken by the Contractor to identify embedded items, and alternate routing was investigated, the repair work will be compensated by the Owner through a Change Order. If it was reasonable to expect an embedded item could have been present at the location, the Contractor shall repair at no additional cost to the Owner.

3.3 CORING

- A. Coring shall be performed with an approved non-impact rotary tool with diamond core drills. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.
- B. All equipment shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.
- C. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.

- D. Slurry or tailings resulting from coring operations shall be vacuumed or otherwise removed from the area following drilling. Slurry or tailings shall not be allowed to enter floor drains.
- E. Work area (e.g., adjacent walls, floors, ceilings, pipes, conduits, etc.) shall be cleaned to remove splash residues from coring operation.

3.4 CUTTING

- A. Cutting shall be performed with a concrete wall saw and diamond saw blades of proper size.
- B. Provide for control of slurry generated by sawing operation on both sides of wall.
- C. When cutting a reinforced concrete wall, the cutting shall be done so as not to damage bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.
- D. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
- E. Provide equipment of adequate size to remove cut panel.
- F. Slurry or tailings resulting from cutting operations shall be vacuumed or otherwise removed from the area following drilling. Slurry or tailings shall not be allowed to enter floor drains.
- G. Work area (e.g., adjacent walls, floors, ceilings, pipes, conduits, etc.) shall be cleaned to remove splash residues from cutting operation.

3.5 PERFORMANCE

- A. Perform all required excavating and backfilling as required under pertinent sections of these specifications. Perform cutting, coring and demolition by methods which will prevent damage to other portions of the work and will provide proper surfaces to receive installation of repair and/or new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerances and finishes.
- B. Coring or cutting which exposes cut surfaces of reinforcing steel or structural steel shall be coated. Coating shall be 10 mil (dry film thickness) applied in two 5 mil (dry film thickness) coats of a single component moisture cured coal tar urethane or two part coal tar epoxy corrosion barrier. Alternately the exposed steel can be cut back two inches from the surface and a non-shrink grout applied over the steel flush to the concrete core or cut surface.
- C. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.
- D. Finish patching shall match existing surfaces as approved.

END OF SECTION

SECTION 01050COORDINATIONPART 1 - GENERAL1.1 DESCRIPTION

- A. Contractor is required to work in close proximity to Owner's existing facilities. The Contractor, under this Contract, will be responsible for coordinating construction activities with Owner to ensure that services, facilities, and safe working conditions are maintained.
- B. Any damage to existing structures, equipment and property, accepted equipment or structures, and property; as a result of the Contractor's or his subcontractor's operations shall be made good by the Contractor at no additional cost to the Owner.

1.2 COORDINATION WITH OTHERS

- A. Town of Waterford:
 - 1. Contractor shall coordinate all work on Town property with Waterford Utility Commission personnel.
 - 2. Contractor shall coordinate all activities that will interrupt wastewater flows with the Waterford Utility Commission.
 - 3. The Contractor shall be responsible for coordinating and maintaining public services to all public and private properties.
 - 4. Contractor shall coordinate access, egress, detours and traffic control, if required, at the site with the Waterford Police Department. The Contractor shall notify Waterford Police, Fire Department and Rescue Squad at least 24 hours in advance of any street closings or detours.
- B. Eversource (Gas and Electric):
 - 1. The Contractor shall be responsible for coordinating all work around Eversource facilities with Eversource and shall bear all costs of inspection requirements, temporary facilities relocation and other requirements.
- C. Call Before You Dig (CBYD):
 - 1. The Contractor shall be responsible for coordinating and contacting Call Before You Dig prior to the commencement of work.
- D. The Contractor shall provide the Engineer and Owner a construction schedule indicating the times to perform the work required. The Contractor shall update the schedule when required and give the facility one week notice before the start of any work. The Contractor shall provide the facility personnel enough time to obtain materials and perform the work required of them. The Contractor shall communicate with the Engineer and Owner concerning updating the schedule, job progress, delay or early starts that affect the work, facility staffing, etc.

END OF SECTION

SECTION 01150MEASUREMENT AND PAYMENTPART 1 - GENERAL1.1 DESCRIPTION

- A. For lump sum items, payment shall be made to the Contractor in accordance with an accepted Progress Schedule and Schedule of Values on the basis of actual work completed.

1.2 SCOPE OF PAYMENT

- A. Payments to the Contractor will be made for the actual quantities of the Contract items performed and accepted in accordance with the Contract Documents. Upon completion of the construction, if these actual quantities show either an increase or decrease from the quantities given in the Bid Form, the Contract unit prices will still prevail.
- B. The Contractor shall accept in compensation, as herein provided, in full payment for furnishing all materials, labor, tools, equipment, and incidentals necessary to the completed work and for performing all work contemplated and embraced by the Contract; also for all loss or damage arising from the nature of the Work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the Work and until its final acceptance by the Engineer, and for all risks of every description connected with the prosecution of the work, except as provided herein, also for all expenses incurred in consequence of the suspension of the work as herein authorized.
- C. The payment of any partial estimate or of any retained percentage except by and under the approved final invoice, in no way shall affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damage due to such defects.

1.3 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

- A. When alterations in the quantities of work not requiring supplemental agreements, as hereinbefore provided for, are ordered and performed, the Contractor shall accept payment in full at the Contract price for the actual quantities of work done. No allowance will be made for anticipated profits. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

1.4 OMITTED ITEMS

- A. Should any items contained in the bid form be found unnecessary for the proper completion of the work contracted, the Engineer may eliminate such items from the Contract, and such action shall in no way invalidate the Contract, and no allowance will be made for items so eliminated in making final payment to the Contractor.

1.5 PARTIAL PAYMENTS

- A. Partial payments shall be made monthly as the work progresses. Partial payment shall be made subject to the provisions of the Agreement.

1.6 PAYMENT FOR MATERIAL DELIVERED

- A. When requested by the Contractor and at the discretion of the Owner, payment may be made for all or part of the value of acceptable, non-perishable materials and equipment which are to be incorporated into bid items, have not been used, and have been delivered to the construction site or placed in storage places acceptable to the Owner.
- B. No payment shall be made upon fuels, supplies, lumber, false work, or other materials, or on temporary structures or other work of any kind which are not a permanent part of the Contract.

1.7 FINAL PAYMENT

- A. The Engineer will make, as soon as practicable after the entire completion of the project, a final quantity invoice of the amount of the Work performed and the value of such Work. Owner shall make final payments of the sum found due less retainages subject to the provisions of the Agreement.

1.8 INCIDENTAL WORK

- A. Incidental work items for which separate payment is not made include (but are not limited to) the following items:
1. Clearing, grubbing and stripping
 2. Dust control
 3. Dewatering
 4. Clean-up
 5. Erosion and sedimentation control
 6. Loam, seeding, grading, liming, fertilization, mulching, and watering.
 7. Restoration of property, and replacement of fences, curbs, structures and other minor items disturbed by the construction activities.
 8. Coordination with the Owner, Utilities and others, including related inspection cost (refer to Section 01050)
 9. Utility crossings and relocations, unless payment is otherwise made
 10. Trench boxes, steel and/or wood sheeting as required, including that left in place
 11. Project record documents
 12. Materials testing
 13. Construction schedules, bonds, insurance, shop drawings, warranties, guarantees, certifications, and other submittals required by the Contract Documents
 14. Temporary utilities for construction and to maintain existing service during construction
 15. Quality assurance testing

16. Temporary construction and other facilities not to be permanently incorporated into the Work necessary for construction sequencing and maintenance of operations
17. Weather protection
18. Permits not otherwise paid for or provided by the Owner
19. Visits to the Project site or elsewhere by personnel or agents of the Contractor, including manufacturer's representatives, as may be required.
20. On-site and other facilities acceptable to Engineer for the storage of materials, supplies and equipment to be incorporated into the Work
21. Mobilization/demobilization.
22. Test pits to determine existing utility locations, soils conditions, and as required to complete the project.
23. Pavement Markings
24. Removal of Existing Pavement
25. Temporary Pavement
26. Earthwork (except ledge)
27. Maintenance of all existing sewer flows, repair of existing sewer pipes, and bypass pumping.
28. Pre-Construction photographs.
29. Traffic Control and Project Signage
30. Minor Items--such as relocation of sign posts, guard rails, rock wall, mail boxes, curbs, traffic loop detectors, pavement markings, etc., damaged as a result of construction activities.
31. Removal and disposal of existing sanitary sewer structures and pipe as and where indicated on the drawings.
32. Final cleaning.
33. Miscellaneous demolition required by the construction.

1.9 DESCRIPTION OF PAY ITEMS

- A. The following sections describe the measurement of and payment for the work to be done under the respective items listed in the Bid Form.
- B. Each unit or lump-sum price stated in the Bid Form shall constitute full compensation, as herein specified, for each item of the work completed.

(1) Evergreen Avenue Pump Station HVAC/Electrical Improvements Complete

- A. Method of Measurement: Lump Sum.
- B. Basis of Payment:
 1. Said lump sum price shall constitute full compensation for furnishing all labor, materials, tools, and equipment necessary for the HVAC and Electrical Improvements at the Evergreen Avenue Sewer Pump Station, complete as shown on the drawings.

(2) Blue Hills Pump Station HVAC/Electrical Improvements Complete Less Item #3

- A. Method of Measurement: Lump Sum.
- B. Basis of Payment:

1. Said lump sum price shall constitute full compensation for furnishing all labor, materials, tools, and equipment necessary for the HVAC and Electrical Improvements at the Blue Hills Sewer Pump Station, complete as shown on the drawings.

(3) Blue Hills Pump Station HVAC – Provide/Install Ductwork Modifications to HV-1

A. Method of Measurement: Lump Sum.

B. Basis of Payment:

1. Said lump sum price shall constitute full compensation for furnishing all labor, materials, tools, and equipment necessary to reconfigure the inlet ductwork to HV-1 at the Blue Hills Sewer Pump Station, complete as shown on the drawings. All other work at this station will be under Bid Item #2.

(4) Owners System Integrator Allowance

A. Method of Measurement:

1. Cash Allowance for SCADA integration services. Integrator shall be selected by the Owner.
2. System Integrator shall provide all required programming to tie the new equipment into the existing control/SCADA system as determined necessary. All costs associated with field conduit and wiring, field testing shall be included in Item 1 and as shown on the drawings.

B. Basis of Payment:

1. Payment shall be in accordance with the Schedule of Values and progress of the work.
2. Adjustment to the final cost for this Item, if necessary, will be made based on invoices for the work provided with no mark-up. Owner will assist Contractor in establishing any adjustments to this item.

END OF SECTION

SECTION 01320SAFETY AND HEALTH PLANPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work, as outlined herein. Within (10) days after the effective date of the Agreement between Owner and Contractor, submit to the Engineer a Safety and Health Plan as specified herein.
2. Contractor shall comply with all applicable Laws and Regulations related to the safety of persons or property, or for the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
3. Contractor shall designate a qualified and experienced safety representative (OSHA defined "Competent Person") at the site whose duties and responsibilities shall be the prevention of accidents and maintaining and supervising of safety precautions and programs, including a "Job Hazards Analysis".

B. Content of Safety and Health Plan:

1. Prepare complete safety and health plan in accordance with the requirements of CFR Title 29 Part 1926 - Safety and Health Regulations for Construction.
 - a. Provide documentation that Contractor's hazardous communication program is up to date.
 - b. Provide documentation that Contractor's safety training is up to date.
 - c. Prepare a project specific Safety and Health Plan addressing construction safety issues, including but not limited to excavations, fall protection and egress, as well as provisions for construction in hazardous environmental conditions at the wastewater treatment facility. The hazardous environmental conditions at the wastewater treatment facility include, but are not limited to, confined space entry, electrically-classified spaces, and chemical storage and handling areas, to name a few.
2. Safety provisions for confined space entry shall follow General Industry Standard CFR Title 29 Part 1910.146 and will be incorporated into the Safety and Health Plan.
 - a. The Owner has provided Table 1 at the end of this section listing confined space locations which may be encountered during the execution of this Contract. Spaces listed as Permit Required Confined Space may only be entered with a permit, alternate procedures (1910.146 (c) (5)), or reclassification to non-permit required confined space (1910.146 (c) (7)). The Contractor is required to perform a site evaluation to identify all hazards and potential hazards in work areas whether included in Table 1 or not, prior to control of site.

- b. The Contractor shall be responsible for all aspects of construction site safety including development of appropriate confined space entry procedures. The plan shall include, but not necessarily be limited to, the following:
 - Definitions
 - Confined Space Evaluations
 - Equipment Selection
 - Confined Space Entry Training Documentation
 - Permit Required Confined Space Entry Requirements
 - Testing (Monitoring) and Ventilation
 - Confined Space Entry Permit Form
 - Rescue and Emergency Procedures
 - Emergency Contact Information
 - c. The Contractor shall inform the Owner and Engineer's representative whenever work will be performed in a confined space and the permit space program that the Contractor will follow.
 - d. The Contractor shall inform the Owner and Engineer's representative of any hazards confronted or created during entry operations, either through a briefing or during the entry operation.
 - e. The Contractor will coordinate entry operations with the Owner when both Owner personnel and Contractor personnel will be working in or near permit spaces.
 - f. The Owner, Engineer, their representatives, independent testing laboratories and government agencies, when inspecting the site, shall be supplied by the Contractor proper safety equipment when entry into a confined space is required.
- C. Updating:
1. Contractor shall be responsible for updating the Safety and Health Plan as appropriate throughout the course of the construction period.

1.2 SUBMITTALS

- A. **Contractor shall be responsible for all aspects of construction site safety.** Provide 3 copies of the Contractor's site specific Safety and Health Plan to the Engineer. The Safety and Health Plan is provided for information only to inform the Owner, Engineer (and Resident Project Representative) of the project specific safety program requirements. The Contractor will overview the plan with the Owner (and staff), Engineer (and Resident Project Representative) at the beginning of the project, and subsequently when the safety plan is updated.
- B. Provide updated Safety and Health Plans as necessary during the course of the project.
- C. Contractor's most current Safety and Health Plan shall be available at the construction site throughout the construction project.

1.3 ON-SITE COORDINATION MEETINGS

- A. Contractor shall review key aspects of Safety and Health Plan at the Pre-Construction Meeting, and subsequent on-site safety informational meeting.

- B. Contractor shall report to Engineer and Owner at each progress meeting concerning compliance with the Safety and Health Plan for the most recent construction period and new considerations and requirements for the upcoming period.
- C. Contractor shall hold weekly on-site coordination meetings with Resident Project Representative and Owner to ensure that Owner's staff is aware of key Safety and Health Plan requirements of the current phase of construction.

END OF SECTION

SECTION 01340SUBMITTALSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included:
 - 1. Submit to the Engineer, Shop Drawings, Operation and Maintenance Manuals, Manufacturers' Certificates, Project Data, and Samples required by the Specification Sections.
- B. Related Work Specified Elsewhere:
 - 1. Construction Schedules: Section 01310

1.2 SHOP DRAWINGS

- A. Shop Drawings are required for each and every element of the work. Each shop drawing shall be assigned a number consisting of the Specification Section number followed by a dash and then a sequential number beginning with 01 (e.g., 16000-01) for purposes of easy identification. Resubmittals shall include an alphabetic suffix after the corresponding sequential number (e.g., 16000-01A).
- B. Shop Drawings are generally defined as all fabrication and erection drawings, diagrams, brochures, schedules, bills of material, manufacturers data, spare parts lists, and other data prepared by the Contractor, his subcontractors, suppliers, or manufacturers which illustrate the manufacturer, fabrication, construction, and installation of the work, or a portion thereof.
- C. The Contractor shall submit to the Engineer a pre-determined number of hardcopies of Shop Drawings and approved data (for Owner's, Engineer's and Field Representative's files), and one electronic Portable Document Format (PDF) transmitted using e-mail, File Transfer Protocol (FTP), or approved submittal sharing software. The Engineer shall return one hardcopy and electronic PDF to the Contractor for duplication and distribution to subcontractors, suppliers and manufacturers. All shop drawing comments will be summarized on the Submittal Review Form and must be retained with each submittal hardcopy and electronic PDF. Number of copies, mandatory hardcopy submissions for specific submittals, format, and transmission method will be finalized at Pre-Construction Meeting.
- D. The Contractor shall provide a completed Contractor Submittal Certification Form (copy provided for Contractor's use at the end of this Specification Section) which shall be attached to every hardcopy and electronic PDF of each shop drawing. Shop Drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the work.
- E. Shop Drawings shall be submitted as a complete package by specification section, unless otherwise reviewed and approved by the Engineer. It is the intent that all information, materials and samples associated with each specification section be included as a single submittal for the Engineer's review. Any deviation from this

requirement, such as submitting miscellaneous metals grouped by structure, shall be requested in writing with an anticipated shop drawing breakdown/schedule prior to any associated submittal.

- F. The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the work due to the absence of such drawings.
- G. No material or equipment shall be purchased or fabricated especially for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.
- H. Until the necessary review has been made, the Contractor shall not proceed with any portion of the work (such as the construction of foundations), the design or details of which are dependent upon the design or details of work, materials, equipment or other features for which review is required.
- I. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. Hard copies of shop drawings shall be of standardized sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard sizes shall be: (a) 24 inches by 36 inches; (b) 11 inches by 17 inches, and (c) 11 inches by 8-1/2 inches. Provision shall be made in preparing the shop drawings to provide a binding margin on the left hand side of the sheet. Shop drawings submitted other than as specified herein may be returned for resubmittal without being reviewed.
- J. Only drawings which have been checked and corrected by the fabricator should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer.
- K. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in his letter of transmittal. Shop Drawings that contain significant deviations that are not brought to the attention of the Engineer may be subject to rejection.
- L. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, he shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all work necessary to make such modifications.
- M. A maximum of two submissions of each Shop Drawing will be reviewed, checked, and commented upon without charge to the Contractor. Any additional submissions which are ordered by the Engineer to fulfill the stipulations of the Drawings and Specifications, and which are required by virtue of the Contractor's neglect or failure to comply with the requirements of the Drawings and Specifications, or to

make those modifications and/or corrections ordered by the Engineer in the review of the first two submissions of each Shop Drawing, will be reviewed and checked as deemed necessary by the Engineer, and the cost of such review and checking, as determined by the Owner, and based upon Engineer's documentation of time and rates established for additional services in the Owner-Engineer Agreement for this Project, may be deducted from the Contractor to make all modifications and/or corrections as may be required by the Engineer in an accurate, complete, and timely fashion. Resubmittals for the sole purpose of providing written responses to review comments will not be considered a resubmittal counting towards the two submission limit.

1.3 SAMPLES

- A. The Contractor shall submit samples when requested by the Engineer to establish conformance with the specifications, and as necessary to define color selections available.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall furnish the Engineer a predetermined number of hardcopies and 1 electronic PDF of a complete instruction manual for installation, operation and maintenance of each item specified (unless otherwise specified) transmitted using e-mail, File Transfer Protocol (FTP), Compact Disc (CD) or approved submittal sharing software. At least 3 months prior to the expected substantial completion date, the Contractor shall submit to the Engineer all manuals in accordance with the requirements specified herein.
- B. Each manual shall be provided in a stand-alone binder or shall be suitable for insertion into a 3-ring binder. Include the General Contractor's and Manufacturer's representative's contact information on the front cover. O&M manuals must be appropriate for the project and customized for the project. If a Manufacturer's standard O&M manual is included in the submittal, all non-applicable content must be removed or crossed out.
- C. Manuals shall include operating and maintenance information on all systems and pieces of equipment. The manual shall contain sufficient data to install, operate, maintain, repair and rebuild all components of the equipment, design data specific to the project. Descriptions of operation should include procedures for both normal and emergency operation. All information required by the Operations and Maintenance Manual Certification Form described herein and any additional information deemed necessary by the Owner and Engineer for proper installation, operation and maintenance. Also include model numbers and serial numbers, as well as rated capacities and motor data, where applicable.
- D. Attached to every hardcopy and electronic PDF of each Operations and Maintenance Manual submitted, the Contractor shall provide a copy of the complete Operations and Maintenance Manual Certification Form (copy provided for the Contractor's use at the end of this Specification Section) signed by both the Contractor and the Manufacturer.

1.5 MANUFACTURER'S CERTIFICATES

- A. Prior to accepting the installation, the Contractor shall submit manufacturer's certificates for each item specified.
- B. Such manufacturer's certificates shall state that the equipment has been installed under either the continuous or periodic supervision of the manufacturer's authorized representative, that it has been adjusted and initially operated in the presence of the manufacturer's authorized representative, and that it is operating in accordance with the specified requirements, to the manufacturer's satisfaction. All costs for meeting this requirement shall be included in the Contractor's bid price.

1.6 SUBMISSION REQUIREMENTS

- A. Accompany submittals with transmittal letter, containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. The sequential shop drawing number for each shop drawing, project data and sample submitted shall be:
 - i. Specification Section number followed by a dash and then a sequential number beginning with 01 (e.g., 16000-01).
 - ii. Under limited situations when additional different pieces of equipment are submitted under the same specification section, those submittals shall be numbered sequentially (e.g. 05500-01, 05500-02, 05500-03, etc.).
 - iii. Resubmittals shall include decimal point and an alphabetic suffix after the corresponding sequential number (e.g., 16000-01A).
 - iv. O&M submittals shall be numbered with the Specification Section number followed by a dash, the letters "OM", another dash, and then a sequential number beginning with 01 (e.g. 16000-OM-01). Resubmittals of O&Ms shall include an alphabetic suffix after the corresponding sequential number (e.g., 16000-OM-01A).
 - 5. Notification of deviations from Contract Documents.
 - 6. Other pertinent data.
- B. A completed Contractor Submittal Certification Form shall be attached to each hardcopy and electronic PDF of each shop drawing and must include:
 - 1. Project name
 - 2. Specification Section and sequential number with alphabet suffix for resubmittal
 - 3. Description
 - 4. Identification of deviations from Contract Documents.
 - 5. Contractor's stamp, initialed or signed, certifying review of the submittal, verification of field measurements and compliance with Contract Documents.
 - 6. Where specified or when requested by the Engineer, manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements.
 - 7. Where specified, manufacturer's guarantee.
- C. Requirements for Electronic Submittals:
 - 1. Each individual shop drawing or O&M submittal shall be contained in one

- PDF.
2. The first page of the PDF shall be the Contractor Submittal Certification Form as described above.
 3. Subject lines for e-mails transmitting PDF submissions and subsequent correspondence referring to specific submittals shall identify the submittal's Specification Section, sequential number, appropriate alphabet suffix for resubmittals, and a brief description (e.g. 16010-01-Electrical General).
 3. The electronic PDF shall be **exactly** as submitted in the hardcopy and shall be transmitted using e-mail, File Transfer Protocol (FTP), or approved submittal sharing software.
 4. PDF versions of 24x36 drawings shall be converted to 24 x 36 PDFs so as not to lose the clarity of the original drawing.
 5. Electronic PDF submittals that are not submitted in accordance with the requirements stated above will not be reviewed by the Engineer.

1.7 RESUBMISSION REQUIREMENTS

- A. Revise initial drawings as required and resubmit as specified for initial submittal.
- B. Indicate on drawings any changes which have been made other than those required by Engineer. All renumbering of shop drawings, relabeling of individual pieces or assemblies or relocating of pieces or assemblies to other Drawings within the submittal shall be clearly brought to the attention of the Engineer.

1.8 ENGINEER'S REVIEW

- A. The review of shop and working drawings hereunder will be general only, and nothing contained in this specification shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified thereunder.
- B. The Engineer's review comments will be summarized on a Submittal Review Form, which includes an action code. A description of each action code is provided below.
 1. **No Exceptions Taken (Status 0 on shop drawing log).** The shop drawing complies with the Contract Document requirements. No changes or further information are required. Where appropriate, the submittal review form will be used to alert the Contractor, Owner and Field personnel of remaining items within that specification section that still needs to be submitted.
 2. **Make Corrections Indicated (Status 1 on shop drawing log).** The shop drawing complies with the Contract Document requirements except for minor changes, as indicated. Resubmittal is not required unless it is specifically called for; however, Engineer requires that all comments will be addressed by the Contractor, unless otherwise notified in writing prior to execution of the relevant work.
 3. **Conditional to Remarks (Status 2 on shop drawing log).** The shop drawing potentially complies with the Contract Document requirements, contingent upon satisfactory resolution of review comments. Remarks will explicitly list

what information needs to be resubmitted. Resubmittal from the Contractor should include a cover letter or summary which indicates how each review comment has been addressed.

4. **Revise and Resubmit (Status 3 on shop drawing log).** The shop drawing does not comply with the Contract Document requirement as submitted, but may with changes indicated and/or submission of additional information. The entire package must be resubmitted with the necessary information and a cover letter which indicates how each review comment has been addressed and where to find the information in the resubmittal.
5. **Rejected (Status 4 on shop drawing log).** The shop drawing does not comply with the Contract Document requirements, for the reasons indicated in the remarks, and is unacceptable.
6. **In Review (Status 5 on shop drawing log).** The shop drawing is currently under review.
7. **For Information Only (Status 6 on shop drawing log).** The shop drawing review was informational only. No comments are provided.

CONTRACTOR SUBMITTAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ ENGINEER'S PROJ. NO: _____

ENGINEER: _____

SHOP DRAWING NUMBER:	_____ SPECIFICATION SECTION OR DRAWING NO:	- _____ SEQUENTIAL NUMBER (& ALPHA SUFFIX FOR RESUBMITTAL)
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DESCRIPTION: _____

MANUFACTURER: _____

The above referenced submittal has been reviewed by the undersigned and I/we certify that the material and/or equipment meets or exceeds the project specification requirements with

- NO DEVIATIONS
or
 A COMPLETE LIST OF DEVIATIONS AS FOLLOWS^a:

By: _____ By: _____
Contractor^b

Manufacturer^c

Date: _____ Date: _____

^a Any deviations not brought to the attention of the Engineer for review and concurrence shall be the responsibility of the Contractor to correct, if so directed.

^b Required on all submittals

^c When required by specifications Page ___ of ___

General Contractor's Stamp

OPERATIONS AND MAINTENANCE MANUAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ ENGINEER'S PROJ. NO: _____

ENGINEER: _____

O&M	- OM -	
NUMBER: _____	SPECIFICATION SECTION OR DRAWING NO:	SEQUENTIAL NUMBER (& ALPHA SUFFIX FOR RESUBMITTAL)

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced operations and maintenance manual has been reviewed by the undersigned and I/we certify that the manual is customized as needed for this project, is suitable for mounting in a 3-ring binder, and contains the following items:

- | | |
|---|--|
| <input type="checkbox"/> Table of Contents | <input type="checkbox"/> Project-Related Design Data |
| <input type="checkbox"/> Maintenance Schedule and Summary | <input type="checkbox"/> Wiring Diagrams |
| <input type="checkbox"/> Lubrication Schedule | <input type="checkbox"/> Equipment Layout Drawings & Schematics |
| <input type="checkbox"/> Troubleshooting Information | <input type="checkbox"/> Equipment Performance Curves |
| <input type="checkbox"/> Warranty Information | <input type="checkbox"/> Parts and Service Contact Information |
| <input type="checkbox"/> Rebuild Information for All Components/
Systems | <input type="checkbox"/> Manufacturer's Contact Information |
| <input type="checkbox"/> Startup, Operation, Shutdown Procedures | <input type="checkbox"/> Emergency Operations Plan |
| <input type="checkbox"/> Safety Procedures | <input type="checkbox"/> List of Part Numbers for all Components |
| <input type="checkbox"/> Shop Drawings corrected to As-Built
Conditions | <input type="checkbox"/> List of Spare Parts Supplied and Cost |
| | <input type="checkbox"/> Other System Specific Information |

By: _____ By: _____
Contractor^a Manufacturer^b

Date: _____ Date: _____

^a Contact information shall include name, address and telephone number.

^b Required on all Operation and Maintenance Manuals.

^c When required by Specifications.

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General Contractor's Stamp

PROCESS EQUIPMENT MANUFACTURER SUBMITTAL CERTIFICATION
(Divisions 15)

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

As an authorized representative of the equipment manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of Section 15. The undersigned authorized representative of the manufacturer further certifies that the equipment manufacturer or supplier has reviewed the Construction Documents, the intended installation by the Contractor, and the intended functional and operational conditions; determined all conditions to be acceptable; and found no conditions which would cause the warranty to be void; or the equipment to function improperly, or not meet the performance requirements.

(Authorized Representative of the Manufacturer)

(Date)

END OF SECTION

SECTION 02050DEMOLITIONPART 1 - GENERAL1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall furnish all labor, materials, tools, equipment and apparatus necessary and shall do all work required to complete the demolition, removal, and alterations of existing facilities as indicated on the Drawings, as herein specified, and/or as directed by the Engineer.
2. Demolition and alteration work within occupied areas shall be accomplished with minimum interference to the occupants and to the plant which shall be in continuous operation during construction.
3. All equipment, piping, and other materials that are not to be relocated or to be returned to the Owner shall become the property of the Contractor and shall be disposed of by him, away from the site of the work and at his own expense.
4. All demolition or removal of existing structures, utilities, equipment, and appurtenances shall be accomplished without damaging the integrity of existing structures, equipment, and appurtenances to remain, to be salvaged for relocation or stored for future use.
5. Such items that are damaged shall be either repaired or replaced at the Contractor's expense to a condition at least equal to that which existed prior to the start of his work.
6. Unless otherwise indicated, all items labeled to be "removed", "demolished" or "remove/demolish" shall be removed and disposed of off site in accordance with all Local, State and Federal Regulations.

B. Related Work Specified Elsewhere: (When Applicable)

1. See Summary of Work, Section 01010.

1.2 JOB CONDITIONS

A. Condition of Structures:

1. The Owner assumes no responsibility for the actual condition of structures to be demolished.
2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner as far as practicable. However, variations within the structures may occur due to Owner's removal and salvage operations prior to the start of demolition work (where applicable).

1.3 UTILITIES

A. Utility Locations:

1. Utility locations shown on the plans are approximate only, based on information supplied by the utility companies.

B. Coordination with Utilities:

1. The Contractor shall make all necessary arrangements and perform any necessary work to the satisfaction of affected utility companies and governmental divisions involved with the discontinuance or interruption of affected public utilities and services.

1.4 SUBMITTALS

A. Schedule - Demolition:

1. Submit two (2) copies of proposed methods and operations of demolition to the Engineer for review prior to the start of work. Include in the schedule the coordination for shut-off, capping and continuation of utility services as required.
2. Provide a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations.

1.5 PROTECTIONS

- A. Ensure the safe passage of persons around the area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons. Erect temporary, covered passageways as required by authorities having jurisdiction.
- B. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

1.6 DAMAGES

- A. The Contractor shall promptly repair damages caused by demolition operations to adjacent facilities at no cost to the Owner.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 PERFORMANCE

- A. Remove and dispose of non-salvageable material in accordance with all applicable local and state laws, ordinances and code requirements.
- B. Dispose of material daily as it accumulates.
- C. Carefully remove, store and protect from damage all materials to be salvaged.
- E. Maintaining Traffic:
 1. Ensure minimum interference with roads, streets, driveways, sidewalks and adjacent facilities.
 2. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
- F. Architectural, structural, mechanical, process and electrical demolition, removal and alteration are indicated in the corresponding sections.
- G. Mechanical/Process Demolition:

1. Mechanical/Process demolition in general shall consist of the dismantling and removal of existing piping, tanks, pumps, motors, equipment and other appurtenances as specified, and indicated on the Drawings.
 2. It shall also include, where necessary, the cutting of existing piping for the purpose of making connections thereto.
 3. Piping not indicated to be removed but which may interfere with construction shall be removed to the nearest solid support, capped and left in place. Where piping that is to be removed passes through the wall of existing structures, it shall be cut off and properly capped on each side of the wall.
 4. When piping is to be altered or removed underground, the remaining piping shall be properly capped or plugged.
 5. Abandoned underground piping shall be left in place unless it interferes with new structures or unless otherwise noted on the Drawings.
- H. Salvage:
1. Salvaged items shall be stored on site for the Owner in an acceptable location and manner.
- I. Demolition Sequence:
1. The demolition sequence is to conform the reviewed and approved project schedule, and restrictions outlined in Section 01310, Construction Schedules.
- J. Pest Control:
1. Provide pest control when needed or when directed by the Engineer.
 2. Exterminate and prevent migration of rodents to adjoining buildings in accordance with the requirements of the state or local health department.

END OF SECTION

SECTION 15061STEEL PIPE & FITTINGSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install steel pipe and fittings of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.
- B. **Paint and label all new gas piping to match existing.**
- C. Related Work Specified Elsewhere (When Applicable): "Pipe and Pipe Fittings - General" is specified in this Division.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Standard Steel Pipe:
 - 1. Classes and maximum working pressures shall be as specified in ANSI B31.1 and as shown on the Drawings.
 - 2. ASTM A-53 carbon steel, welded or seamless.
 - 3. Black steel.
 - 4. End connections: As shown on the Drawings.
- B. Fittings:
 - 1. General Service Screwed: Standard pattern malleable iron with full-length clean-cut threads, ANSI B16.3.
 - 2. Unions: 250-pound series malleable iron with brass to iron seats.

PART 3 - EXECUTION3.1 INSTALLATION

- A. Threaded Joints:
 - 1. Ream the ends of threaded pipe to remove all burrs.
 - 2. Cut threads clean with long tapers.
 - 3. Remove all dirt and chips from the inside of the pipe and fittings and from the threads.
 - 4. Make up joints with an approved pipe joint compound or tape applied to the male threads only.
 - 5. When connecting pipes to recessed drainage fittings, seat them against the shoulder of the fittings.
 - 6. When required to back off joints, entirely disjoint, wipe the threads of both the pipe and fittings clean, apply new joint compound, and reassemble the connection.
- B. Support: Support all pipes in accordance with the International Mechanical Code & International Plumbing Code
- C. Cutting: Cut pipe from measurements taken at the site; not from the Drawings.
- D. To permit convenient disassembly for alterations and repairs, install unions or flanges where shown on the Drawings and:

1. In long runs of piping
2. In bypasses around equipment
3. In connections to traps, tanks, pumps, and other equipment
4. Between shutoff valves
5. In other locations as directed by the Engineer, and as indicated on the Drawings.

END OF SECTION

SECTION 15092PIPE SLEEVES & SEALSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install wall sleeves and seals of the type(s) and sizes(s) and in the location(s) shown on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Plumbing - General is specified in Section 15400.
 - 2. HVAC - General is specified in Section 15600.

1.2 QUALITY ASSURANCE

- A. Provide and install all sleeves of the types specified herein, as shown on the Drawings and as directed by the Engineer.
- B. Provide sleeves that are airtight, gastight or watertight as required.

PART 2 - PRODUCTS2.1 TYPES AND LOCATIONS

- A. Penetrations Through Existing Construction:
 - 1. Interior masonry, drywall, or wood partition - Air to Air:
 - a. Cleanly cut brick or block as required. Grout sleeve into place using non-shrink grout.
 - b. Cleanly cut wood frames partitions as required. Set sleeve into position and secure.
 - c. Sleeves to be as required for New Construction - Interior masonry, drywall, or wood partition - Air to Air.
 - d. Holes bored with equipment leaving a smooth hole in masonry walls less than 1/2 inch larger than the pipe will not require a sleeve, unless otherwise specified.
 - e. Minimum 1/4-inch annular space between cored opening or sleeve and pipe or insulation.
 - f. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07900 for standard penetrations.
 - g. Install split cover plates in all finished areas. Both sides of wall if required. Plates shall be chrome finished, suitably sized to fit pipe in question and cover opening.
 - 2. Interior Concrete Partitions - Air to Air:
 - a. Core smooth-walled opening with coring machine. Grout sleeve into place using non-shrink grout.
 - b. Schedule 40 galvanized steel pipe with 1-inch x 1/8 inch thick welded sealing and anchoring collar in middle, hot-dip galvanize after fabrication. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.

- c. Holes cored with equipment leaving a smooth hole, less than 1/2 inch larger than the pipe will not require a sleeve, unless otherwise specified.
 - d. Minimum 1/4-inch annular space between cored opening or sleeve and pipe or insulation.
 - e. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07900 for standard penetrations.
3. Interior Concrete Partitions - Air to Air:
 - a. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
 - b. Size of cored opening as required by seal manufacturer.
 - c. Seal with rubber link compression seal.
4. Interior Concrete Partitions - Air to Air (Unclassified to Classified):
 - a. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
 - b. Size of cored opening as required by seal manufacturer.
 - c. Seal with two, back to back rubber link compression seals.
5. Exterior Masonry Walls
 - a. Core drill a smooth hole through all layers of the existing masonry. Hole shall be sized to facilitate standard rubber link compression seal installation.
 - b. Install rubber link compression seal at each layer of masonry.
 - c. Seal each face with polyurethane sealant.
 - d. If a clean, smooth hole cannot be achieved, remove the masonry as required to install Schedule 40 galvanized wall sleeve. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness. Grout sleeve in place. Install rubber link compression seal and sealant as noted above.
6. Exterior Wood Walls
 - a. Remove existing siding and other materials, as required to install the new item.
 - b. Restore the wall and siding to provide a weather-tight seal acceptable to the Engineer.
7. Concrete Floor Penetrations - Air to Air:
 - a. Same as "Interior Concrete Partitions - Air to Air", except that sleeve will not be required.
 - b. Stainless steel pipe riser clamp with stainless steel threaded rod embedded into concrete floor to be installed on topside of penetration to support the pipe vertically.
 - c. Install rubber link compression seal, as shown, covered by self-leveling sealant (SikaFlex or equivalent).
 - d. Refer to details on Process Drawings.
8. Concrete Exterior Walls - Air to Ground:
 - a. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
 - b. Size of cored opening as required by seal manufacturer.
 - c. Seal with rubber link compression seal.

9. Other conditions shall be installed as reviewed and accepted by the Engineer.
- B. Pipe openings in and penetrations through precast concrete structures shall be as specified in Division 2 and 3.
- C. Rubber Link Compression Seals:
 1. Acceptable Manufacturers:
 - a. Link Seal by Thunderline Company
 - b. Innerlynx by Advance Products and Systems
 - c. Or equivalent.
 2. Multi-rubber link type with pressure plates, bolts, nuts and sealing element providing a leak proof seal. Model numbers provided below are based on Link Seal by Thunderline Company are to establish type and level of quality.
 3. General Service (Model C):
 - a. Glass Reinforced Nylon Pressure Plate.
 - b. Carbon steel zinc-phosphated nut and bolt.
 - c. Sealing element: EPDM rubber.
 - d. Temperature Rating: -40°F to 250°F.
 4. Corrosive Service: (Model S-316):
 - a. Use in the following locations: Sludge tanks, scum tanks, digesters, wetwells, manholes, dewatering rooms, headworks rooms, exterior tanks, chemical rooms, as shown on the Drawings.
 - b. Glass Reinforced Nylon Pressure Plate.
 - c. Bolt and nut, 18-8 stainless steel.
 - d. Sealing element: EPDM rubber.
 - e. Temperature Rating: -40°F to 250°F.
 5. Potable/Clean Water Service (Model S61)
 - a. Blue reinforced Nylon polymer pressure plates.
 - b. 316 stainless steel nuts and bolts.
 - c. Sealing element: Black EPDM NSF 61 certified.
 - d. Temperature Rating: -40° to 250° F.
 - e. Certified to NSF/ANSI standard 61.
 6. High Temperature Service (Model T)
 - a. Steel zinc dichromate pressure plates.
 - b. Carbon steel with zinc dichromate finish nuts and bolts.
 - c. Sealing element: Silicone.
 - d. Temperature Rating: -67° to 400° F.
 7. Refer to details on Process Drawings.
- D. Wall Plates: Provide split type cast iron or brass wall plates on pipes penetrating walls in finished spaces such as labs and offices. Refer to details on Process Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Existing Construction:
 1. The location will be reviewed and accepted by the Engineer prior to coring or cutting hole.
 2. For concrete, holes shall be located to avoid the reinforcing steel when possible.
 3. Patch all damaged work as required to maintain a neat and clean appearance.

- B. Rubber Link Compression Seals: Install as required and in strict accordance with the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 15400PLUMBING – GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Description: Perform the following items of work required to complete the work of this Section, as shown on the DRAWINGS and specified herein:
1. All labor, materials, equipment and transportation shall be provided as required to completely install the plumbing and water systems, with all connections as shown on the DRAWINGS and described in these specifications or as required by the International Plumbing Code as amended by the State of Connecticut. The accompanying DRAWINGS do not show every detail of pipe, valves, fittings, hangers, equipment and fixtures which are necessary for the complete installation but are provided to show the general arrangement and extent of work to be performed.
- B. Work Included: The plumbing work shall include, but not be limited to the following (when applicable):
1. Fuel gas supply system.
 2. All other plumbing items indicated on the DRAWINGS, specified herein, or needed for a complete and proper plumbing installation.
- C. Related Work Specified Elsewhere (When Applicable)
1. Project cleaning is specified in Division 1.
 2. Excavation and backfill is specified in Division 2.
 3. Concrete is specified in Division 3.
 4. Caulking and flashing are specified in Division 7.
 5. Painting is specified in Division 9.
 6. Pipe Sleeves and Seals are specified in Section 15092.
 7. Piping, pipe fittings, valves, insulation, fixtures, equipment, and accessories are specified in the appropriate Sections of this Division.
 8. Electrical is specified in Division 16.
 9. Pipe identification is specified in Division 9.
- D. Drawings and Measurements:
1. The Drawings show the general arrangement, direction, and sizes of pipes. They are not intended to show every offset, valve, and fitting, and every structural difficulty that may be encountered.
 2. All measurements shall be verified at the job site.

1.2 QUALITY ASSURANCE

- A. Materials and Workmanship: All materials and workmanship shall be suitable for the respective work and the type of service encountered.
- B. Equipment: All equipment shall be constructed to operate safely without water hammer and undue wear.
- C. Local Codes: Perform all work in accordance with applicable state and local plumbing codes, except where requirements of this Contract are more stringent.

- D. Permits: Arrange for all permits, inspections, and tests required by codes at no additional cost to the Owner.
- E. Standards: When standards are referred to, the latest issue shall apply.

1.3 SUBMITTALS

- A. Prior to ordering fixtures, equipment and appurtenances, submit shop drawings in accordance with the General Conditions of the Construction Contract.
- B. Submit to the Engineer: Copies of manufacturer's installation, maintenance and operating instructions including parts lists for all equipment furnished as specified in the General Conditions of the Construction Contract.
- C. Submit a list of local supply houses for replacement parts for all equipment furnished.

1.4 DELIVERY, STORAGE & HANDLING

- A. Exercise care during loading, transporting, unloading and handling to prevent damage of any nature to interior and exterior surfaces of equipment, fixtures, pipe and fittings.
- B. Do not drop equipment and fixtures.
- C. Store materials on the project site in enclosures or under protective coverings.
- D. Assure that all materials are kept clean and dry.
- E. Do not store materials directly on the ground.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials that are new, suitable for intended use, and of type, style, and quality specified and as shown on the Drawings.
- B. Provide pipe, fittings, and devices that meet requirements of local plumbing codes and be in accordance with applicable ASTM, ANSI, and Commercial Standard (CS) standards.

2.2 BOLTS, ANCHOR BOLTS AND NUTS

- A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.
- B. All bolts, anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated below or specified elsewhere.
 - 1. Galvanized steel in accordance with Division 5 unless otherwise indicated below or specified elsewhere.
 - 2. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
 - 3. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all submerged applications, including but not limited to the headworks, dewatering rooms, chemical rooms, clarifiers, aeration basins, splitter structures, equalization or storage tanks, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.

2.3 EQUIPMENT AND VALVE TAGS

- A. All new plumbing and HVAC (Mechanical Systems) equipment shall be identified by a color coded equipment/valve tag, provided and installed by the Contractor. Contractor shall submit a complete list of proposed Identification Tag information and it shall be reviewed by the Engineer and Owner and revised as indicated. In general, tag information shall match the information provided on the Drawings.
- B. Tags shall conform to the following specifications:
 - 1. The tags shall be 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. Top hole size is 5/32" for hanging tags.
 - 2. Tags shall be available in 7 different outside colors. Owner and Engineer shall select up to 4 different colors for the project.
 - 3. Tags shall have up to three lines engraved on a side and eight characters per line of identification information. Tags shall be engraved one side.
 - 4. Tags shall be secured to valves with nylon cable ties or adjustable stainless steel bead chain. Securing method shall be selected by the Owner and Engineer.
 - 5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two SS screws or SS pop rivets.
 - 6. Tags shall have a service temperature of -40°F to 175°F
 - 7. Manufactured by Seton Name Plate Corporation, New Haven, CT, Brimar Industries, Garfield, NJ, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all plumbing and piping systems in a neat workmanlike manner.
- B. Lines and Grades:
 - 1. Unless otherwise shown on the Drawings, install all piping parallel to the building walls wherever possible.
 - 2. Install all piping to accurate lines and grades.
- C. Supports: Provide pipe hangers and supports as required by the International Plumbing Code.
- D. Expansion: Provide suitable provisions for expansion of pipelines wherever necessary.
- E. Do not install piping through, directly over, or in front of electrical switchgears and power panels.
- F. Caulk the spaces between the pipe and walls, ceilings, and floors gas tight.
- G. Fittings for Dismantling Piping: Provide a sufficient number of unions to allow the dismantling of all piping.

3.2 TESTING

- A. When the installation is complete, test all pipelines in the presence of the Engineer and the Plumbing or Building Inspector in accordance with the requirements of the local and state plumbing codes, at no additional cost to the Owner. Provide all necessary equipment and utilities.
- B. Test underground piping prior to backfilling.
- C. Test piping prior to application of paint and insulation.

- D. Separately test portions of piping which will be concealed before completion.
- E. Procedure:
 - 1. Fuel Gas Piping: Test with compressed air at 15 psi for 30 minutes with no loss in pressure at test gauge. Bubble test all fittings and joints with a soap/water solution.
 - 2. Isolate any equipment that cannot withstand test pressures prior to any testing.
- F. Repairs:
 - 1. Should leaks be found, repair as required even to the extent of disassembling and remaking the joints, or replacing sections of pipe.
 - 2. Caulking of threads or the use of chemical compounds to correct leaks will not be permitted.
 - 3. Replace defective pipe and fittings and repeat tests until the testing results are approved by the Engineer.

3.3 PAINING AND IDENTIFICATION

- A. All plumbing piping, valves, pumps and equipment shall be painted and labeled in accordance with Specification Section 09900.

END OF SECTION

SECTION 15600HVAC - GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Work included:
1. Furnish all labor, materials, equipment and transportation as required to completely install the heating and ventilation system as shown on the Drawings and as specified herein.
 2. The heating and ventilating work shall include, but not be limited to the following:
 - a. Ductwork and devices.
 - b. Air moving and air handling equipment.
 - c. Automatic temperature control systems.
 - d. Balancing air systems.
 - e. Installation of components and devices furnished by other trades that are located in Heating and Ventilating piping, ducts, or equipment.
- B. Related Work Specified Elsewhere (When Applicable) :
1. Excavation and backfill is specified in Division 2.
 2. Concrete is specified in Division 3.
 3. Structural steel is specified in Division 5.
 4. Painting is specified in Division 9.
 5. Pipe Sleeves and Seals are specified in Section 15092.
 6. Pipe, insulation, ductwork, dampers, fans, etc., are specified in the appropriate Sections in this Division.
 7. Electrical Work:
 - a. The H&V work shall include the installation of all motors, temperature controls, limit switches, etc., as herein specified. All 480-volt, 208-volt, and 120-volt wiring and connections, and all motor starters, not specified in this Section, will be provided under Division 16 - Electrical.
 - b. All 24 volt wiring and auxiliary devices required for the specified systems, equipment and operations indicated in this Section shall be provided under this Section, unless specifically indicated on the Drawings related to Division 16 - Electrical. This shall include, but is not necessarily limited to, all wiring for automatic temperature and damper modulation control.
 - c. The materials and methods for all electrical work provided under this Section shall comply with the requirements specified under Division 16 - Electrical. Coordinate equipment ratings, starter sizes, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages with Division 16.
- C. Design Criteria: The Drawings do not show every detail of pipe, valves, fittings, hangers and equipment which are necessary for the complete installation, but are provided to show the general arrangement and extent of work to be performed.

1.2 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings as specified in the General Conditions of the Construction Contract and as stated in each Section.
- B. Submit manufacturer's installation, operation, and maintenance information for all mechanical equipment as specified in the General Conditions. Information shall consist of, but not be limited to, the following:
 - 1. Manufacturer's operation & maintenance manuals.
 - 2. Parts List.
 - 3. Address of local suppliers for parts.
 - 4. Address of local factory approved service organizations.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the care and protection of all materials and mechanical work until the project is accepted by the Owner.
- B. Immediately remove from the construction site all materials damaged and/or destroyed and replace with new materials to the complete satisfaction of the Engineer without additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide and install only new materials and equipment and of the latest design of the respective manufacturers.
- B. All materials and equipment of the same classification shall be the product of the same manufacturer unless otherwise specified.
- C. Provide all electrical specialties and accessories as specified with the equipment in accordance with requirements of Division 16. All specialties and accessories shall meet the NEMA Electrical Classification of the space in which they are installed. See Drawing Sheet E-1 for the NEMA Schedule.
- D. Furnish to the proper trades, all manufacturer's wiring diagrams for installation of mechanical equipment.
- E. Provide tee fittings, elbows, reducers, sheet metal safing, and other required components to install equipment and control devices furnished by other trades.
- F. Furnish and install all necessary supports and bases for all items furnished under HVAC as required for the specific item/equipment to provide alignment to adjacent inlet and outlet interconnecting piping and/or ductwork. In the absence of specific details within the Contract Documents for the supports and bases, submit proposal outlining supports/bases for the specific item/equipment being provided including materials of construction, size, components and other necessary details for review and acceptance by the Engineer. Materials of construction shall be suitable for the intended operating environment. Standard 4-inch concrete housekeeping pads are not included within this specification and are furnished by others.

2.2 BOLTS, ANCHOR BOLTS AND NUTS

- A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.

- B. All bolts, anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated below or specified elsewhere.
 - 1. Galvanized steel in accordance with Division 5 unless otherwise indicated below or specified elsewhere.
 - 2. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
 - 3. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all submerged applications, including but not limited to the headworks, dewatering rooms, chemical rooms, clarifiers, aeration basins, splitter structures, equalization or storage tanks, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.

2.3 EQUIPMENT AND VALVE TAGS

- A. All new plumbing and HVAC (Mechanical Systems) equipment shall be identified by a color coded equipment/valve tag, provided and installed by the Contractor. Contractor shall submit a complete list of proposed Identification Tag information and it shall be reviewed by the Engineer and Owner and revised as indicated. In general, tag information shall match the information provided on the Drawings.
- B. Tags shall conform to the following specifications:
 - 1. The tags shall be 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. Top hole size is 5/32" for hanging tags.
 - 2. Tags shall be available in 7 different outside colors. Owner and Engineer shall select up to 4 different colors for the project.
 - 3. Tags shall have up to three lines engraved on a side and eight characters per line of identification information. Tags shall be engraved one side.
 - 4. Tags shall be secured to valves with nylon cable ties or adjustable stainless steel bead chain. Securing method shall be selected by the Owner and Engineer.
 - 5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two SS screws or SS pop rivets.
 - 6. Tags shall have a service temperature of -40°F to 175°F
 - 7. Manufactured by Seton Name Plate Corporation, New Haven, CT, Brimar Industries, Garfield, NJ, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all work with a neat and orderly appearance, as specified and as shown on the Drawings.
- B. Make all installations structurally sound throughout.
- C. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, work of other trades, and traffic areas.
- D. Perform all work incidental to the installation of the apparatus and materials including, but not limited to, cutting, patching, trenching, excavating, backfilling, trench covering, plastering and the constructing of chases, slots, furring, foundations,

piers and pads, when applicable. All work shall be performed in accordance with the applicable Divisions of this Specification by qualified workmen regularly employed in the applicable trades.

3.2 CLEANING

- A. Do not allow refuse and surplus materials to accumulate and obstruct the construction site.
- B. Upon completion of the installation, remove refuse and surplus materials from the construction site and leave the building neat and clean.

3.3 BALANCING

- A. Balancing of air and water system flows shall be in accordance with Section 15907.

3.4 IDENTIFICATION

- A. All HVAC piping, valves, pumps and equipment shall be painted and labeled in accordance with Specification Section 09900 or as specified herein.

END OF SECTION

SECTION 15604AUTOMATIC TEMPERATURE CONTROL (ELECTRIC)PART 1 - GENERAL1.1 DESCRIPTION

- A. Furnish, install and test an Automatic Temperature Control (ATC) system of the type and function required on the Drawings and as herein specified.
 - 1. Type of System: Electric.
- B. Related Work Specified Elsewhere: "HVAC - General" is specified in this Division. "Cabinets and Enclosures" is specified in Section 16160.
- C. Other Trades: The automatic temperature control trades shall coordinate and supervise other trades whose work affects the control systems.
- D. Work Performed by Other Trades: The following incidental work shall be furnished by the designated trade under the supervision of the automatic temperature control (ATC) trade:
 - 1. The heating/cooling trades shall:
 - a. Install automatic valves and separable wells that are specified to be supplied as a portion of the control systems.
 - b. Furnish and install all necessary: valved pressure taps, water, drain and overflow connections and piping.
 - 2. The sheet metal trades shall:
 - a. Furnish and install all automatic dampers.
 - b. Provide necessary blank-off plates required to install dampers that are smaller than duct size.
 - c. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
 - d. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.
 - e. Provide access doors or other approved means of access through ducts for service to control equipment.

1.2 QUALITY ASSURANCE

- A. The system shall be installed, tested, and balanced by competent mechanics regularly employed by the temperature control manufacturer.
- B. Acceptable Manufacturers:
 - 1. Honeywell.
 - 2. Johnson Service Co.
 - 3. MCC Powers
 - 4. Barber-Coleman
 - 5. Robertshaw
 - 6. or equal

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop drawings shall be submitted for approval as required by the General Conditions. Shop drawings shall consist of, but not be limited to, the following:
1. Manufacturer's literature for all equipment including maintenance and operating instructions and parts lists.
 2. Description of operation for all systems.
 3. Electric wiring diagrams showing all wiring, and equipment including all interconnections on a terminal to terminal basis. Refer to ladder wiring diagrams shown on the Drawings. Note any discrepancies due to actual system submitted.
 4. Panel layouts for all local and central panels, and panel sizes.
 5. Valve and damper operator schedule showing size, configuration, capacity and location of all equipment.
 6. A detailed explanation of any control system that is different, or will function differently than that specified.

1.4 JOB CONDITIONS

- A. Scheduling of Work: Schedule all work so as not to delay the work of other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
1. The control system shall consist of all thermostats, temperature transmitters, controllers, automatic valves and dampers, damper operators, control panels, and other accessory equipment to fill the intent of the specification and provide for a complete and operable system.
 2. All 24 volt control wiring shall be provided by the automatic temperature control contractor as shown or required to provide a complete system.
 3. Refer to Drawings for electrical wiring and interlocks.
 4. All panels and devices shall meet the NEMA electrical classification of the space in which they are installed. See Drawing Sheet E-1 for NEMA schedule.
- B. Industrial Temperature Controller:
1. Furnish and install industrial/heavy commercial grade, Temperature Controllers in NEMA 12, 3R, 4/4X process and production areas capable of controlling heating and cooling equipment through motor starters, variable speed drives, industrial relays or other equipment control devices.
 2. The temperature controller shall be programmable for staged on-off heating and cooling control with front mounted program pushbuttons with LCD backlit display to show current temperature, setpoint and programming modes.
 3. Temperature controller shall be wall mounted in a metal enclosure. The enclosure shall meet the NEMA requirements of the area in which they are installed. Minimum rating shall be dust tight, NEMA 12.
 4. Power shall be 120 VAC with battery backup or programmed parameter stored in non-volatile memory.
 5. The controller will include a minimum of four (4) form C contacts rated a minimum of 5 amps at 120 VAC.

AUTOMATIC TEMPERATURE CONTROL (ELECTRIC)

6. Differential shall be programmable from 1-5 °F.
 7. Temperature sensor shall be a shielded and water tight platinum RTD temperature sensor mounted external to the control enclosure or remotely mounted as required.
 8. In areas of a building that comply with the Americans with disabilities act, thermostats shall be mounted at a height of 48" above a finished floor.
 9. Honeywell Model T775, Johnson Controls, or equal.
- C. Duct and Immersion Thermostats:
1. Duct and immersion thermostats of the single input type shall have integral setpoint adjustments and throttling ranges adequate for the application. Duct thermostats shall have sensing elements of sufficient length and accuracy to measure average duct temperature in each location.
 2. Controllers shall be designed and constructed for equipment room use and shall not be affected by ambient temperature and humidity.
 3. Duct mounted or immersion type shall have spans of one hundred degrees or two hundred degrees Fahrenheit as required. Averaging element sensors shall have a minimum nine-foot capillary element. Temperature sensors shall be of rigid stem using bimetallic sensing elements except where averaging is required.
 4. Sensors shall be of corrosion resistant construction, tamper proof, suitable for mounting on a vibrating surface. If capillary, shall be temperature compensated and armored or installed in protective tubing.
 5. All sensing elements for water pipe mounting shall be furnished complete with separable protecting wells filled with heat conductive compound. Sensors shall be factory calibrated and tamper proof. If easily adjustable sensors are provided, they shall be located inside metal enclosures with cylinder lock and key to prevent unauthorized setting.
- D. High Temperature Safety Thermostat:
1. Electric: High temperature safety thermostat shall be duct mounted manual reset type with adjustable setpoint. (75-165 degrees F).
- E. Thermometers:
1. A thermometer shall be located adjacent to each rigid stem thermostat. A dual thermometer with liquid-filled remote system shall be mounted adjacent to each remote bulb thermostat. Averaging bulb thermometers shall be used where averaging bulb thermostats are required.
 2. Provide duct-type thermometers in all fresh air intake, mixed air, return air, and all supply fan discharges and elsewhere where noted or shown. Thermometers shall have the proper range scales for the locations where installed.
 3. Panel-mounted indicating thermometers shall be minimum two inches' diameter.
- F. Duct-mounted Airflow Switch:
1. SPDT paddle-type or thermal dispersion proof- of- airflow switch, for mounting in ductwork of ventilation equipment serving Class 1/Division 2 rated areas and Unclassified rated areas in accordance with NFPA 820.
 - a. Paddle type: Stainless steel paddle, range adjustment screw, 120 Volt, 16 FLS AC rated. Unit shall have NEMA 4X or NEMA 7 enclosure in areas

- requiring same. Furnish switch, for mounting in ductwork by mechanical contractor; provide wiring to ATC panel. Dwyer V4, Johnson Controls, or equal.
- b. Thermal dispersion: 316 Stainless steel sensor head, NEMA 4X and Class 1 Division 1&2 rated powder coated housing, 120VAC, 4W. Ameritrol FX, Johnson Controls, or equal.
- G. Dampers:
1. All control dampers shall be furnished as part of Section 15862.
 2. All dampers shall be installed by sheet metal trades.
- H. Damper Operators and Linkages:
1. Damper operators shall be electric open-close or fully proportioning as indicated or required.
 2. Linkages shall be suitable to connect operator to damper leaves and transmit full torque of motor. All necessary hardware shall be included with the linkages.
 3. Damper motors shall be quiet in operation and shall have ample power to overcome friction of damper linkage and air pressure acting on louvers to position dampers accurately and smoothly. The damper operator mounting arrangement shall be outside the airstream wherever possible.
 4. The operators shall be capable of operating at varying rates of speed to correspond to the dictates of the controllers and variable load requirements. The operators shall be capable of operating in sequence when required by the sequence of the operation. The operators shall have external adjustable stops to limit the stroke in either direction. The operator linkage arrangement shall be such as to permit normally open or normally closed positions of the dampers as required.
 5. Electric Operators:
 - a. On-off, reversing, or proportional as required.
 - b. Spring return to closed or open position as required.
 6. Dampers associated with emergency generator cooling shall fail open on loss of electrical power.
- I. Electric Humidistats:
1. Humidistats shall be line or low voltage with an adjustable setpoint range as indicated or required. Contacts shall be rated to handle the current load for the application.
- J. Miscellaneous Devices:
1. Provide all the necessary relays, positioners, clocks, transformers, etc. to make a complete and operable system.
 2. Locate these devices on local panel unless specified otherwise.
- K. Miscellaneous Hand Switches and Indicator Lights:
1. Size: 30 mm
 2. All indicator lights shall be 120V AC, LED with push to test option.
 3. Reference Section 16900 for additional specifications.
 4. Number of positions and nameplate legends shall be as indicated in Paragraph 3.1 of this specification.
- L. Relays:

1. Pilot duty relays shall be Form C, UL listed, two (2) to four (4) pole relay with DIN rail mounted base rated a minimum of 5 amps at 120 VAC. Relay shall have indicator and mechanical test pushbutton.
 2. Industrial relays or contactors shall be used to directly drive 120 VAC single phase equipment.
 3. Refer to Section 16900 for additional requirements.
- M. Panels:
1. Panels shall be provided to enclose all relays, switches, and controllers as required.
 2. Required indicating and control devices shall be installed in the cover.
 3. Terminal strips shall be provided for all electrical connections.
 4. Panels shall be central and/or local as indicated or required.
 5. Control Panels shall be provided in accordance with Section 16160 and NEMA schedule on drawing sheet E-1.
- N. Timer/Controller: Repeat Reset Cycle Timers shall be rated 120 volts. The cycle shall automatically reset to origin upon loss of power. The "ON" timing circuit shall be continuously adjustable up to a period of 60 minutes. The "OFF" timing circuit shall be continuously adjustable up to a period of 10 hours. Both circuits shall have a minimum setting of 3% of range. Setting accuracy shall be 10% of range maximum. Timer life shall have a warrantee through 10,000,000 operations (no load). An LED cycle progress annunciator shall be provided with each timing circuit. Contacts shall be NO and/or NC as detailed on the Drawings, and shall be rated 7 amperes at 125 volts. Repeat, Reset cycle Timers shall be suitable for recessed panel mounting, and shall be Automatic Timing Controls 342 series, Omron Electronics, or equal.
- O. Combination Horn/Strobe Unit: 24V, polycarbonate weatherproof, surface mounted combination horn/strobe unit (unmarked). The unit shall be powered and controlled by the associated ATC panel. The horn and strobe circuits shall be capable of independent operation. Edwards Signaling 868 STR series, Eaton, or equal.

PART 3 - EXECUTION

3.1 DESCRIPTION OF OPERATION

- A. Evergreen PS Drywell Ventilation:
1. Controlled by the following associated with the ATC panel:
 - a. Hand/Auto switch
 - b. Light status relays (provided by Division 16). Provide wiring to dry contacts; coordinate locations with electrical contractor and electrical plans; refer to ATC riser diagrams for additional information.
 2. When the lights in the space served are energized, the space shall be considered occupied; when the lights are de-energized, the space shall be considered unoccupied.
 3. If the space is occupied OR the switch is in "Hand" position;
 - a. AHU-EG1
 - i. The motorized return air damper shall be closed fully.
 - ii. The motorized outside air damper shall be open fully.
 - iii. The fan shall be energized and operate continuously at the design

- airflow.
- b. EF-EG2
 - i. The motorized backdraft damper (existing) shall open.
 - ii. The fan shall be energized.
 - iii. The VFD shall modulate the fan speed to operate at the design airflow.
4. If the space is unoccupied AND the switch is in the “Auto” position:
- a. AHU-EG1
 - i. The motorized return air damper shall be open to allow 75% of the design airflow to be recirculated to the unit.
 - ii. The motorized outside air damper shall be open to allow 25% of the design airflow to be introduced from the outside.
 - iii. The fan shall be energized and operate continuously at the design airflow.
 - b. EF-EG2
 - i. The motorized backdraft damper (existing) shall open.
 - ii. The fan shall be energized.
 - iii. The VFD shall modulate the fan speed to operate at 25% of the design airflow.
5. Safeties:
- a. Duct-Mounted Flow Switch: If either proof-of-flow switch (FSL-EG1 or FSL-EG2) indicates a lack of air flow the associated horns and strobes (H/S-EG1, H/S-EG2, & H/S-EG3) shall be activated.
 - i. Maintenance Switch: Provide two position selector switch on door of ATC panel. Label switch “Ventilation Monitoring Alarm” and the positions “Maintenance” and “Active”. The switch shall disengage the operation of the horns and strobes when in the “Maintenance” position.
- B. Evergreen PS Drywell Heating & Cooling:
1. AHU-EG1
 - a. The packaged unitary controls and manufacturer provided remote controller/sensor shall modulate the unit (compressors, hot gas reheat, gas furnace, etc.) as necessary to maintain the setpoints.
 - i. Cooling:
 - (1) Space temperature - 85°F (adj.)
 - ii. Heating:
 - (1) Space temperature - 55°F (adj.)
 - (2) Discharge air temperature - 55°F (adj.)
 - iii. Dehumidification:
 - (1) Space relative humidity - 50% (adj.)
 - (2) Discharge air temperature - 70°F (when space cooling not required and unit in dehumidification mode)
- C. Evergreen PS Wetwell Ventilation:
1. Controlled by the following associated with the ATC panel:
 - a. Hand/Off/Auto switch
 - b. Run cycle timer

- c. Outside air temperature sensor
 - d. Light status relays (provided by Division 16). Provide wiring to dry contacts; coordinate locations with electrical contractor and electrical plans; refer to ATC riser diagrams for additional information.
2. When the lights in the space served are energized, the space shall be considered occupied; when the lights are de-energized, the space shall be considered unoccupied.
3. Whenever the MUA-EG1 fan is energized, the gas heating shall stage as necessary to maintain a 50°F (adj) discharge air temperature.
4. If the outside air temperature is greater than 50°F OR the space is occupied OR the switch is in “Hand” position;
- a. MUA-EG1
 - i. The motorized outside air damper shall open fully.
 - ii. Damper D-EG1 shall open fully.
 - iii. Damper D-EG2 shall close fully.
 - iv. The fan shall be energized.
 - b. EF-EG1
 - i. The fan shall be energized.
5. If the switch is in the “Off” position;
- a. MUA-EG1
 - i. The motorized outside air damper shall close fully.
 - ii. Damper D-EG1 shall close fully.
 - iii. Damper D-EG2 shall open fully.
 - iv. The fan shall be de-energized.
 - b. EF-EG1
 - i. The fan shall be de-energized.
6. If the outside air temperature is less than 50°F AND the space is unoccupied AND the switch is in “Auto” position;
- a. Equipment shall be controlled by the run cycle timer on repeating schedule:
 - i. Active:
 - (1) MUA-EG1
 - (a) The motorized outside air damper shall open fully.
 - (b) Damper D-EG1 shall open fully.
 - (c) Damper D-EG2 shall close fully.
 - (d) The fan shall be energized.
 - (2) EF-EG1
 - (a) The fan shall be energized.
 - ii. Inactive:
 - (1) MUA-EG1
 - (a) The motorized outside air damper shall close fully.
 - (b) Damper D-EG1 shall close fully.
 - (c) Damper D-EG2 shall open fully.
 - (d) The fan shall be de-energized.
 - (2) EF-EG1
 - (a) The fan shall be de-energized.

- iii. Active – 10 minutes; Inactive – 20 minutes (adj.)
- D. Blue Hills PS Drywell Modified Ventilation Controls:
1. Controlled by the following associated with panel ATC-1:
 - a. Hand/Off/Auto switch (existing)
 - b. Outside air temperature sensor (existing)
 - c. Light status relays (provided by Division 16). Provide wiring to dry contacts; coordinate locations with electrical contractor and electrical plans; refer to ATC riser diagrams for additional information. (existing)
 2. When the lights in the space served are energized, the space shall be considered occupied; when the lights are de-energized, the space shall be considered unoccupied.
 3. Coordinate dehumidification setpoint with existing condensing unit (CU-1) controls; “dehumidification is required” will refer to periods when the space humidity is greater than the setpoint and CU-1 is operating; “dehumidification is not required” will refer to periods when the space humidity is less than the setpoint and CU-1 is not operating.
 4. If dehumidification is not required AND any of the following conditions: the outside air temperature is greater than 50°F OR the space is occupied OR the switch is in “Hand” position;
 - a. HV-1 (existing)
 - i. D-BH1 shall be open to maximum position.
 - ii. The fan shall be operating at high speed to provide 100% of the design airflow.
 - b. EF-BH1
 - i. The fan shall be energized.
 - ii. The integral VFD shall modulate the fan speed to operate at 100% of the design airflow.
 5. If dehumidification is required AND any of the following conditions: the outside air temperature is greater than 50°F OR the space is occupied OR the switch is in “Hand” position;
 - a. HV-1 (existing)
 - i. D-BH1 shall be closed as needed to allow 50% of the design airflow to pass through the dehumidification coil (DC-1).
 - ii. The fan shall be operating at high speed to provide 100% of the design airflow.
 - b. EF-BH1
 - i. The fan shall be energized.
 - ii. The integral VFD shall modulate the fan speed to operate at 100% of the design airflow.
 6. If dehumidification is not required AND the outside air temperature is less than 50°F AND the space is unoccupied AND the switch is in “Auto” position;
 - a. HV-1 (existing)
 - i. D-BH1 shall be open to maximum position.
 - ii. The fan shall be operating at low speed to provide 50% of the design airflow.
 - b. EF-BH1

- i. The fan shall be energized.
 - ii. The integral VFD shall modulate the fan speed to operate at 50% of the design airflow.
7. If dehumidification is required AND the outside air temperature is less than 50°F AND the space is unoccupied AND the switch is in “Auto” position;
 - a. HV-1 (existing)
 - i. D-BH1 shall be closed fully.
 - ii. The fan shall be operating at low speed to provide 50% of the design airflow.
 - b. EF-BH1
 - i. The fan shall be energized.
 - ii. The integral VFD shall modulate the fan speed to operate at 50% of the design airflow.

3.2 INSTALLATION

- A. The automatic temperature control mechanics shall provide supervision and direction for all trades that are installing equipment supplied by the temperature control manufacturer.
- B. All controllers, wiring, equipment, etc., shall be installed by mechanics regularly employed by the temperature control manufacturer.
- C. Control wiring shall be neatly installed, parallel to building lines, and in locations not subject to damage.

3.3 TESTING AND COMPLETION

- A. Demonstrate the function of each system in the presence of the Engineer.
- B. Upon completion of the project, the control system provider shall:
 1. Completely adjust, ready for use, all thermostats, controllers, valves, damper operators, relays, etc., provided under this Section.
 2. Furnish three (3) instruction manuals covering the function and operation of the control systems on the project for the use of the Owner's operating personnel. A representative of the ATC systems provider shall be available on site for 8 hours of start-up and shall conduct an operational test of the system in the presence and satisfaction of the Engineer's designated representative and the Owner's representative. During this 8-hour period, the technician shall instruct the Owner's Representatives in the proper use and routine maintenance of all ATC equipment.

3.4 OPERATOR TRAINING

- A. Operator Training shall be performed by a duly authorized representative of the ATC system provider, who is fully trained in the installation, startup and operation of the equipment.
- B. Provide combined training and operational assistance for plant operators in the proper operations of the ATC system equipment, and in the techniques, methods, schedules, etc. associated with maintenance.
- C. The level of the training and operational assistance provided shall be as required to ensure proper understanding of the equipment's operations, maintenance and warranty conditions. Should the representative require time in addition to the

minimums indicated herein to sufficiently detail the proper operations and maintenance of the equipment, it will be provided at no additional cost to Owner. Under absolutely no circumstances shall warranties become void due to Owner's failure to follow operational and maintenance procedures which were not fully detailed and described in Owner's representatives during these sessions.

- D. At the Owner's discretion, the training sessions may be video recorded for Owner's future use.
- E. The system provider representative shall fill out the Equipment Training Certification form included within this Section. Training will not be considered complete until this form has been provided to the Engineer.

3.5 IDENTIFICATION

- A. Provide all control equipment, panels and manual controls with black lamacoid nameplates engraved with white letters indicating the function, tag number, service or apparatus being served.
- B. Properly number all wires and terminals where applicable.

3.6 GUARANTEE

- A. The control system designated on Drawings and plans and herein specified, shall be guaranteed to be free from original defects in both material and workmanship for a period of one (1) year of normal use and service, excepting damages from other causes. This guarantee shall become effective starting the date the Owner begins to receive beneficial use of the system.

3.7 PROGRAMMED MAINTENANCE

- A. Upon completion of the installation, the control contractor shall submit to the Owner for consideration, an agreement, to provide the necessary programmed maintenance to keep the various control systems in proper working condition.
- B. This proposed programmed maintenance agreement shall fully describe the maintenance work to be performed and shall advise the cost of this work during the 1-year guarantee period provided as part of this Contract by the ATC Contractor as well as for subsequent years thereafter.

ATC SYSTEM TRAINING CERTIFICATION

Owner: _____ Date: _____

Project: _____

Contractor: _____

ATC System Provider _____
Representative: _____

Equipment: _____

1. I have trained the Owner's personnel in the proper operation and maintenance of the above equipment.

(Authorized Representative of the ATC System Provider) (Date)

2. The personnel listed below attended the training session.

(Owner's Representative) (Date)

3. Witnessed by

Wright-Pierce (Date)

END OF SECTION

SECTION 15763AIR HANDLING UNITS
HEATING AND VENTILATINGPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install where shown on the Drawings, complete heating/ventilating and cooling units.
- B. Related Work Specified Elsewhere: "HVAC - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. Verification of Unit Output: Heating, cooling and air flow capacities shall be ARI certified.
- B. Acceptable Manufacturers:
 - 1. Reznor.
 - 2. Greenheck Fan Corp.
 - 3. Trane Company.
 - 4. American Air Filter
 - 5. McQuay, Inc.
 - 6. Or approved equal.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Gas-Fired Makeup Air Units of the size and type as shown on the Drawings.
 - 1. General:
 - a. Packaged, outdoor heating and makeup air, power vented unit. The unit shall be minimum 81% efficient, designed for slab or roof curb mounting. The gas furnace is to be arranged for ducted flue gas exhaust.
 - b. The packaged heating and makeup air system shall be design-certified to ANSI Z83.8 and CSA 2.6 Standards. The energy usage shall be designed to meet ASHRAE Standard 90.1.
 - 2. Cabinet Construction
 - a. Cabinet shall have through-the-base utility knockouts. Control, burner, and blower service compartment doors shall be hinged. Blower door hardware shall be heavy duty stainless. Control and burner door hardware shall have heavy duty external hardware.
 - b. Unit cabinet to be supplied with double wall steel construction with factory installed 1 1/2 Lb. density insulation. R value of said insulation shall be 3.8 or greater. Insulation with foil backing is not acceptable.
 - c. The packaged system shall have a pre-coat RAL 1001 white paint finish. Finish shall be a minimum 80 gloss on G90 galvanized steel.
 - d. All painted metal shall pass 1,000 hour salt spray test per ASTM B-117.

- e. Unit shall be designed with heavy 16 gauge prepainted steel rail perimeter base. Said base shall feature provisions for corner lifting, with lifting strap holes to facilitate handling and installation.
3. Combustion Air and Venting
 - a. The unit shall have a factory-installed power venter device with a centrifugal wheel and direct drive motor to draw combustion air through an inlet in the cabinet.
4. Electrical Specifications & Control Systems
 - a. All units shall be equipped with 24-volt control transformer; protective air proving switch; resiliently isolated venter motor; and a high temperature limit control. Operation shall be controlled through an integrated circuit board. The circuit board shall monitor heater operation and have LED diagnostic indicator lights to identify abnormalities in control functions.
 - b. Unit Shall be supplied with a Motor starter, IEC open, for single-speed motors.
 - c. The unit shall be supplied with factory installed disconnect. The line voltage connections to the unit shall be made through a flush-mounted, NEMA 4X switch with lock-out feature. The disconnect shall be rated for the unit MCA/MOP as shown on the schedule. The unit shall carry a rating plate showing necessary data and all approvals.
 - d. Unit shall be supplied with factory-installed GFI Convenience outlet on unit.
 - e. The unit shall have a factory installed dirty filter switch installed. The switch shall have an adjustable differential pressure range between 0.25 - 1.5 inch w.c. The switch shall be connected to the unit's controller and display and alarm when the switch makes indicating an alarm.
 - f. The unit shall operate to maintain the discharge air temperature setpoint: 70°F DAT (Range 50 – 100°F)
 - g. The unit shall operate based upon contact closure. In the occupied mode the unit supply fan shall run continuously.
 - h. The intake dampers shall operate based upon one of the following: 100% outside air 2-position. In the unoccupied period the outside air damper shall be 100% closed.
 - i. The control system shall incorporate all the necessary safeties.
5. Supply Blower
 - a. The unit blower shall include an adjustable belt-driven centrifugal fan.
 - b. The blower assembly shall be factory set to specified CFM at the given static pressure.
 - c. The blower assembly shall have adjustable sheave for airflow adjustment.
 - d. The blower assembly shall be shipped with spare belts.
6. Air Intake: Unit to be furnished with factory supplied 100% outside air screened inlet hood with moisture eliminator louvers.
7. Supply Motor: Unit shall be supplied from factory with EPACT compliant TEFC blower motor.
8. Filtering: Blower cabinet shall have Filter Section with an integral filter rack and 4" Pleated Filters.

9. Fuel & Burner Type
 - a. Unit to be supplied for operation with natural gas as fuel source.
 - b. Units to be supplied from factory adjusted for installation at altitudes from elevations sea level-2000 Feet.
 - c. Burner shall be of a single body design with Stainless Steel face insert. Said burner shall require one orifice supplying multiple heat exchanger tubes.
 - d. The units shall incorporate a single, one-piece burner assembly with a single orifice per staging. The burner shall have a continuous wound close pressed stainless-steel ribbon separating the flame from the burner interior.
 - e. All units shall have a single venturi tube and orifice supplying fuel to a one-piece burner housing per staging.
 - f. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control.
10. Gas Train, Controls & Ignition
 - a. Gas controls for furnace shall be designed for makeup air heating application.
 - b. The unit shall have electronic modulation offering at least full modulation to 28% of full fire (capacity) input rate (Note: 50% modulating gas valves will not be accepted).
 - c. Modulating gas control shall be certified by CSA for use in the United States and Canada.
 - d. The furnace shall maintain an average thermal efficiency over the range of modulation that is equal to or exceeds the full input rate thermal efficiency.
 - e. The furnace shall ignite at any fire rate within its modulation range, not just high fire on start.
 - f. Furnace shall be provided with an electronic modulating gas regulator which provides for firing rates between 25% and 100%, or 4 to 1 turndown ratio, while maintaining part-load thermal efficiency to comply with and exceed the current 75% minimum requirement of ASHRAE 90.1.
 - g. A main redundant safety shut-off valve shall include a servo regulator which maintains constant gas pressure to the modulating regulator under wide variations in gas supply pressure. Said valve shall also include the safety pilot valve, and the manual shutoff valve. On/off control of the unit shall be by external control system.
11. Heat Exchanger
 - a. Heat exchanger shall be manufactured from die-formed halves of 316 Stainless Steel.
 - b. Manufacturer shall provide said unit with a 10-year extended (Parts only) warranty on the heat exchanger. (Non-Prorated)
 - c. Note: Manufacturer's Limited Warranty for heat exchangers applies. Refer to written limited warranty for terms.
 - d. The heater shall be equipped with a multicell, 4 pass serpentine style steel heat exchanger. Heat exchanger tubes shall be press fabricated.

- e. All heat exchangers shall be fabricated with no welding or brazing, only tool pressed mechanical joints. All heat exchanger cells shall be designed with an aerodynamic cross section to provide maximum airflow.
- f. Furnace Section shall have a factory-installed Heat Exchanger Condensate Drain.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coil piping connections shall be made with unions or flanges, and in such a manner that piping can be easily removed to allow for coil removal.
- B. Install unit so as to provide access to all moving parts, grease fittings, and access doors or panels.
- C. Install unit to allow for coil removal.
- D. Install second set of filters in unit after final clean-up, and prior to final acceptance of the building. Provide the third set of filters to the Owner.
- E. Do not operate unit without filters in place.

END OF SECTION

SECTION 15764AIR HANDLING UNITS
HEATING/VENTILATING & COOLINGPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish and install where shown on the Drawings, complete heating/ventilating and cooling units.
- B. Related Work Specified Elsewhere: "HVAC - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. Verification of Unit Output: Heating, cooling and air flow capacities shall be ARI certified.
- B. Acceptable Manufacturers:
 - 1. Reznor.
 - 2. Greenheck Fan Corp.
 - 3. Trane Company.
 - 4. American Air Filter
 - 5. McQuay, Inc.
 - 6. Or approved equal.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Packaged Air Handling Units of the size and type as shown on the Drawings.
 - 1. A. DX Cooling
 - a. Furnish and install packaged air handling unit for treatment of up to 100% constant outside air per plans and specifications. Unit shall be completely factory assembled, tested, internally wired, fully charged with Refrigerant R410A, and shipped as one piece. Unit shall consist of foam insulated weather-tight casing with optional field installed outdoor intake hood, compressors, air-cooled condenser coils, condenser fans, evaporator coils, supply fan, motors and drives, and unit controls. Packaged Cooling and Heating Units shall carry an ETL listing.
 - b. DX systems shall be designed to provide 10% to 100% incremental capacity control for treatment of up to 100% outside air with up to 80 degree F dewpoint entering the unit. Unit shall have hermetic compressors with a scroll design with internal pressure relief and motor temperature winding protection. Compressor shall be equipped with reversal rotation protection. Refrigeration protection shall include low and high pressure switches, refrigerant circuit frost protection, liquid line filters/dryers and service gage ports. The unit shall have a factory installed refrigerant charges to provide unit performance as shown in the schedule. Low pressure switch shall operate at 35 psi or lower pressure. The auto reset

- low pressure switch shall not reset until the pressure rises about 50 psi. The manual reset high pressure switch shall operate above 600 psi with 15 psi. The unit will not reset without a user manually pushing the reset button and the refrigerant line pressure is below 400 psi. Refrigeration control shall include thermal expansion valves, external equalizers and distributors for each compressor circuit.
- c. The refrigerant system shall have a non-user adjustable 5 minute minimum ON and minimum OFF timer circuit protection. The refrigerant circuit shall have an anti-cycle timer in addition to the minimum ON/OFF timer that prevents the compressor(s) from cycle on the minimum timer circuit.
 - d. The refrigerant system shall include evaporator coil. The copper tube-aluminum plate fin evaporator coil shall be 4 rows with 14 fins per inch to meet leaving air performance as shown on the unit schedule. The multi-circuit evaporator coils shall be interlaced configuration. The entire coil face area shall be active with a single circuit or multiple circuit activation such that the entire coil face shall provide air cooling and dehumidification in part load operation. Split coil face design not acceptable because it does not allow full active face area for dehumidification in the part load operation. The evaporator coils shall be protected from frosting by a low temperature cutout. The factory installed froststat on each circuit shall interrupt power to the associated compressor when the temperature drops below 35°F. The frost stat shall not deactivate until the circuit temperature rises to 50°F. The coils shall be leak tested at the factory to ensure pressure integrity. The unit shall include air cooled condenser coils sized to provide the unit performance as shown in the mechanical schedule. The condenser coil shall be light weight 5/16 copper tubing with aluminum fins. The condenser shall be compact 2 row coil design with low refrigerant volume.
 - e. The condensate drain pan shall be rust proof or high corrosion resistant 316 stainless steel. The drain outlet shall be attached to a double sloped drain pan with a minimum 1/8 inch per foot slope. The drain pan shall collect potential condensate from all evaporator/condenser coils and distributor area in the air stream to prevent blow-off condensate reaching unprotected bottom unit surfaces. The unit shall have field supplied and installed P trap, in accordance with all local and area codes and Best Practices.
 - f. The unit shall be supplied with standard efficiency condenser fan motor(s) rated for the necessary condenser coil airflows. The condenser fans shall be accessible for servicing. The condenser fan system shall be dynamically balanced at the factory and installed with vibration dampening to reduce ambient noise.
 - g. Factory installed hot gas bypass options shall be available on all fixed capacity refrigerant stages in addition to multiple steps of capacity modulation to supplement discharge air control. The hot gas bypass valve shall have a range of 95 -115 psi with a factory setting of 105. (SST 33.7F) The valve shall be rated to handle 30% of the associated compressor

- capacity. The HGBP circuit shall be equipped to prevent reverse flow through the valve.
- h. The unit shall have a factory installed removable condenser coil hail guard providing protection from large debris and hail that can cause significant damage to the condenser coils. The hail guard shall not obstruct condenser airflow or add significant condenser fan static pressure. The hail guard shall prevent half-inch diameter debris from hitting the condenser coil.
 - i. The condenser coils shall be copper tube and aluminum fin design. The coils shall be light weight and low refrigerant volume with the use of 5/16 copper tubing.
 - j. The evaporator coil(s) shall be copper tube and aluminum fin design. The evaporator coils shall be interlaced, 4 row design maximizing latent performance as shown on the unit's mechanical schedule.
 - k. Unit shall include DX based reheat. The method of reheat shall comply with ASHRAE 90.1 requirements. Unit shall include a dedicated compressor and refrigeration circuit using full condenser reheat or total heat of rejection to the supply airstream. The reheat coil position shall include a minimum separation of 10 inches from the cooling coil to eliminate re-evaporation of cooling coil condensate. The circuit shall be capable of delivering a nominal 13°F to 17°F temperature rise from the main evaporator temperature without the need for modulating the capacity for all entering outside air conditions. The reheat system shall modulate to maintain the user adjustable unit leaving air temperature setpoint while also maintaining a constant evaporator temperature setpoint. The reheat coil shall operate down to 50°F ambient temperature without the need of low ambient kit. The reheat coil shall provide greater than 7 COP efficiency at 65°F db / 64°F wb entering air temperature. Manufacturer shall show unit performance at above condition. The refrigerant circuits shall include thermal expansion valves with external equalizers. Service gage ports and refrigerant line filter dryers are factory installed as standard. Pre-cooling coils shall be two row depth with 6 fin per inch to minimize air pressure drop.
2. Gas Heating
- a. The system shall be provided with gas heat with the capacity shown the schedule. Gas heating system shall be factory install consisting of heat exchanger, venter fan, spark ignition system, control valves and all necessary safeties to provide a fully operational heating system ready for operation from the factory. The heat exchanger shall be constructed of 409 stainless steel for make-up air applications. The heat exchanger shall properly drain condensate or other water during the heating and cooling season. The system shall modulate both the gas and combustion air to maintain temperature setpoint(s) and thermal efficiency. The heat exchanger shall be capable of 100°F temperature rise for 100% outside air treatment. The heating system shall be certified to ANSI Standard Z83.8/CSA 2.6. The heat exchanger shall be 4 pass serpentine, non-

- welded, constructed of 316 stainless steel. Safety Features shall consist but not limited to:
- i. Automatic discharge air limit control.
 - ii. Air proving pressure switch.
 - iii. Color coded wiring and matching terminal blocks.
 - iv. Circuit breaker protected transformers
- b. The gas heating shall utilize natural gas.
 - c. Heating system shall have a minimum thermal efficiency of 81%. The thermal efficiency shall not fall below 80% through the modulated operational range. The Heat exchanger shall have condensate drain to remove and/or prevent water build up in the unit. The condensate shall be piped to the appropriate building system for removal.
 - d. Provide 5:1 power vented modulation. The single gas heat section shall have a single modulating gas valve with spark ignition controls. The modulating valve shall allow capacity control from 20 to 100%. (5:1). The gas control shall consist of ignition board, 2-speed venter, flame sensor, igniter, gas valve and associated safeties. The spark ignition board shall have LED status & diagnostic. The unit shall lock out heating system for the following failures: venter pressure switch failure, ignition lockout, excessive limit switch losses and excessive flame sense losses. The gas control system shall be designed to maintain constant gas efficiency throughout is modulated range. The control system shall allow 50% capacity ignition for 1-2 minutes than it shall allow the valve to modulate to maintain the active discharge air or space temperature setpoints.
3. Cabinet
- a. Unit shall have foam panel construction for all exterior surfaces and base. The foam insulation shall meet ASTM E-84 with a flame spread of 20 and smoke density of 300. No foam panel acceptable if unit construction exceeds R12 value, no exposed installation air stream and exceed flame safety characteristic of foam paneling. Outer casing shall be fabricated from G90 galvanized steel substrate with 60 gloss painted finish coat. Finish shall be rated for > 1000 salt spray hours. The cabinet design shall prevent condensation forming on the outside of the unit casing in operation via a dedicated thermal break from all internal components to the external surface. Fully gasketed, hinged doors of foam construction shall provide access to filters, dampers, evaporator coils section, supply fan section. Provide hinged single wall construction doors for the heater section and control section. On hinged doors frequently used for service (i.e. filter and coil access) The unit control panel section shall be laid out to provide separation of high and low voltage components per UL standards. High voltage contactors & distribution shall be touch safe. The control panels shall be hinged for easy access to the unit controls. For ease of service, all electrical components will be clearly identified with 1/2 inch diameter self-adhesive labels to match the unit specific wiring diagram. The low voltage and unit controller access electrical panel shall be physically isolated from the high voltage section. The open door to the control section

reveals the wiring diagrams, DDC programming instructions and all manuals and literature protected and permanently attached to the cover. Control transformers will incorporate integral, resettable circuit breaker protection.

4. Supply Fan

- a. The unit's supply fan shall be direct drive with an ABB variable frequency drive allowing peak fan efficiency and system RPM. The fan system shall be made of galvanized steel. The impeller shall have RAL 5002 coating, directional arrows marketing. The fan sled shall allow up to 176°F for the impeller and the motor shall allow ambient temperatures -4°F to 104°F. The impeller and motor shall be designed for continuous operation. The 7 blade, welded construction impeller shall be dynamically balanced at the factory with hub; admissible vibration level less than 0.11 in/s in conformity with ANSI/AMCA 204.
- b. The supply fan sled shall have slide out design for easy inspection and replacement.
- c. The fan sled shall also allow inspection of the gas or electric heat exchangers.
- d. The fan sled shall have rubber dampers to isolate and minimize vibration.
- e. The fan sled shall include inlet cone with measuring device for airflow measurement. The packaged unit shall allow fan inlet differential pressure readings inside the control panel to measure supply fan CFM with an accuracy of +/-5%. The unit controller shall allow fan speed settings for occupied and unoccupied modes. The unit controller shall also allow fan speed settings for heating and cooling modes. The unit shall meet the schedule performance. The unit control system shall have test and balance function to allow permanent setting of the airflow(s) as shown in the mechanical schedule.
- f. The ABB frequency drive shall be factory installed with line reactor, ECM Filter and all necessary wiring per UL standard. The drive shall have built in menu drive display with test, start-up, maintenance and diagnostic assistant. The drive shall be factory programmed for 30 second soft start. The drive shall have the following protection and alarms: single phase, overvoltage trip limit, under voltage trip limit, over temperature, microprocessor fault, motor stall protection, motor over temperature.
- g. Supply fan shall be controlled constant volume

5. Intake & Section

- a. Unit shall include outdoor air hood design for 100% airflow to allow uniform coil velocity and filter loading. The motorized damper shall be spring return for closure during unit shutdown or power interruption. Outdoor air inlet hood shall include 1-inch permanent filters and screen. Hood filter and screen shall meet MERV 4 rating. Hood airflow shall not exceed 300 fpm intake velocity to prevent snow and rain entrainment. Units designed for 100% outside air intake only shall include an integrated transition section (without return air opening) designed specifically for 100% outside air introduction

- b. Units shall be available with fully integrated factory installed 100% motorized outdoor damper and return damper.
 - c. The damper(s) shall have 4 position damper control: Sensors/Signal: Quantity 2, user supplied, dry contact closures. (4 wires) Sequence: Whenever the supply fan is ON in the occupied mode, the dampers will open to a user defined % of outside air based upon 2 dry contact closure inputs. When the supply fan is on in the unoccupied mode the dampers will open to a second user defined % of outside air based on 2 dry contact closure points. When the supply fan is OFF, the dampers will be closed to outside air.
 - d. Damper Construction: The control damper shall be low leak with blade and jamb seals. The damper leakage shall not exceed 10 cfm per square foot at 4" sp. The damper shall be constructed of 16 gage galvanized steel with reinforcement to insure structural integrity. Blade edge seals shall be PVC coated polyester fabric suitable for -25°F to +180°F mechanically locked into the blade edge. Jamb seals shall be flexible stainless-steel metal, compression type to prevent leakage between end of the blade and the damper frame. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Linkage shall be concealed out of airstream, within the damper frame to reduce pressure drop and noise and lessen the need for maintenance.
 - e. The unit shall have factory installed 4" MERV 8 filters before the evaporator coils. The filters shall be accessible through a hinged door. None hinge door access is not acceptable. The filters shall be pleated V configuration with an average arrestance of 95%; MERV Rating 8 per ASHRAE 52.2-99. The filters shall be manufactured from recycled synthetic material with moisture & microbial growth resistant properties. The filter shall have less than 0.36" w.c. pressure drop at 500 fpm air velocity. The filter area shall be sized to handle the rated airflow as shown on the mechanical schedule.
6. Full Perimeter Curbs:
- a. Manufacturer shall furnish a 36" Tall Curb, with Horizontal Discharge, capable of up to 10,000 cfm. Shall be a full perimeter curb with integral horizontal supply air and return air ductwork and duct connections. The horizontal airflow curb shall be designed for slab installation.
7. Make-up Air Control System.
- a. The unit shall operate to maintain one of the following discharge air temperature setpoints during all weather conditions.
 - i. Space Cooling Required: 55F DAT (Range 50 - 100F)
 - ii. Space Heating Required: 90F DAT (Range 50 - 100F)
 - iii. Space cooling required during winter operation. 55F DAT (Range 50 - 100F)
 - iv. Neutral Air - Dehumidified: 70F DAT @ 52-55 Dewpoint (Range 50 - 100F)
 - v. Neutral Air - Heating: 70F DAT (Range 50 - 100F)

- b. The unit shall operate based upon a contact closure or a BMS command to operate in either occupied or unoccupied mode.
 - c. The mechanical heating and cooling shall operate to maintain the discharge air temperature setpoint.
 - d. The control system shall incorporate all the necessary safeties.
 - e. The alarm functionality shall include low temperature, compressor failure, sensor failure, smoke alarm, power failure, heating failure and supply fan failure. The failures shall protect the unit and displays a code at the unit's display and the optional wall mounted display. The unit will have test and diagnostics routines for services and start-up.
 - f. The control system shall be able to provide neutral air and space temperature control per the sequences of operation.
 - g. The unit shall be supplied with a wall mounted DDC temperature monitor and setpoint adjustment interface device. The wall mounted unit communicating thermostat shall provide space temperature and space humidity values back to the unit controller. The room module shall allow the user to set the space temperature setpoint and read current values. The room module shall allow the user to read alarm codes from the control system. The room interface module shall allow occupancy time schedules and direct unit mode commands.
 - h. The unit shall be supplied with factory installed disconnect. The line voltage connections to the unit shall be made through a flush-mounted, NEMA 4X switches with lock-out feature. The disconnect shall be rated for the unit MCA/MOP as shown on the schedule. The unit shall carry a rating plate showing necessary data and all approval.
8. Options:
- a. A weatherproof convenience outlet shall be provided. The outlet shall be field powered utilizing an independent circuit from the main unit power. The circuit shall be 20-amp circuit with breaker and installed per local and state building codes.
 - b. The unit shall have a factory installed dirty filter switch installed for both the unit DX filters and the energy recovery filters. The switch shall have an adjustable differential pressure range between 0.25 - 1.5-inch w.c. The switch shall be connected to the unit's controller and display and alarm when the switch makes indicating an alarm.
 - c. Unit shall have factory installed phase lost protection
 - d. Unit shall have a factory provided 5-year compressor warranty
 - e. Unit shall have a factory provided 10-year gas heat exchanger warranty

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coil piping connections shall be made with unions or flanges, and in such a manner that piping can be easily removed to allow for coil removal.
- B. Install unit so as to provide access to all moving parts, grease fittings, and access doors or panels.

- C. Install unit to allow for coil removal.
- D. Install second set of filters in unit after final clean-up, and prior to final acceptance of the building. Provide the third set of filters to the Owner.

END OF SECTION

SECTION 15820
VENTILATION FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install ventilation fans of the types and arrangement as shown on the Drawings and as specified herein.
- B. Related Work Specified Elsewhere "HVAC - General" is specified in this Division. "Electrical-General" is specified in Section 16010.

1.2 QUALITY ASSURANCE

- A. Standards
 - 1. Air Movement and Control Association
AMCA 210-85 Laboratory Methods of Testing Fans for Rating
AMCA 300-85 Test Code for Sound Rating
 - 2. National Fire Protection Association
NFPA 70-90 National Electrical Code
NFPA 90A Installation of Air Conditioning and Ventilating Systems
- B. Each fan shall be licensed by AMCA to bear the Certified Rating Seal. When this standard is not applicable, the manufacturer shall submit data to verify the fan capacity at the specified operating condition.

1.3 SUBMITTALS

- A. General: Submittals shall be in accordance with specification Section 01340.
- B. Submittals shall show physical dimensions, shaft sizes, drives, drive arrangement, motor data, electrical data and performance curves. Where there is a requirement for explosion proof motor the shop drawing will verify that the motor and associated wiring devices meet Class I, Group D, Division I requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Refer to the Drawings for the following information (when applicable):
 - 1. Specific type and size of fan.
 - 2. Electrical characteristics - voltage and phase.
 - 3. Direct or belt drive.
 - 4. Requirement for explosion proof motors including wiring devices (Class I, Group D, Division 1).
 - 5. Requirements of explosion proof fan construction shall comply with AMCA Standards handbook Publication 99-86, construction type "B".
 - 6. Special corrosion resistant coatings.
 - 7. Additional accessories and specialties.
- B. Motors:
 - 1. Totally enclosed fan cooled (TEFC) unless noted otherwise.

2. Integral thermal overload protection on single phase fractional horsepower motors
 3. ECM motors shall be DC electronic commutation type motor (ECM) specifically designed for fan applications. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
- C. Belt Drive Units:
1. Shaft seals (axial & vane axial).
 2. Belt guard (full belt enclosure).
 3. Motor cover (weatherproof for exterior mounted fans and fans in wet areas).
 4. Variable pitch sheave on motor.
 5. Idler wheel when required for belt adjustment.
 6. Adjustable motor base when required for belt adjustment.
- D. Roof Curbs:
1. Required for all roof mounted fans unless an integral part of roof structure and so shown on the Architectural Drawings.
 2. 18 inches high.
 3. Supplied with fan.
 4. Prefabricated all welded aluminum construction structurally reinforced to support fan.
 5. 1½ inch thick rigid fiberglass insulation.
 6. Wood blocking when required for fan installation.
- E. Inline Centrifugal Fans:
1. Acceptable Manufacturers
 - a. Greenheck Fan Corp.
 - b. Loren Cook, Co.
 - c. PennBarry
 - d. Or equal.
 2. Duct mounted, belt or direct driven as scheduled.
 3. Fan wheels, aluminum backward inclined.
 4. Housing, all aluminum construction.
 5. Mounting brackets and vibration isolations required for wall mounting or hanging from ceiling as shown.
 6. AMCA certified for both air and sound performance.
 7. Completely wired internally with leads brought to an external junction box.
 8. Belt drive fans shall have variable pitch sheaves selected with scheduled operating point midrange of the selected sheave.
- F. Power Roof Ventilators; Upblast Type:
1. Acceptable Manufacturers:
 - a. Greenheck Fan Corp.
 - b. Loren Cook, Co.
 - c. PennBarry
 - d. Or equal.

2. Ventilator housings: Spun aluminum construction completely weatherproofed and securely seated on and fastened to the roof curb.
3. Hood shall be designed with necessary wind bands, and venturi inlet to provide a vertical upward discharge pattern.
4. Fan Wheels: Aluminum Centrifugal, backward inclined, non-overloading, quiet-operating, statically and dynamically balanced.
5. Unit shall include motor and drive assembly cooling tube, and drainage area with drain plug.
6. Gravity backdraft damper unless motorized damper is required and shown on the Drawings.
7. Aluminum bird screen.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as required in strict accordance with the manufacturer's instructions and recommendations and as shown on the Drawings.
- B. Provide flexible duct connections on inlet and outlet of fan when fans are ducted.
- C. Install fans on roof or exterior wall with flashing to prevent water and weather from entering building.
- D. Performance testing and balancing shall be in accordance with specification Section 15907-Testing and Balancing Heating and Ventilating Systems.

END OF SECTION

SECTION 15862DAMPERSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Provide and install dampers and accessories where shown on the Drawings.
- B. Related Work Specified Elsewhere:
 - 1. "HVAC General" is specified in this Division.
 - 2. Electrical is specified in Division 16.
 - 3. Combination louvers and dampers are specified in Section 15869.

1.2 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Greenheck
 - 2. Air Balance, Inc.
 - 3. Airstream
 - 4. Louvers & Dampers, Inc.
 - 5. Ruskin.
 - 6. Or equal.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings in accordance with the General Conditions of the Construction Contract.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver as Work progress requires.
- B. Protect in a suitable weathertight enclosure to prevent damage of any nature.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Motor Operated Air Control Dampers:
 - 1. Material to match ductwork material in space installed.
 - 2. Control Dampers - Galvanized:
 - a. Equal to Greenheck VCD-23 control damper.
 - b. Frame:
 - i. 16 ga. galvanized steel formed into a 5" x 1" structural hat channel
 - ii. Top and bottom frame members on dampers less than 17" high shall be low profile design to maximize free area.
 - iii. 4-piece construction with minimum 1-1/2" integral overlapping gusset reinforcements in each corner to assure square corners and resist racking.
 - c. Blades:
 - i. Parallel or opposed blade as indicated.

- ii. 16 ga. galvanized steel strengthened by three longitudinal 1" deep V grooves running the entire length of each blade.
 - iii. Provide symmetrical blades of varying size as required to completely fill the damper opening.
 - iv. Blade orientation shall be horizontal.
 - d. Fully gasketed with a maximum allowable leakage of 8 cfm per square foot of face area at 4 inches W.C. differential pressure.
 - e. Bearings and blade shafts shall be non-corrosive.
 - 3. Control Dampers – Aluminum:
 - a. Equal to Greenheck VCD-43 control damper.
 - b. Frame:
 - i. Aluminum frame formed into a 5" x 1" structural hat channel
 - ii. Top and bottom frame members on dampers less than 17" high shall be low profile design to maximize free area.
 - iii. 4-piece construction with minimum 1-1/2" integral overlapping gusset reinforcements in each corner to assure square corners and resist racking.
 - c. Blades:
 - i. Parallel or opposed blade as indicated.
 - ii. Extruded airfoil shaped, aluminum construction with metal blade to metal blade overlap.
 - iii. Provide symmetrical blades of varying size as required to completely fill the damper opening. Blade orientation is horizontal.
 - d. Fully gasketed with a maximum allowable leakage of 8 cfm per square foot of face area at 4 inches W.C. differential pressure.
 - e. Bearings and blade shafts shall be non-corrosive.
- B. Damper Operators:
 - 1. Manual operators: Chrome plated locking quadrant supplied by damper or louver manufacturer. Provide with standoff brackets as necessary.
 - 2. Motor operators and linkage to connect motor to damper linkage will be furnished and installed by the Automatic Temperature Control (ATC) Contractor.
 - 3. Normal closed or open as noted, spring return, electric motor operated. Modulating type as indicated in Section 15604.
- C. Miscellaneous Connecting Sheet Metal:
 - 1. Galvanized steel or aluminum to match adjacent duct.
 - 2. Thickness: Per SMACNA
 - 3. Joints, seams, connections, cross bracing, flanges and supports as required for installation and recommended by SMACNA.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install dampers, operators and linkage in strict accordance with the manufacturer's instructions and recommendations.
- B. Insure all blades open, close, and seal properly.
- C. Adjust weights on backdraft dampers.

END OF SECTION

SECTION 15891
DUCT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install all duct insulation as shown on the Drawings and specified herein.
- B. Related Work Specified Elsewhere: "HVAC - General" is specified in this Division.

1.2 QUALITY ASSURANCE

- A. Fire Hazard Rating: When tested by ASTM E84 method flame spread rating shall not exceed 25.
- B. Acceptable Manufacturers:
 - 1. Closed cellular flexible plastic:
 - a. Armacell "AP/ARMAFLEX".
 - b. Rubetex.
 - c. Or approved equal
 - 2. Fiberglass:
 - a. Owens-Corning.
 - b. Knauf.
 - c. Certainteed.
 - d. Or approved equal.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit samples of each insulation type.
- B. Submit 2'-0" piece of sealing tape.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Duct insulation for non-wet area locations.
 - 1. Ductwork:
 - a. 1½ inch thick fiberglass ductwrap
 - b. Factory applied reinforced aluminum or vinyl vapor barrier facing.
 - c. Thermal conductivity @ 75°F: 0.26/BTU-in/hr-ft²-°F maximum
 - d. Equal to Owens-Corning series ED-100 FRK-25
- B. Exterior Duct Insulation
 - 1. Closed cellular flexible plastic
 - a. 2" thick
 - b. Thermal conductivity at @ 75°F: 0.25/BTU-in/hr-ft²-°F maximum
 - c. U.L. flame spread: 25 or less
 - d. Finish: Armaflex WB finish with 10X10 Leno Weave glass mesh

PART 3 - EXECUTION

3.1 APPLICATION

- A. Duct Insulation:
 - 1. Required on all supply and return ductwork at Evergreen PS Wetwell Entry, Drywell Entry, and exterior.
 - 2. Required on all outside air intakes from exterior wall or roof to duct termination including fan casing.
 - 3. Required on all heated or cooled supply air ductwork from air handling unit to duct termination including air handler if not factory insulated.
 - 4. Required on exhaust ductwork from outside closure damper to exterior wall or roof.
 - 5. Insulate entire ducts and seal to prevent condensation on cold surfaces, including standing seams, support straps, and other metal attached to the ductwork.
 - 6. Insulate access doors and gaskets to prevent metal to metal contact.
- B. Apply insulation to clean, dry ductwork.
- C. Remove damaged insulation and replace to the satisfaction of the Engineer at no additional cost to the Owner.
- D. Use sealing tapes 3 inches wide, reinforced, pressure sensitive type, SMACNA approved. Tapes that do not adhere to insulation shall be cause for rejection of all insulation work. Only apply tape when ambient temperature is between 40°F and 100°F.
- E. Closed cellular plastic:
 - 1. Obtain adhesive from the insulation manufacturer and apply to entire duct surface, and all joints.
 - 2. Apply in strict accordance with manufacturer's instructions and recommendations.
- F. Fiberglass Ductwrap:
 - 1. Apply insulation adhesive in 4" wide strips, 8" on center, circumferentially around duct.
 - 2. Tightly wrap insulation around duct with all joints butted and longitudinal joint overlapped 2 inches.
 - 3. On the bottom of ductwork over 24 inches wide, provide and install mechanical fasteners at not more than 18" on center.
 - 4. Tape all joints with 3" wide tape.
 - 5. Tape over protruding stick pins.

END OF SECTION

SECTION 15907TESTING AND BALANCING HEATING AND VENTILATING SYSTEMSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: The testing and balancing Work includes the measurement and setting of air flow devices in accordance with the Contract Documents for the systems, recording data, making tests, and preparing reports, all as hereinafter specified. Perform the Work specified in this Section on, and after the completion of, Work on the HVAC systems.
- B. Related Work Specified Elsewhere:
 - 1. "HVAC - General" is specified in this Division.
- C. Qualifications: Obtain the services of a qualified testing organization, approved by the Engineer, to perform the testing and balancing work as herein specified.
- D. Procedures: Accomplish the Work in accordance with the Agenda specified herein. Follow procedures described herein and, in general, if not specifically described herein, the Work shall be in accordance with the Associated Air Balance Council's "National Standards for Field Measurements and Instrumentation Total System Balance", Volume Two, No. 12173, and standards of NEBB.
- E. Cooperate with the selected test and balance agency in the following manner:
 - 1. Provide sufficient time before final completion date so that tests and balancing can be accomplished.
 - 2. Provide immediate labor and tools to make corrections when required without undue delay. Install balancing dampers as required by test and balance agency.
 - 3. Put all heating, ventilating and air conditioning systems and equipment into full operation and continue the operation of same during each working day of testing and balancing.
 - 4. Keep the testing and balancing agency informed of any major changes made to the system during construction, and provide with a complete set of as-built drawings.
 - 5. Include the costs of dampers, pulley and belt changes and the costs of obtaining the test and balancing agency in the Contract price.
- F. Installation shall not be considered complete until final reports by the testing agency have been submitted to the Engineer and approved.

1.2 SUBMITTALS TO THE ENGINEER

- A. Submit the name of the proposed testing organization to the Engineer for approval within 90 days after Contract award.
- B. Provide all results of all required tests for the Engineer's approval.

1.3 AGENDA

- A. Preliminary Report: Review Drawings and Specifications prior to the installation of any of the affected systems and submit a written report to the Engineer indicating

- any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.
- B. Submit an agenda for approval by the Engineer prior to start of testing and balancing work. The agenda shall include the following:
 - 1. A complete listing of all air flow and air terminal measurements to be performed.
 - 2. Specific test procedures and parameters for determining specified quantities, e.g., flow, drafts, etc., from the actual field measurements to establish compliance with the Contract Documents.
 - 3. Samples of forms showing applications of procedures and calculations to typical systems.
 - C. Advise the Engineer in advance when the testing will begin so that the testing procedure and techniques can be evaluated and approved or modified.
 - D. Procedure Reporting: Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch), and factors used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Not applicable in this Section.

PART 3 - EXECUTION

3.1 PROCEDURES AND INSTRUMENTS - GENERAL

- A. Requirements: Adjust all systems and components to perform as required by the Drawings and Specifications.
- B. Test Duration: Perform operating tests of heating coils, fans and other equipment no less than a four-hour duration after stabilized operating conditions have been established. Base capacities on temperatures and air quantities measured during such tests.
- C. Instrumentation: Use methods of application of instrumentation in accordance with the approved agenda.
- D. Use only instruments used for measurements that are accurate, and calibrated within 6 months of the testing with calibration histories for each instrument available for examination. Have each test instrument calibrated by a laboratory approved by the Engineer or by the manufacturer. The Engineer has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.
- E. Apply all instruments in accordance with manufacturer's instructions and recommendations.
- F. Provide all labor, instruments and appliances required. Do not install instruments that are permanent installations used for the tests, e.g., gages, thermometers, etc., until just prior to the tests to avoid damage and changes in calibration.
- G. Accuracy of all thermometers shall be plus or minus 1 graduation at the temperatures to be measured. Graduations shall conform to the following schedule.

TESTING AND BALANCING HEATING AND VENTILATING SYSTEMS

<u>Medium</u>	<u>Design Temperature Differential (°F)</u>	<u>Maximum Graduation (°F)</u>
Air	10 or less	1/2
Air	over 10	1

3.2 AIR SYSTEM PROCEDURES

- A. Adjustments: Adjust all air handling systems to provide the required design air quantity to, or through, each component. Conduct adjustment and balancing of all systems during the period of the year approximating maximum seasonal operation, unless otherwise directed or approved by the Engineer.
- B. Equalizers: Adjust equalizing devices to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.
- C. Balance: Use flow adjusting (volume control) devices to balance air quantities only, i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of normal limits.
- D. Accomplish balancing between runs (submains, branch mains and branches) generally by flow regulating devices at, or in, the divided flow fitting.
- E. Restriction imposed by flow regulating devices in or at terminals shall be minimal. Make final measurements of air quantity after the air terminal has been adjusted to provide the optimum air patterns of diffusion.
- F. Fan Adjustment: Generally vary the total air system quantities, by adjusting fan speeds, or axial-flow fan wheel blade pitch. Use damper restriction of a system's total flow only for systems with direct connected fans (without adjustable pitch blades), provided system pressure is less than 1/2 inch w.g.
- G. Except as specified herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE Handbook of Fundamentals.
- H. Omit pitot tubes traverse when the duct serves only a single room of space and its design volume is less than 200 cfm. In lieu of Pitot tube traverse, determine air flow in the duct by totaling volume of individual terminals served, measured as specified herein.
- I. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), determine air quantity by measurements at terminals served.
- J. Test Holes: Provide test holes, in straight ducts, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.
- K. Air Terminal Balancing.
- L. Air Motion: Air motion and distribution shall be as specified and as shown on Drawings. In addition to air motion measurements, make smoke tests wherever requested by the Engineer, to demonstrate the air distribution from air terminals, at no additional cost to the Owner.
- M. Changes in the specified agenda due to field conditions, will be considered for approval by the Engineer.

3.3 TEST RECORDS

- A. Submittal: Submit three (3) copies of the reports described herein, covering air system performance, and air motion (fpm), to the Engineer prior to final tests and inspection.
- B. Instrument Records: Include types, serial numbers, and dates of calibration of all instruments.
- C. Reports: Identify conspicuous items not conforming to Contract requirements in the reports.

3.4 AIR SYSTEM DATA

- A. Report: Include in the certified report, for each air-handling system, the following data (as applicable):
 - 1. Equipment (fan or factory fabricated station unit):
 - a. Installation Data:
 - i. Manufacturer and Model.
 - ii. Size.
 - iii. Arrangement, Discharge, and Class.
 - iv. Motor H.P., Voltage, Phase, Cycles and Full Load Amps.
 - v. Location and Local Identification Data.
 - b. Design Data: Data listed in schedules on the Drawings and in the Specifications.
 - c. Fan Recorded (Test) Data:
 - i. C.F.M.: Discharge CFM and % of OA under minimum conditions.
 - ii. Static Pressure: S.P. total, S.P. suction and S.P. discharge.
 - iii. R.P.M.: Fan and motor.
 - iv. Motor Operating Amps.
 - v. Motor Operating B.H.P.
 - vi. Motor Sheave Size and Make.
 - vii. Fan Sheave Size and Make.
 - viii. Number of Belts Size and Make.
 - 2. Duct Systems:
 - a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-Air, and Exhaust:
 - i. Duct size(s)
 - ii. Number of Pitot tube (Pressure) Measurements.
 - iii. Sum of Velocity Measurements (Note: Do not add pressure measurements).
 - iv. Average Velocity.
 - v. Recorded (Test) C.F.M.
 - vi. Design C.F.M.
 - b. Individual Air Terminals:
 - i. Terminal Identification (Supply or Exhaust, Location and Number designation).
 - ii. Type, Size, Manufacturer and Catalog Identification.
 - iii. Applicable Factor for Application, Velocity, Area, etc., and Designated Area.
 - iv. Design and Recorded Velocities - F.P.M. (State "core", "inlet",

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- etc., as applicable). Record data for three readings and average.
- v. Design and Recorded Quantities - C.F.M. Record data for three readings and average.
 - vi. Deflector Vane or Diffusion Cone Settings.

3.5 FINAL TESTS, INSPECTION AND ACCEPTANCE

- A. General: Make tests to demonstrate that the capacities and general performance of air systems comply with the Contract Documents.
- B. At the time of final inspection, recheck, in the presence of the Engineer, random selections of data (air quantities and air motion) recorded in the Certified Report.
- C. Points and areas for recheck will be selected by the Engineer.
- D. Measurement and test procedures shall be the same as approved by the Engineer for the Work forming basis of report.
- E. Selections for recheck (specific plus random), in general, will not exceed 15 percent of the total number tabulated in the report.
- F. Retests: If random tests elicit a measured flow deviation of ten percent or more from that recorded in the Balance Report listings, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, readjust all systems and re-test. Submit new data recorded, new Balance Reports and make new inspection tests, all at no additional cost to the Owner.
- G. Marking of Settings: Following final acceptance of Balance Reports by the Engineer, permanently mark the settings of all valves, splitters, dampers, and other adjustment devices so that adjustment can be restored if disturbed at any time. Do not mark devices until after final acceptance.

END OF SECTION

SECTION 16010ELECTRICAL - GENERALPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide all labor, materials, equipment, operations, methods and procedures as indicated in the Contract Documents, together with all items necessary for or incidental to the completion of the work.
- B. All systems or additions to existing systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly functioning systems.
- C. All systems shall be adjusted, tested, inspected and turned over to the Owner in perfect working order.
- D. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install", as used in DIVISION 16 or as indicated on the Drawings related to DIVISION 16 shall mean a complete and properly functioning Electrical installation performed by the Contractor.
- E. References:
 - 1. Refer to Architectural, Structural, Heating and Ventilating, Plumbing, Process Piping and Instrumentation Drawings to coordinate material and equipment locations and electrical requirements.
 - 2. Applicable portions of DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS together with DIVISION 1 - "GENERAL REQUIREMENTS", are part of DIVISION 16.
 - 3. Refer to SECTION 00100 - INSTRUCTIONS TO BIDDERS; SECTION 00700 - GENERAL CONDITIONS; SECTION 00800 - SUPPLEMENTARY CONDITIONS; and as specified herein regarding substitutions of materials and equipment.
- F. Division 16 Contract Requirements and Responsibilities:
 - 1. The requirements of Division 16 - Electrical is based on the information provided in the Contract Documents. This information has been outlined in either the specifications or the drawings or both. The contractor's responsibility of Division - 16 Electrical is to review all information in both the specifications and the drawings in order to determine the complete work required. Whether the work is specified in the Specifications or shown on the Drawings it is required as part of the work. No additional compensation or interpretations stating that it was not shown in both locations will be acceptable or allowed.
- G. Work Specified Herein:
 - 1. Visit and examine the project site and become familiar with all existing conditions pertinent to the work to be performed thereon. No additional compensation will be allowed for failure to be so informed. This contractor is responsible to be familiarized with the conditions of the project during the bidding period in order to bring any clarifications or issues to the attention of the Engineer prior to submission of his/her final bid price.

2. The following scope of work is a brief generalization of the type and extent of the work specified under DIVISION 16. Detailed requirements are indicated on the Drawings and in related sections of the Specifications. The work specified under DIVISION 16 includes, but is not limited to the following:
 - a. Provide Electrical Service and Distribution Systems as indicated on the "Single-Line Diagrams", related drawings and schedules, and as specified herein. There is a significant amount of electrical demolition and reconnection of equipment to remain for the work required for this project and therefore a thorough understanding of the existing conditions is critical. It is to be understood that the drawings do not intend to show or provide details for all of the existing conditions or equipment to be demolished. In addition, not all existing condition information may reflect exact conditions due to the accuracy of existing data and information. As an example, there are a significant number of existing branch circuit panelboards which have been listed and shown for this project. The existing panelboard schedules have been shown and noted as could be determined or as noted on existing information. The Contractor's responsibility is to field investigate and determine all existing conditions. Any and all existing equipment which is found to remain shall be reconnected to new panelboards with new conduit and wiring of equal sizing and conditions which presently exists in order to provide a complete system reconnection. No exception will be allowed for any extra compensation to perform this work. This contractor is responsible to be familiarized with the conditions of the project during the bidding period in order to bring any clarifications or issues to the attention of the Engineer prior to submission of his/her final bid price.
 - b. Provide all required 480 Volt, 208 Volt, 240V, and 120 Volt Power and Control wiring, Signal wiring, grounding, and connections for equipment specified under DIVISION 15 except as indicated on the Drawings and specified herein.
 - c. Provide all required and supplemental motor starters, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages specified under DIVISION 15. All rating and sizing shall match the requirements of equipment specified. No additional compensation will be allowed for modifications required due to equipment and devices which differ from those of specified equipment.
 - d. Provide complete branch circuit wiring systems including all raceways, conductors, cables, outlet and junction boxes, wiring devices and device connections as shown on the Drawings and as specified herein.
- H. Work Specified Elsewhere:
 1. The materials and methods used for all Electrical Work indicated in the Contract Documents shall meet the requirements specified in Division 16.
 2. The following Electrical Work and Work relating to the Electrical Work will be performed under other Divisions of the Contract Documents. This Contractor is to review all of the Contract Documents and Drawings and shall

work closely with the other related areas which will affect his/her work under this Contract in order to avoid any and all conflicts:

- a. Substitutions, product options, cleaning up and project record documents are specified in DIVISION 1.
- b. Mechanical equipment is specified in DIVISION 15.

I. Removals and Relocations and Rearrangements:

1. Examine the existing site, structure(s) and installation(s) for the work of all trades which will influence the cost of the work under DIVISION 16. This work shall include removals, relocations, rewiring and rearrangements relating to the work of all trades which may interfere with, disturb or complicate the performance of the work under DIVISION 16; and relating to the work involving systems, equipment and related service lines which shall continue to be utilized as part of the finished project.
2. When the Contract Documents indicate elimination of, or structural changes in walls, floors, ceilings, enclosures, pipe chases, etc., remove, relocate, rearrange and reconnect as required, all existing Electrical Work such that systems to remain shall continue to function properly.
3. Provide in the Base Bid all associated labor, material and costs to include all removals, relocations, rewiring, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.
4. Demolition:
 - a. Disconnect and remove existing equipment, devices, boxes, conduit, and associated electrical equipment as shown on the contract drawings.
 - b. Any demolition, relocation or rearrangement work performed which results in unused openings in control panels, instrument panels, control stations, pull or junction boxes, etc., which are to remain shall be plugged by appropriate means such that it maintains the integrity of the NEMA classification of the area, as defined on Drawing E-1.
 - c. Any demolition, relocation or rearrangements which results in unused openings in walls, ceilings, floors, etc. shall be sealed using approved methods to maintain the fire rating and NEMA classification of the existing structure.
 - d. Review all Contract Documents and coordinate with all disciplines for a complete understanding of this demolition work. Provide all new work required to modify these changes along with all requirements for installation of the new work, as shown on the Contract Drawings.
 - e. There are areas where the demolition shall require that existing pullboxes, conduit, wiring and associated devices be disconnected, removed, relocated and in some cases, be replaced in order for the new equipment, walls, structures, etc. to be constructed and installed. In most cases, the detail of these existing conditions has not been shown. This Contractor will be responsible to perform all work necessary to demolish all required conduit, wiring, boxes and associated equipment for the noted and intended demolition. At no time shall this Contractor imply that he/she does not understand the responsibility of associated demolition as the

Contractor shall visit the site locations and shall become familiar with the areas where this work is to be performed. If there are any concerns or issues regarding this work they need to be addressed and submitted to the Engineer for clarification prior to submission of the final bid price for the work of this Contract. All costs associated with this work is the responsibility of this Contractor and shall be included as part of the overall costs for the electrical work of this project. No additional costs shall be allowed by this Contractor for any demolition work required under the work of this contract.

- f. Disconnect and remove all abandoned conduits, wiring, boxes, equipment, controls, hangers, etc. shown or not shown, which is located within the area of construction under this contract.

J. Codes and Fees:

1. Comply with the following codes, standards, regulations and specifications:
 - a. National Electrical Code (N.F.P.A. No. 70 - most recent edition)
 - b. Life Safety Code (N.F.P.A. No. 101 - most recent edition)
 - c. Occupational Safety and Health Act (O.S.H.A.) - regarding construction practices.
 - d. Utility company standards, specifications and requirements.
 - e. Telephone company standards, specifications and requirements.
 - f. Cable company standards, specification and requirements.
 - g. State and local electrical codes, building codes, and fire codes for the locale where the work is to be performed.
 - h. N.F.P.A. 820 Standards for Fire Protection in Wastewater Treatment and Collection Facilities.
2. Compliance with the above codes, standards, etc., does not relieve the Contractor from the requirements of the Contract Documents which may exceed these codes, standards, etc. but which are not contrary to them.
3. If it is observed that the Contract Documents are at variance with any of the above codes, standards, etc., promptly notify the Engineer in writing, and necessary changes shall be adjusted by appropriate modification. If any work is performed which is contrary to such codes, standards, etc., the Contractor shall assume full responsibility therefore and shall bear all costs in correcting such work in order to comply with such codes, standards, etc.
4. Secure and pay for all permits, fees and licenses necessary for the proper execution of the work under DIVISION 16.

K. Tests and Procedures Prior To Start-up:

1. Refer to Section 16950 - Testing Electrical Systems and start-up for testing and scheduling requirements.

L. Demonstration of Complete Electrical Systems:

1. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated and accepted in writing. Final demonstrations shall be made only after the Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
2. Refer to Section 16950 for additional requirements.

M. Identification:

1. All distribution equipment (switchboards, motor control centers, distribution panelboards, transformers, transfer switches, disconnects, starters, control panels, control stations, etc.) shall have an engraved lamacoid tag, permanently mounted adjacent to the manufacturer's nameplate, indicating the equipment's designation (as called out on the Drawings) and identification number per the Contract Documents.
2. All switchboard and distribution panel overcurrent devices, motor control center devices, individually mounted motor controllers, disconnect switches, control devices, etc., shall be provided with permanently attached engraved lamacoid tags indicating the equipment which they serve or control per the equipment designation and identification number indicated in the Contract Documents, and in accordance with OSHA requirements.
3. All branch circuit panelboards shall have, on the inner side of the door, a permanently attached, engraved lamacoid tag with the identification number of that panelboard. Provide and mount under plastic, in the directory frame of each panelboard, a neatly typewritten directory identifying the branch circuit overcurrent devices and the circuits, devices and areas which they serve.
4. All individually mounted panelboards, disconnects, motor controllers, control stations, etc. shall have a second engraved lamacoid tag below the first one which identifies from where the equipment is receiving power. This second label shall be smaller in height.
5. Nomenclature on these nametags shall be project specific and wherever possible shall be full and complete. Excess abbreviations will not be allowed.
6. Power conductors shall be continuously polarized and color coded throughout using the following scheme:
 - a. White or gray - All neutral conductors, 208/120V systems
 - b. White w/tracer of any color but Green - All neutral conductors, 480/277 volt systems
 - c. Green - All ground conductors
 - d. Phase Conductors

208/120V	240/120V	480/277V
<u>Systems</u>	<u>Systems</u>	<u>Systems</u>
Phase A - Black	Phase A - Black/(Red)	Phase A - Yellow
Phase B - Red	Phase B - Red/(Blue)	Phase B - Brown
Phase C - Blue		Phase C - Orange

- e. For Conductors No. 6 and smaller, color coding shall correspond to the color of the conductor insulation. For color coding of wire larger than No. 6, use self-adhesive, wrap-around type markers. These markers shall be used at all panelboards, junction boxes, disconnect switches, circuit breakers, etc.
7. All individual conductors shall be identified using unique numerical tags corresponding to conductor designations indicated on approved shop drawings of schematic diagrams for all terminations. This includes all process- and non-

process-related wiring done as part of the work, such as fire alarm panels. Conductors shall be clearly identified at each terminal block, equipment connection and junction. Markings shall utilize the equipment designation and terminal block number in the device higher upstream in the system hierarchy. Markings shall follow the format "Device Tag-Equipment Served Tag-Device Terminal Block No." Refer to Division 13 for communication and manufacturer instrument cable labeling requirements.

- a. System hierarchy shall be defined as follows:
 - i. Master Terminal Unit
 - ii. Remote Terminal Unit
 - iii. Motor Control Center
 - iv. Transmitters, Local Control Stations
 - v. Elements
 - b. Examples:
 - i. From MCC-DB-2 TB No. 53 to SLSC-1: "MCCDB2-SLSC1-53"
 - ii. From DBCP TB No. 17 to SLSC-1: "DBCP-SLSC1-17"
 - iii. From PBCP TB No. 8 to FIT-411: "PBCP-FIT411-8"
8. All feeder cables shall be marked indicating load for each feeder for all junction boxes, handholes, and manholes.
 9. Conduits shall be marked at both ends with designations corresponding to the conduit schedule on approved drawings. Such marking shall include the designation of the conduit, the destination of the conduit, and the type of conductors in the conduit, being power (P), control (C), or signal (S). The format for the marking shall be "Conduit Designation-Equipment Designation."
 - a. For example, conduit P79 provides a power connection from Control Panel CP-CF to LIT-172. The marking at CP-CF shall therefore read "P79-LIT712." The corresponding marking at LIT-712 shall read "P79-CPCF."
 - b. Conduit C90 provides a control connection from Motor Control Center MCC-1 to Control Panel CP-M. The marking at MCC-1 shall therefore read "C90-CPM." The corresponding marking at CP-M shall read "C90-MCC1."
 - c. Conduit S37 provides a signal connection from Control Panel CP-CF to CFP-800. The marking at CP_CF shall therefore read "S37-CFP800." The corresponding marking at CFP-800 shall read "S37-CPCF."
 10. Labels and tags shall be typewritten and pre-manufactured for the intended purpose. Labels and tags with "tails" will not be accepted. All labels and tags must be installed prior to site acceptance.
 11. Lamacoid tags shall be nominal 1" x 4" with 3/8" white lettering on black background.
 12. The following safety signage shall be provided for the following equipment. Signage shall be lamacoid plastic (Large Letters) yellow background with red engraved letters:
 - a. All switchboards, motor control centers, VFD equipment, automatic transfer switches, solid-state, reduced-voltage starters, enclosed circuit breakers, etc., shall be provided with signage to read "DANGER - HIGH

- VOLTAGE". Each section (vertical component of multi-section enclosure) shall be furnished with an individual signage. Final requirements shall be determined at the discretion of the Engineer.
- b. All motor control center motors starters, individual motor starters and/or control panels shall be provided with signage to read "CAUTION - This Enclosure Contains Voltage Sources from Outside of This Enclosure".
 - c. All switchboards, motor control centers, panel boards, transformers control panels, etc., shall have large letter lamacoid nameplates which reflect the full tag names and designations noted on the Contract Drawings.
 - d. All switchboards, motor control centers, panel boards, transformers control panels, etc., shall have Arc Flash labels as provided and determined by the Arc Flash Study.
13. Label and identify with branch circuit and lighting panel for all light switches, manual motor starters, and receptacles.
- N. All electrical equipment shall be suitable for the areas where mounted in accordance with Area Classifications indicated on Electrical Drawings. In specific, refer to Drawing E-1 NEMA classification for Electrical Equipment and Enclosures for specific requirements and these specifications. In addition, there are several areas which have been indicated to meet NEC National Electrical Code requirements based on the final location of the equipment. Coordinate and provide these NEMA ratings whether or not specifically stated on the Drawings. Contractor shall assure that the proper type, enclosure, mounting and catalog numbers are provided during the Submittal phase.

1.2 QUALITY ASSURANCE

- A. Supply all new materials, devices and equipment in conformance with:
- 1. Underwriter's Laboratory, Inc.
 - 2. National Electrical Manufacturers Association.
 - 3. American National Standards Institute.
 - 4. National Electrical Code (NEC).
 - 5. Local Power Company.
 - 6. Local Telephone Company
 - 7. Local Internet Provider
 - 8. OSHA
- B. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to no exceptions taken by the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's review. The discontinuance of production of any material or product after the Engineer's review has been made shall not relieve the Contractor from furnishing an alternate of equal quality and design without additional cost.
- C. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.

- D. The Contractor shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of designing and maintaining these systems. For a period of twelve (12) months from the date of acceptance of the work, provide all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.
- E. All switchboards, motor control centers, panelboards, motor starters, transformers, and distribution equipment shall be by the same manufacturer based on providing the Owner with equipment of the same type. This will allow for replacement and spare parts of the same type and also allow efficient maintenance of this equipment.
- F. All electrical equipment shall be suitable for the areas where mounted in accordance with Area Classifications indicated on Electrical Drawing E-1. Contractor shall assure all equipment is installed in strict accordance with the latest version of the National Electrical Code.
- G. All equipment to be submitted such as low voltage switchboards, motor control centers, panelboards, dry-type transformers, motor starters, disconnect switches, etc. shall be furnished by the same single manufacturer unless otherwise noted. Substitutions of multiple manufacturers for this equipment shall be rejected.

1.3 SUBSTITUTIONS

A. General

1. Where new equipment is specified to be provided as part of an extension to an existing system, the manufacturer of the new equipment shall match that of the original. Substitutions will not be considered as equal unless specifically noted so.
2. Certain new equipment and systems have been specified with one or more make(s) followed by the phrase "or equal". In such cases, the Contractor may submit a proposed substitution for review by the Engineer. The decision of equality of a proposed substitution rests fully with the Engineer.
3. Certain new equipment and systems have been specified with one or more make(s) WITHOUT the phrase "or equal". In such cases, only one of the manufactured products listed will be allowed. No other manufacturer is allowed.
4. Where substitutions are allowed as "equal" it shall be the Contractor's responsibility to make any and all necessary modifications required to accommodate the installation of the substituted item(s) at no additional cost to the Owner.
5. The Drawings have been designed and shown with a basis of design being of a specific vendor. This Contractor shall understand that if the submission is by another vendor to be considered as an equal then it shall be his/her responsibility to provide a system which will be thoroughly coordinated to meet the intended design. Any additional equipment, conduit, wiring, controls, etc., required to make the final installation "as equal" will be the responsibility of the Contractor and shall be included at no cost to the Owner.

6. Systems submitted which require extensive work in order to review will be rejected or the Contractor shall be assessed additional costs for additional resubmissions required for obtaining no exceptions by the engineer for the equipment to be considered as an acceptable equal submission.

1.4 SUBMITTALS TO THE ENGINEER

- A. Submit Shop Drawings, O&M documentation, and manufacturer certificates per Section 01340.
- B. Provide all certificates of inspection and approval from all regulatory agencies having jurisdiction over the Work under Division 16.
- C. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer prior to energizing the Electrical system.
- D. Submit complete documentation for coordination, short circuit, and arc flash study and report immediately upon approval of equipment and prior to start-up and testing of any equipment. Selection of equipment in order to make any necessary changes based on the study's findings before the equipment is approved. No start-up will be allowed without this study and report and without the final recommended system settings being implemented and tested in the field. If equipment needs to be ordered prior to receiving the study, all necessary changes will be the responsibility of the contractor at no additional costs.
- E. Furnish the Engineer with a written statement from the Owner indicating that he is satisfied with the operating instructions given.
- F. These requirements for Shop Drawings are in addition to the standards in Section 01340.
 1. Shop Drawings Shall Consist of:
 - a. Project name and location.
 - b. Contractor's name.
 - c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/ type and catalog number.
 - d. Manufacturer's scale or dimensioned drawings along with standard catalog "cut" sheets. These cut sheets shall be marked up to indicate equipment, sizes, types, etc., of equipment and all options being provided.
 - e. Equipment ratings, service clearances and configuration.
 - f. Listing of accessories to be furnished.
 - g. Single-line and schematic diagrams where applicable. All text and symbols shall be easily legible and submitted on a 11"x17" sized drawing(s) as necessary.
 - h. Refer to related sections of the specifications for special shop drawing requirements for individual equipment types.
 2. All Cut Sheets shall be marked up to indicate specific equipment, specific sizes, specific types, etc., for all equipment and materials with all options provided for this project. Catalog cut sheets that are not properly marked up or are difficult to read and understand as to what equipment or application that it is used for will be returned un-reviewed for re-submittal.
 3. The contract drawings have provided detailed customized schematic wiring diagrams for all motor control center equipment as well as individual wall

mounted starters, control panels, etc. These are very detailed and a lot of effort has been expended to compile these diagrams. The equipment manufacturer/supplier of this equipment as specified shall be responsible to provide the following detailed and customized schematic wiring diagrams.

- a. A separate customized and detailed schematic for each piece of equipment (i.e. RAS pumps No. 1, No. 2 and No. 3). Even though the schematic appears to be same for this equipment a separate schematic for each will be provided with the referenced title (i.e. RAS Pump No. 1, etc.) noted on the respective schematic.
 - b. Each schematic shall indicate and show the specific devices (hand-off-auto, run light, ETM, etc.) and a reference to where this is located.
 - c. All contacts and interlocks shall be identified as to their location.
 - d. All metering and interface devices such as digital metering, TVSS, lightning protection, etc., shall be shown, identified, and dimensional heights from bottom of equipment shall be noted.
 - e. Failure to provide the proper customized schematic wiring diagrams shall be grounds for automatic rejection. Any delays, scheduling issues and additional contract time and cost associated with these delays due to equipment not being approved or being rejected for these reasons shall be the responsibility of the Contractor.
- G. The following example is provided as a suggested formatting guideline. In addition to expediting the review process, this formatting will help ensure that the vendor has included all items applicable to the submittal, reduce the number of re-submittals and ensure a quality project.
1. Submittal Formatting:
 - a. Project information as required by the contract specifications.
 - b. Contact page.
 - c. Index sheet - this sheet shall list each tab with a description of its contents, i.e., Tab 1 - MCC 12.
 - d. Each tab shall be set up as follows:
 - i. Pertinent project specific information and modifications associated with this MCC, with references to the general information tab number.
 - ii. A parts list of all items/devices and accessories associated with this MCC including starters, relays, controls, fuses, etc.
 - iii. A project specific nameplate data sheet for the MCC - this shall include, but not limited to, full project specific title descriptions, starter/feeder information and submitted wiring diagram number.
 - iv. Dimensioned MCC layout plans and elevations pertaining only to this MCC.
 - v. Project specific MCC one line diagram.
 - vi. A complete set of project specific wiring diagrams for all loads associated with this MCC. Wiring diagrams shall include the following general information: The full project specific title of the load served and the submitted applicable compartment number. If more than one motor of a specific load within the applicable MCC

is indicated then separate and identified wiring diagrams shall be submitted for each load description and compartment number. All wiring diagram information and notation shall be clearly defined and referenced. Common wiring diagrams will not be acceptable.

2. As shown, this format is set up for a motor control center submittal, however, the same format shall be used for all switchboards, control panels, lighting panels etc.
3. Each submittal shall be neatly bound with typewritten index sheets.
4. Each control panel, system or equipment package shall be submitted in its entirety with all associated controls, devices, panels, layouts, wiring diagrams etc., included.
5. If the contractor relies on the equipment provider to submit this information, it shall be the Contractor's responsibility to ensure the format is as noted above. Submittals which do not clearly indicate, in an organized manner, what is being provided will be rejected, without being reviewed, for the submittal.
6. Equipment submitted which will be used throughout the facility, such as Local Control Stations, junction boxes, conduit, panels etc., shall clearly indicate which areas these will be located or used for, either on the submittal or a cross referenced list i.e., PVC conduit - Chemical Room, or screw type covered stainless steel enclosure - pullbox in NEMA 4X environments, etc.

1.5 RECORD DRAWINGS

- A. At the completion of the installation, provide reproducible Record Drawings indicating the final configuration of all Electrical Systems as they were installed. Symbols, equipment designations, etc. shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground.
- B. Contractor shall provide detailed instrumentation loop diagrams, control panel diagrams, and motor schematics indicating exact point to point wiring. The electrical contractor and instrumentation vendor shall prepare the diagrams jointly to allow full coordination.
The requirements above are in addition to the standards for Record Drawings in Section 01720.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
- B. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
- C. Check for defective or damaged materials, and for incomplete equipment shipments within seven (7) days after equipment delivery to the project site.
- D. Store materials and equipment on the construction site in enclosures or under protective covering and off the ground in order to keep materials and equipment undamaged, clean, and dry.
- E. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that

are defective or that have been damaged during installation, at no additional cost to the Owner.

1.7 GUARANTEE/WARRANTY

- A. Guarantee all equipment, materials and workmanship in accordance with the General Conditions and Supplemental Conditions of the Construction Contract and Section 11000.
- B. Warrant all material furnished and work executed is in accordance with all applicable laws and regulations.

1.8 SUBCONTRACTOR COORDINATION AND RESPONSIBILITY

- A. Coordination with Division 15
 - 1. Electrical subcontractor is responsible to review the HVAC Drawings and Specifications to determine the power conduit and wiring requirements. Electrical subcontractor is responsible to implement conduit and wiring needs to match the functional descriptions in DIV. 15 except that specifically identified as being provided by the HVAC subcontractor. HVAC subcontractor shall be responsible for all control, low voltage 24VDC / 24VAC, conduit and wiring. This shall include, but is not necessarily limited to, wiring for automatic temperature control, and control wiring for plumbing systems. The HVAC subcontractor shall provide all miscellaneous 120VAC control from HVAC control panels to final control devices, as required, unless specifically included in Electrical work per the Drawings and Specifications.
- B. Coordination with Miscellaneous Divisions
 - 1. The electrical contractor shall coordinate all coring, cutting and patching of openings in existing structures and locations with the General Contractor in a timely manner not to delay scheduling of the project.
- C. Schedules:
 - 1. The electrical subcontractor shall maintain close contact and coordination at all times with the work of these related Divisions in order to provide a complete electrical system or delay the scheduling of the project.
 - 2. Perform all coordination and scheduling of all cutting, temporary power usage with all other trades. patching, trenching, painting, trench covers, plastering, chases, slots, furring, grounds, masonry foundations, piers, excavating, pole bases, backfilling, pads, duct banks and other work incidental to installation of apparatus as required for electrical work.

1.9 CONDUIT LAYOUT PLANS AND DETAILS FOR CONCEALED AND EXPOSED WORK

- A. The Contract documents require that conduit be concealed in walls, floors, ceilings or below floor slab in slab on grade areas due to the configuration and layout of the proposed building construction.
- B. In areas of exposed conduits, conduits shall be installed via vertical drops down to equipment in order to maintain a clean and consistent look of conduit for this installation. Horizontal runs shall be limited to ceiling racked installation and shall drop down to equipment. In areas of hung ceilings and accessible space above ceilings conduits shall be installed concealed within these areas with vertical drop

- down to the equipment to be fed.
- C. A detailed conduit layout plan and routing path for the new addition shall be submitted for review and with no exceptions taken by the engineer prior to performing any work. The plan shall clearly indicate the equipment locations and path of runs along with overall sizes of conduits to be installed for a complete layout plan.
 - D. The contract drawings specifically note areas with blockout structural openings for the installation of conduits into and within the proposed building. A coordination review of equipment locations and layouts will be required such that the conduit layout plan has been pre-planned and approved prior to the commencing of the work. There is a significant amount of conduit to be installed under this project and this plan will provide an overview of the intended work to be preformed.
 - E. The contractor shall be allowed to reduce the number of conduit runs by combining conduit runs and increasing overall conduit sizes based on the National Electrical Code (NEC) allowable sizing and derating requirements. The contract documents will limit this however based on the allowable sizing of conduits within the slab and also this will be limited to smaller branch circuit feeders. Individual motor feeders to equipment such as pumps, process equipment runs, electrical distribution feeders and HVAC larger loads will not be allowed to be combined as further stated within the contract documents.
 - F. The Conduit and Wire Schedule has provided a summary of individual conduit runs throughout the project in order to clearly indicate where conduit and wiring is to be installed. The contractor shall utilize the schedule along with the electrical plans to develop the overall Conduit Layout Plan as required under this section. The submitted plans shall be formatted on 2' x 3' full size plans and submitted as part of the shop drawings requirements for this project prior to commencing any and all work.
 - G. The electrical contract drawings are diagrammatic and may not specifically show exact locations of the equipment. The contractor shall coordinate all conduit layout, and dimensions with the final equipment locations for the entire project for both concealed and exposed conduit runs.

1.10 MEASUREMENT AND PAYMENT

- A. Measurement and payment for the work described in this section will be made in accordance with the provisions of DIVISION 1 MEASUREMENT AND PAYMENT.

1.11 REQUEST FOR INFORMATION

- A. When there is a conflict or coordination issue, or if additional information is necessary for the contractor to proceed with the intended work, a Request of Information (RFI) form shall be submitted through the General Contractor to the Engineer. The specific issue shall be described in the RFI and shall be sent to the engineer for review and a response provided in an appropriate time period. RFI form shall be available via the General Contractor through the Engineer as required for this contract. This process shall be used as part of the work of this contract.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be as specified in the appropriate Sections of DIVISION 16.
- B. No exceptions to the Engineer of materials shall be as indicated in these Sections.

PART 3 - INSTALLATION

3.1 INSTALLATION

- A. Installation shall be as specified in the appropriate Sections of DIVISION 16.

3.2 TESTS

- A. Refer to all related requirements as set forth within SECTION 16950 and additional testing as indicated in the appropriate Sections of DIVISION 16.

3.3 CLEANING

- A. Do not allow refuse and surplus materials to accumulate on the project site during the course of the work. Areas shall be cleaned and picked up on a daily basis.
- B. Upon completion of the work, remove all refuse and surplus materials and leave the premises neat and clean on a daily basis.
- C. Clean all equipment surfaces and touch up all damaged surfaces to the satisfaction of the Engineer.
- D. Clean all lighting fixture reflector assemblies, lenses, louvers and lamps upon completion of the installation.

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Drawings are diagrammatic, unless detailed dimensioned Drawings are included, and show approximate locations of distribution equipment, fixtures, control panels and wiring devices. Equipment layouts shall be submitted prior to work in these areas with sufficient time for a detailed review. All equipment and locations shall be closely reviewed and coordinated. Coordinate all work and equipment locations with the Engineer prior to performing final installations.
- B. While the general run of electrical feeders, branch circuits and conduits are indicated on the Drawings, it is not intended that exact routing be determined there from. Conductors can be combined in conduits for ease of construction as permitted by these specifications and the latest edition of the N.E.C.
- C. Circuit designations can be found on the contract drawings in the combination of any of the following formats:

Single Line Diagrams	"Home Runs"
Electrical Schematics	Wiring Diagrams
Control and Instrumentation Diagrams	Panelboard Schedules Conduit and Wire Schedule

The Contractor shall be responsible for reviewing all drawings and may modify these designations subject to field conditions and review of the Engineer.

- D. Measurements shall be made and coordinated with all approved equipment at the site and in the buildings during construction and all systems installed as the work progresses in such a manner that the equipment, piping, vents, ducts, conduit, etc., will fit in the space provided, maintain head room and if in unfinished areas, be as neatly installed, as obscure and "out-of-the- way" as physically possible.
- E. Prior to submission for review any item of equipment, determine whether or not it will fit in the space provided and that no design changes in conduits, wiring or controls will be required. Any changes in the size, location or interconnections of the material or equipment supplied, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Engineer and no exceptions must be taken before such alterations are made.
- F. All equipment and accessories and its interconnecting piping, ductwork, conduits, etc., shall be installed in such a manner that ample maintenance passage and Code-required space/access will be provided.
- G. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. In general ductwork shall be given preference (except where grading of piping becomes a problem) followed by piping then electrical

wiring. If, after installation of any equipment, piping, ducts, conduit, etc., it is determined that ample maintenance and passage space has not been provided, the work shall be rearranged and/or furnished with other equipment as required to provide this space at no additional cost to the Engineer. The Contractor shall review the drawings for all other trades to determine any potential interferences and identify and coordinate with those with other trades.

- H. When there is a conflict or coordination issue, or if additional information is necessary for the contractor to proceed with the intended work, a Request for Information (RFI) form shall be submitted through the General Contractor to the Engineer. The specific issue shall be described in the RFI and shall be sent to the Engineer for review and a response shall be provided in an appropriate time period. RFI form shall be available via the General Contractor through the Engineer as required for this contract. This process shall be used as part of the work of this contract.

1.2 QUALITY ASSURANCE

- A. In General, the workmanship of the electrical installation shall be as described in the N.E.C.A. Electrical Design Guidelines. All methods of construction, details of workmanship, etc. that are not specifically described therein or indicated in the Contract Documents, shall be subject to the control and approval of the Engineer.
- B. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the Specifications.
- C. Work determined by the Engineer to be unsatisfactory according to industry standards shall be redone at the Contractor's expense, with no additional compensation.
- D. All efforts shall be made in the location and installations of all raceways and equipment for a neat, logical, and safe installation as it pertains to personnel and operations.
- E. An electrical conduit and associated electrical devices, etc., shall be installed concealed wherever possible in order to provide for a clean and limited amount of exposed conduit runs. Coordinate all work with the Engineer prior to performing this work.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submittals shall be provided in accordance with Sections 01340, 16010 and as specified in this section.
- B. The contractor shall be responsible to submit a complete list of conduit type to be used for all locations of the project. A Conduit Layout Plan shall be submitted as a shop drawing with the following:
 - 1. Shall include a column for exposed and concealed conduit heading. Mark up each location with the type of conduit to be used for the respective space in the appropriate heading of exposed and concealed installation.
 - 2. Provide detailed drawings indicating intended routing and combination of conductors. Refer to section 16010 for additional requirements.
- C. Submit a shop drawing for the following equipment, materials, products, etc.:
 - 1. Conduit, Raceway and Tubing.
 - 2. Conductors and Cable

3. Outlet Boxes
4. Pull and Junction Boxes and Terminal Cabinets
5. Wiring Devices
6. Control Devices and Equipment
7. Motor Starters
8. Safety Disconnect Switches
9. Enclosed Circuit Breakers
10. Fuses
11. Ground Rods
12. Metal Framing Channel
13. Distribution Equipment (medium and low voltage)
14. Motor Control Centers
15. Control Panels
16. Miscellaneous Electrical Distribution Equipment
17. Conduit and wall and floor link seal fittings
18. Conduit cable sealing fittings
19. Test results on all feeder conductors and heat trace cables as specified in Section 16950.
20. Variable Frequency Drive equipment
21. All other equipment and requirements shown and noted on the drawings

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit, Raceway and Tubing

1. Rigid Heavy Wall Steel Conduit (RSC or RGS) shall be constructed of hot dipped galvanized or electro-galvanized steel. Acceptable Manufacturers: Allied - a division of Atkore, Wheatland, Republic Conduit, or equal.
2. Electrical Metallic Tubing (EMT) shall be constructed of electro-galvanized steel. EMT fittings shall be interlocking compression type of cadmium-plated malleable iron or zinc coated steel, or stainless steel. No die cast, set screw and indenter type fittings shall be used. Acceptable manufactures are Allied - a division of Atkore, Wheatland, Republic Conduit, or equal.
3. Aluminum conduit shall be rigid, heavy wall aluminum. Acceptable manufacturers: Anaconda, Kaiser, VAW, or equal.
4. Flexible Metal Conduit
 - a. Flexible Metal Conduit shall be constructed of one continuous length of U. L. Approved electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges.
 - b. Flexible metal conduit shall be "liquid-tight" with PVC jacket. Acceptable Manufacturers: Alflex - a division of Southwire, Electri-Flex, Thomas & Betts - a division of ABB, or equal.
 - c. Flexible metal conduit installed in hazardous, NEMA 7, Class I Div. 1 areas shall be UL Listed, and shall have a bronze or stainless steel braid covering over a flexible brass inner core. Packing shall be woven cotton braid impregnated with asphalt. Acceptable manufacturer: Crouse-Hinds

- a division of Eaton, Killark, Thomas & Betts - a division of ABB -XP Series, or equal.
5. Non-Metallic (P.V.C.) Conduit shall be Schedule 80, extra heavy wall or Schedule 40, heavy wall and UL Listed for the use intended. Acceptable Manufacturers: Carlon, Harrison, JM Eagle, or equal.
 6. P.V.C. Coated Rigid Galvanized Steel Conduit
 - a. The PVC Coated Rigid Galvanized Steel conduit, shall fully comply with the following industry listings and manufacturer's standards without exception prior to PVC coated application, shall conform to Federal Specifications WW-C-581E, ANSI Standard C80.1, ANSI Standard C80.5 UL Standard #6 and NEMA RN1-2005.
 - b. The PVC coated rigid galvanized steel (RGS) conduit shall comply with the below listed specifications without exceptions allowed. PVC coated rigid galvanized steel (RGS) conduit shall be hot dipped galvanized both internally & externally. The PVC coated rigid galvanized (RGS) conduit shall have hot dipped galvanized threads. The external PVC coating shall be a nominal 40 mils of external PVC coating and 2 mils of blue interior urethane coating. The PVC coating shall be applied by the same manufacturer of the hot dipped galvanized rigid steel (RGS) conduit.
 - c. Conduit bodies and fittings for PVC coated rigid galvanized steel (RGS) conduit shall be from the same manufacturer as the PVC coated rigid galvanized steel (RGS) conduit. Conduit bodies shall be coated on the entire body both internally and externally with 2 mil of blue urethane and exterior coated with 40mil of PVC coating.
 - d. All conduit, conduit bodies, connectors, support systems and accessories in the corrosive areas, above grade or below grade, shall be coated as specified.
 - e. The thickness of the coating is to be a nominal 40 mils except where the configuration or application of the unit dictates otherwise.
 - f. PVC coated conduit shall be UL or ETL Listed.
 - g. During the manufacturing of the PVC coated rigid galvanized steel (RGS) conduit, the factory applied hot dipped galvanized coating of both the internal and external (RGS) conduit shall not be disturbed in any fashion prior to the application of PVC coating being applied as per UL 6. The PVC coated rigid galvanized steel (RGS) conduit shall comply with all UL listings providing the hot dipped galvanized coating as the primary means of protection of corrosion protection for the conduit, and the PVC coating shall be listed as a secondary means of corrosion protection as required by UL 6 and NEMA RN-1-2005.
 - h. Every female opening shall have a plastic sleeve extending one pipe diameter or 2", whichever is less, beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the pipe used with it. The wall thickness of the sleeve shall be the same as the plastic coating.
 - i. Fittings and Accessories:
 - i. Right angle beam clamps and U-bolts will be provided with PVC

- encapsulated nuts that cover all exposed parts of the threads.
 - ii. U-bolts will be sized to snugly fit the nominal 40 mil coated conduit.
 - iii. The screw heads on Form 8 condulets shall be stainless steel encapsulated by the same manufacturer. All conduit bodies used in wash down, wet or outdoor applications shall be NEMA 4X rated.
 - iv. Couplings shall have longitudinal ribs 40 mils in thickness to protect them from wrenches or channel-locks.
 - v. All coated conduit and fittings must be installed wherever possible by a certified trained installer using a tool available from the manufacturer for the use intended in order to protect the PVC coating.
 - j. The interior coating shall be applied in such a manner so as to allow field bending without cracking or flaking of the interior coating.
 - k. All fittings shall be of the same material as the respective raceway system.
7. Acceptable manufacturers shall be: Plasti-Bond, Thomas & Betts-a Division of ABB/Ocal, Perma-COTE, or equal.
- B. Wire Markers:
- 1. For locations where the integrity of the marker is a concern (such as in manholes or outdoor locations) wire markers shall be one piece, nylon locking marker ties equal to "OMNI GRIP" as manufactured by the W. H. Brady company, Panduit PLM series, or equal.
 - 2. For other locations where the integrity of the marker will not be compromised (such as a control panel in a dry, indoor location) plastic-coated sticker-type labels may be used.
- C. Conductors and Cable
- 1. All power wiring conductors (P-X on drawings) shall be insulated for 600 volts, Type XHHW insulation, unless otherwise noted. Conductors shall be standard AWG and KCMIL sizes. Conductors shall be 98 percent copper, stranded, heat and moisture resistant with cross-linked synthetic polymer insulation for all sizes No. 12 AWG and larger. Smaller sizes shall not be used except for communications and special systems. For lighting and receptacle circuits, solid wire may be used in lieu of stranded wire, for No. 12 and No. 10 AWG only. Conductors shall be labeled with U.L. approval and be marked with the manufacturer's name, wire size and insulation type. All underground power cables shall be UL Listed and Labeled for underground use in wet locations. Acceptable Manufacturers: Okonite, Southwire, Pirelli, or equal.
 - 2. Variable frequency drive (VFD) motor supply shall be four (4) conductor tinned stranded copper, with cross-linked polyethylene insulation, overall foil (100% coverage) / tinned copper braid (85% coverage) shields, No. 12 AWG tinned copper drain wire, and outer PVC jacket. Cables shall conform to UL specification for 1000 Volt flexible motor supply cable. All underground power cables shall be U.L. Listed and Labeled for underground use in wet locations. Acceptable Manufacturers: Belden, Olflex, Houston Wire & Cable, or equal.
 - 3. Control Wiring:
 - a. All control wiring (120 or 24 volt, AC or DC) conductors within buildings or above grade shall be insulated for 600 volts, unless otherwise noted,

- and shall be No. 14 AWG minimum size, or larger if so indicated on the Drawings. Conductors shall be 98 percent copper, stranded, heat and moisture resistant, and thermal plastic insulated and shall be type THWN/THHN.
- b. All conductors for control wiring located below grade shall be 600V, 98 percent copper, stranded, heat and moisture resistant, with cross-linked synthetic polymer insulation type XHHW. All underground control cables shall be U.L. Listed and Labeled for underground use in wet locations.
Acceptable Manufacturers: Okonite, Southwire, Pirelli, or equal.
 4. All instrumentation control cables (4-20 mA signal) referred to on the Drawings as "twisted shielded pairs", shall be rated 600V, 80 deg. C, individually shielded twisted pairs, No. 16 AWG, stranded conductors of tinned copper with polyethylene insulation and aluminum-polyester shielding with #18 awg stranded copper drain wire surrounded by a chrome PVC jacket. Control cable shall be UL listed with 100% shield coverage. All underground instrumentation cables shall be U.L. Listed and Labeled for underground use in wet locations. Acceptable Manufacturers: Belden, Alpha Wire & Cable or equal. Provide instrumentation control cables equivalent to Belden type 8719 or equivalent unless specified otherwise by the instrument manufacturer.
 5. Three conductor shielded cable for use with remote potentiometers for varying motor speeds etc. Cable shall be stranded, tinned copper, polyethylene insulated, drain wires with aluminum-polyester shielding with #18 awg stranded copper drain wire surrounded by a chrome PVC jacket. Control cable shall be rated 600 volt and shall be UL listed with 100% shield coverage. Acceptable Manufacturers: Belden, Alpha Wire & Cable or equal. Provide three conductor shielded cables equivalent to Belden type 8618 or equivalent unless specified otherwise by the instrument manufacturer.
 6. RTD wiring shall be rated 600V, 60 degree, triads 3C#16TWS, with stranded, tinned copper, polyethylene insulated, drain wires with aluminum-polyester shielding with #18 awg stranded copper drain wire surrounded by a chrome PVC jacket. Control cable shall be UL listed with 100% shield coverage. Acceptable Manufacturers: Belden, Alpha Wire & Cable, or equal. Provide RTD wiring equivalent to Belden type 8618 or equivalent unless specified otherwise by the instrument manufacturer
 7. Thermocouple wire shall be 600V, No. 16 AWG, solid duplex, tinned copper, polyethylene insulated of materials to match the characteristics of the thermocouple. Thermocouple lead wire shall have PVC insulation with PVC jacket.
 8. Intercommunication Wiring:
 - a. Conductors for intercommunication wiring in indoor applications shall be 150V, 80 deg C, tinned copper, PVC insulated twisted pair, 24 AWG solid conductor with chrome PVC jacket, two-pair minimum. Acceptable Manufacturers: Belden type 9562, Alpha Wire & Cable, or equal.
 - b. Conductors for underground intercommunication wiring shall 24 AWG solid bare copper, low smoke PVC insulated (1s PVC), twisted pairs (unshielded) conductor surrounded by a white category 3 1s PVC outer

jacket, four-pair minimum, U.L. Listed and Labeled for underground wet locations. Acceptable Manufacturers: Belden type 1245A2, Alpha Wire & Cable, or equal.

9. Data Wiring:
 - a. Cables for data wiring shall be Category 6, 4-pair, 24 AWG solid bare copper conductor, unshielded, FEP insulation, plenum rated. Acceptable Manufacturers: Belden Type 7813LC, Alpha Wire & Cable, or equal.

D. Outlet Boxes

1. Standard, recessed outlet boxes and covers shall be galvanized steel not less than 1-1/2 inches deep, 4 inches square or octagonal, with knockouts. Recessed boxes shall only be used for recessed work. Acceptable Manufacturers: Thomas & Betts, Steel City, OZ Gedney, Raco or equal.
2. Outlet boxes exposed to moisture or used for exposed work shall be cadmium cast alloy complete with hubs and gasketed screw fastened covers.
3. Outlet boxes used in hazardous, Class I, Div 1, Group C & D locations shall be UL Listed Feraloy iron alloy body with electrogalvanized and aluminum acrylic paint or epoxy powder coat complete with hubs as required for the installation. Provide covers to fit the application. Covers to be utilized for pendant mounted light fixtures shall incorporate flexible cushion or ball type fixture hangers rated for the area in which it is to be installed. Acceptable manufacturers: Crouse Hinds, Appleton, or equal.
4. Outlet boxes used in corrosive, NEMA 4X areas, shall have a plastic P.V.C. coating as previously described in the conduit, raceway and tubing section. Acceptable manufacturer shall be Rob-Roy "Plasti-Bond", Thomas & Betts, Ocal, or equal.
5. In no case shall boxes be sized smaller than as indicated in Article 314 of the National Electrical Code for the conductor sizes installed.
6. Acceptable Manufacturers: Thomas & Betts, Steel City, OZ Gedney, Crouse-Hinds, Raco or equal.

E. Pull and Junction Boxes

1. Boxes shall be with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type flush covers. Boxes with hinges and side clips are not acceptable. Boxes installed in damp locations shall be of watertight construction with gasketed cover and conduit hubs. Refer to the Electrical Drawing E-1 for NEMA rated areas for this project and pullbox type and use required.
2. Boxes installed in Class I, Div 1, Group C & D locations shall be constructed of copper free aluminum (body and cover), extruded aluminum hinges with stainless steel cover bolts and neoprene gasket. The box shall be UL Listed for the location and sized as required for the application. Provide NEMA 4/7 pullboxes when installed in these areas.
3. Boxes used in corrosive, NEMA 4X areas, shall have a plastic P.V.C. coating as previously described in the conduit, raceway and tubing section. Acceptable manufacturer shall be Rob-Roy "Plasti-Bond", Thomas & Betts – a division of ABB/ Ocal, Perma-COTE, or equal.

4. In no case shall boxes be sized smaller than as indicated in Article 317 of the National Electrical Code for Conduit and Conductor sizes installed.
- F. Expansion Fittings
1. Expansion fittings for exposed conduit runs shall be watertight expansion type designed to compensate for up to 8" of movement (4" in either direction). Fittings shall be U.L. listed, shall be malleable iron or ductile iron with exterior and interior zinc plating for corrosion protection. With U.L. listed internal bonding jumper constructed of a tinned copper braid, sized to meet UL fault current test requirements and comply with bonding requirements –NEC 250-.98. Acceptable Manufacturer: Thomas Betts – a division of ABB Type XJG-TB O.Z./Gedney - a division of Emerson- Type EX, Crouse Hinds, or equal.
 2. Expansion/deflection fittings for concealed conduit runs shall compensate for up to 3/4" of movement in any direction. Fittings shall be U.L. listed and be water, rain and concrete tight. Fittings shall be constructed of bronze end couplings, neoprene sleeve with stainless steel bands and an internal braided tinned copper bonding jumper and Ericson type conduit union. Acceptable manufacturer: O.Z. Gedney type a division of Emerson -DX, Thomas Betts – a division of ABB - type XD, or equal.
- G. Wiring Devices
1. Wiring devices shall be specification grade as described herein. Switch handles, receptacles, etc. shall be installed in a single color. New wiring devices installed in existing facilities shall match previous installed devices. Provide device cover plates of satin finish stainless steel in finished areas and cadmium finished sheet steel in unfinished areas. Acceptable manufacturers are: Hubbell Inc., Cooper-Arrow-Hart – a division Eaton, Pass & Semour – a Division of Legrand, Thomas & Betts – a Division of ABB, or equal. Provide devices as indicated by Contract Documents.
 2. Toggle Switches
 - a. 20 Ampere, 1-pole, 277 Volt: Hubbell 1221
 - b. 20 Ampere, 2-pole, 277 Volt: Hubbell 1222
 - c. 20 Ampere, 3-way, 277 Volt: Hubbell 1223
 - d. 20 Ampere, 4-way, 277 Volt: Hubbell 1224
 - e. 20 Ampere, 1-pole, 277 Volt w/Neon Pilot Light: Hubbell 1221-PL
 - f. 20 Ampere, 2-pole, 277 Volt w/Neon Pilot Light: Hubbell 1222-PL
 - g. 20 Ampere, 3-way, 277 Volt w/Neon Pilot Light: Hubbell 1223-PL
 3. Receptacles
 - a. 20 Ampere, 125 Volt, Single Receptacle: Hubbell 5361
 - b. 20 Ampere, 125 Volt, Duplex Receptacle: Hubbell 5362
 - c. 20 Ampere, 125 Volt, Duplex G.F.I. Receptacle: Hubbell GF-5362
 - d. 30 Ampere, 125/250 Volt, Dryer Receptacle: Hubbell 9430A
 - e. 50 Ampere 125/250 Volt, Range Receptacle: Hubbell 9450A
 - f. 20 Ampere, 125 Volt, Duplex, Weatherproof: Crouse Hinds WLGf-FS with GFI receptacle
 - g. 20 Ampere, 125 Volt, Duplex, Explosion proof:
 - i. Crouse Hinds ENR12201 W/(2) ENP5201 Plugs (Dead End Type)
 - ii. Crouse Hinds ENRC22201 W/(2) ENP5201 Plugs (Feed Thru Type)

- h. 30 Ampere, 600 Volt, 2-wire, 3-Pole Welding Receptacle:
 - i. Crouse Hinds ARE3322 W/APJ3575 Plug (Surface Mount)
 - ii. Crouse Hinds AR332 W/APJ3575 Plug (Flush Mount)
 - i. 30 Ampere, 600 Volt, 3-Wire, 4-Pole Welding Receptacle:
 - i. Crouse Hinds ARE 3422 W/APJ3485 Plug (Surface Mount)
 - ii. Crouse Hinds AR342 W/APJ3485 Plug (Flush Mount)
 - j. 60 Ampere, 600 Volt, 2-Wire, 3-Pole Welding Receptacle:
 - i. Crouse Hinds ARE6323 W/APJ6385 Plug (Surface Mount)
 - ii. Crouse Hinds AR632 W/APJ6385 Plug (Flush Mount)
 - k. 60 Ampere, 600 Volt, 3-Wire, 4-Pole, Welding Receptacle:
 - i. Crouse Hinds ARE6424 W/APJ6485 Plug (Surface Mount)
 - ii. Crouse Hinds AR642 W/APJ6485 Plug (Flush Mount)
 - l. Special duty style and type receptacles greater than 20 ampere shall be submitted for specific applications indicated on the drawings specific for each area and load to be connected.
 - m. Isolated ground type orange coded receptacles rated 20 ampere, 125 volt duplex shall be submitted for all computer power equipment shown on the drawings.
 - n. Metallic and Non-Metallic Pin and Sleeve type devices and Interlocked receptacles shall comply with NEMA 250, UL94, 746C, 840, 1010,1682 and UL1686 and ASTMD570, IEC 309-1 as indicated on detail drawings. Acceptable manufacturers shall be Crouse Hinds – a division of Eaton, Hubbell, Thomas & Betts – a division of ABB, Russell Stoll Max Guard, or equal.
- H. Control Devices and Equipment:
- 1. Photoelectric Control:
 - a. 120 Volt, SPST, 2000 Watt: Tork Model 2101
 - b. 120 Volt, DPST, 6000 Watt: Tork Model 5403
 - 2. Lighting and Control Contactors:
 - a. Contactors shall be electrically operated, electrically held and shall switch a load at 277 volts, 60 hertz and shall have the number of N.O. contacts and N.C. contacts shown on the Drawings. Minimum number of contacts shall be 5 N.O. and 1 N.C. contact.
 - b. The contactor shall be continuously rated 20 amperes per pole for all types of ballast and tungsten lighting and resistance loads, and shall not be de-rated for use on high-inrush loads. The coil should be continuously rated and encapsulated.
 - c. The contactor shall have double-break, silver-cadmium-oxide power contacts. Auxiliary arcing contacts are not acceptable. All power contacts shall be convertible from N.O. to N.C. or vice-versa. All contacts shall have clearly visible N.O. and N.C. contact-status indicators.
 - d. The contactor shall be approved per UL 508 and CSA.
 - e. The contactor shall be designed in accordance with NEMA ICS2-211B. They shall be industrial-duty rated for applications to 600 volts maximum.
 - f. The contactor shall have a NEMA Type 1 enclosure unless noted otherwise on the Drawings.

- g. Refer to Drawings for location, wiring schematics and details.
- h. Acceptable manufacturers: Square D, Cutler-Hammer, or equal.
- i. Provide complete system lighting and control panel layout and wiring diagrams for review and approval.

I. Motor Starters

1. For Single Phase Motors: Fractional Horsepower Manual Motor Starter with Thermal Overload(s) and a red running indicating light unless noted otherwise:
 - a. 120 Volt Single-Pole, Surface Mounted: Square-D FG-1P
 - b. 120 Volt Single-Pole, Flush Mounted: Square-D FS-1P
 - c. 120 Volt, Single-Pole, Surface Mounted, Explosion Proof: Square-D FR-1H
 - d. 120 Volt, Single-Pole, H-O-A Selector, Surface Mounted: Square-D FG-71P
 - e. 120 Volt, Single-Pole Two-Speed, Surface Mounted: Square-D FG-11P
 - f. 240 Volt, Two-Pole, Surface Mounted, Explosion Proof: Square-D FR-2H
 - g. 240 Volt, Two-Pole, Surface Mounted: Square-D FG-2P
 - h. 240 Volt, Two-Pole, Two-Speed, Surface Mounted: Square-D FG-22P
 - i. 240 Volt, Two-Pole, H-O-A Selector, Surface Mounted: Square-D FG-72P
2. For Three Phase Motors: Shall be combination starter/disconnect type, employing magnetic starter (NEMA Size 1 minimum), rated to match the equipment served, with thermal overload protection for each phase and with an M.C.P. type circuit breaker/disconnect sized per the circuit breaker manufacturer's recommendations for coordination with the thermal overload protection, lights, relays and auxiliary devices. Combination starters shall be provided with a 480, 240 or 208-120 volt control power transformer with primary and secondary fusing. Provide 2 N.O. and 2 N.C. auxiliary contacts.
3. Refer to control wiring diagrams on the drawings for specific requirements and devices.
4. Acceptable Manufacturers: Square-D, Cutler-Hammer, Allen-Bradley, or equal.

J. Safety Switches

1. All safety switches shall be NEMA Type HD and Underwriters Laboratories Listed.
2. The handle position shall indicate whether the switch is "ON" or "OFF".
3. All current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall have removable arc suppressers where necessary to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60°C or 75°C, aluminum or copper wires.
4. Provisions for padlocking the switch in the "OFF" position with at least three locks shall be provided.
5. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open.

6. Disconnect switches, indicated on the drawing to be used for motors controlled by variable frequency drives shall be as indicated above, except shall be 4 pole type switches. The fourth pole shall be wired directly to the disable input, in series with the safety e-stop, in order to lock-out and immediately shutdown the drive. The auxiliary 4th pole shall open prior to any of the other three power poles and shall be designed for proper use with VFD type load circuits.
 7. Enclosures
 - a. Safety switch enclosures for non-hazardous locations painted galvanized steel for NEMA 12 area and stainless steel for NEMA 4X areas.
 - b. Switches specified as NEMA 7 Class 1, Division 1 shall be furnished in cast aluminum enclosures with conduit provisions as specified. Enclosures shall be provided with a bolted cover and with sealing means for hazardous location protection. "ON" and "OFF" position identification shall be cast into the cover, not painted on or applied with an adhesive.
 - c. Switches specified as NEMA 7 (Class 1, Division 2) shall be furnished in non metallic enclosures, NEMA 4X/IP66/Class 1, Division 2 rated with conduit provisions as specified. Enclosures shall be provided with "ON" and "OFF" position identification and lockable in the "OFF" position.
 8. Acceptable Manufacturers: Square-D, Cutler-Hammer, General Electric, Siemens, or equal.
- K. Fusible Disconnect Switches
1. Switches shall be horsepower rated for AC and/or DC as indicated by the plans. All fusible switches rated 100 thru 600 amperes at 240 volts and 30 thru 600 amperes at 600 volts shall have a UL approved method of field conversion from standard Class H fuse spacing to Class J fuse spacing. The switch also must accept Class R fuses and have provisions for field installation of a UL listed rejection feature to reject all fuses except Class R. The UL listed short circuit rating of the switches shall be 200,000 rms symmetrical amperes when Class R or Class J fuses are used with the appropriate rejection scheme. The UL listed short circuit rating of the switch, when equipped with Class H fuses, shall be 10,000 rms symmetrical amperes. The cost of any conversion kit and labor associated with conversion to accommodate the required fuses shall be included in the base bid. In general, U.L. Class H fuses are not to be used. Refer to the paragraph on fuses, this section on further requirements for fuses.
 2. Enclosures
 - a. Safety switch enclosures for non-hazardous locations painted galvanized steel for NEMA 12 area and stainless steel for NEMA 4X areas. Refer to Drawing E-1 for NEMA classifications.
 - b. Switches specified as NEMA 7 & 9 shall be furnished in cast aluminum enclosures with conduit provisions as specified. Enclosures shall be provided with a bolted cover and with sealing means for hazardous location protection. "ON" and "OFF" position identification shall be cast into the cover, not painted on or applied with an adhesive.
 3. Acceptable Manufacturers: Square-D, Cutler-Hammer, General Electric, Siemens, or equal.

L. Enclosed Circuit Breakers

1. Circuit breakers shall be molded case, thermal-magnetic type, ratings as noted, with overcenter, trip-free, toggle-type operating mechanism, quick-make, quick-break action and positive handle indication unless otherwise noted. Multiple pole breakers shall be common trip type. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Breakers shall be calibrated for operation, an ambient temperature of 40°C and shall be suitable for mounting and operating in any position. Breakers shall have removable lugs, U. L. listed for copper and aluminum conductors. Breakers shall be installed in enclosures as specified in Section 16160, with NEMA ratings as indicated on the Drawings. Breakers shall be provided with manufacturer installed neutral and ground kits and shall be U.L. listed and labeled for service entrance duty as noted on the drawings and where required by the N.E.C. Short circuit ratings of equipment shall be as noted on the drawings or shall be rated equal to the equipment or motor control center which they feed. The minimum rating shall be 42,000 A RMS symmetrical unless otherwise noted or determined by the Engineer.
2. Acceptable Manufacturers: Square-D, Cutler-Hammer, General Electric, Siemens, or equal.

M. Power Distribution Fuses

1. All fuses rated 600 volts and below shall be rejection type dual-element, time-delay type. Acceptable Manufacturers are Bussman, Littlefuse and Shawmut or equal.
2. Fuses shall be U.L. Class and rating as shown on the drawings or as required by the manufacturer of the equipment they are protecting. In general, fuses shall be:
 - a. U.L. Class RK1 for service entrances and feeders supplying combination motor loads.
 - b. U.L. Class RK5 for motor branch circuits.
3. Provide two (2) complete sets of fuses for all fusible disconnect switches.

N. Ground Rods, Ground Cable, Ground Fittings

1. Ground Rods shall be copper-clad steel at least 3/4-inch in diameter and 10 feet long. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.
2. Ground System Cable and taps shall be copper stranded, sized as indicated on Drawings and/or in Section 16450. Exothermic welding connections shall be required for underground connections; mechanical fittings are acceptable for above ground connections only. Acceptable manufactures are Erico-Cadweld, Thomas & Betts-Blackburn, Galvan, or equal.
3. Irreversible compression connectors must be factory filled with an oxide inhibitor and installed with the same manufacturers die so that the die index matches the listed index on the connectors. Connector must be fully crimped with a 14 ton or larger hydraulic tool so that the index number is indented on the connector. Connectors must comply with IEEE837, UL467 and CSA22.2. As manufactured by: Thomas & Betts-Blackburn, Hubbell-Burndy, Erico, or equal.

- O. Metal Framing Channel
 - 1. Channel for all locations shall be roll formed from stainless steel AISI Type 316. Channel shall be 1-5/8" and comply with the following industry standards: NFPA70, Fed Spec: W-C-582, WW-H-171, MFMA-4, and ASTM B633
 - 2. Use stainless steel fittings and hardware of the same material as channel. Fittings shall be by same manufacturer.
 - 3. All metal framing channel ends shall be furnished and installed with insert type plastic caps for the entire installation of this project at all ends of framing. End caps which install around the outside of the channel will not be allowed.
 - 4. Provide a complete 4" "C" angle channel mounting channel and hardware system as shown on the drawings and for all vertical supports. Refer to the electrical detail drawings for structural sizing and rigidity of "C" channel. Uni-Strut channel shall only be allowed for horizontal support and cannot be used in a vertical support installation.
 - 5. Metal framing shall be B-Line Systems, Inc., Thomas & Betts-Super Strut, Unistrut, or equal.
- P. Link Seal
 - 1. Conduit wall and floor seals for cored holes and sleeved openings shall be Link Seal, Innerlynx, Crouse Hinds, or equal. Refer to the contract drawings for additional requirements.
- Q. Cable Seals
 - 1. Conduit sealing bushings shall be OZ Gedney Co., Type CSB Series, Crouse Hinds, Killark, or equal.
- R. Conduit Seals-Offs
 - 1. Provide Class I, Div. 1, Group D and Class 1, Div. 2 seals as required by the N.E.C. Material shall match the conduit in which being installed. Acceptable manufacturers are Appleton, Crouse-Hinds, Killark, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Unless otherwise noted, wiring for all systems indicated in the Contract Documents shall consist of insulated conductors installed in raceways in accordance with the manufacturer's instructions.
 - 1. Raceways shall be continuous from outlet box to outlet box and from outlet box to cabinet, junction or pull box. Secure and bond raceways to all boxes and cabinets such that each system of raceways will be electrically continuous throughout.
 - 2. Contract drawing E-1 NEMA CLASSIFICATIONS FOR ELECTRICAL EQUIPMENT AND ENCLOSURES indicates the NEMA ratings of each location at the facility.
- B. Unless otherwise indicated on the Drawings and Conduit Installation Schedule on E-1, install all wiring in the following applicable raceway system.
 - 1. Use of Miscellaneous Conduit Types
 - a. Flexible "liquid tight" metal conduit shall be used for final connection to the following:
 - * all motors
 - * rotating or vibrating equipment

* dry type transformers * recessed lighting fixtures

Lengths of liquid tight flexible metal conduit shall be kept to a minimum (12 to 18 inches) and maximum length of 2'-6" except when dictated otherwise by a particular installation approved by the Engineer and as allowed by NEC.

- b. PVC Schedule 80 non metallic conduit shall be used as shown on drawings.
2. All signal wiring shall be installed in rigid galvanized steel or PVC coated rigid galvanized steel conduit.
- C. General Raceways Installation Requirements:
 1. Sized as indicated on the Drawings. Where sizes are not indicated, raceways shall be sized per the National Electrical Code in accordance with the quantity, size, type and insulation of conductors to be installed. However, raceways shall be minimum three quarter (3/4") trade size for all installation unless otherwise noted.
 2. Provide adequate grounding between all outlets and the established electrical system ground. Bond conduit systems per NEC.
 3. Cut square, free of burrs due to field cutting or manufacture, and bushed where necessary. Spray all ends of threaded conduit with cold galvanizing spray compound.
 4. Installed with exterior surfaces not less than six inches (6") from any surface with a temperature of 200°F or higher.
 5. Plugged at the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.
 6. Concealed throughout except where exposure is permitted by the Engineer.
 7. Installed parallel or perpendicular to floors, walls and ceilings.
 8. Installed with a minimum of bends and offsets. All bends shall be made without kinking or destroying the cross section contour of the raceway. Factory made bends shall be used for raceways one-inch (1") trade size and larger.
 9. Installed with U. L. Listed raintight and concrete-tight couplings and connectors.
 10. Firmly fastened within three feet of each outlet box, junction box, cabinet or fitting. Raceways shall not be attached to or supported by wooden plug anchors or supported from Mechanical Work such as ductwork, piping, etc.
 11. Arranged in a neat manner for access and allow for access to work installed by other trades.
 12. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Engineer and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.
 13. Where raceways puncture roof, install pitch pockets as required in order that the roof warranty is maintained.
 14. Where raceways penetrate fire-rated walls, floors, or ceilings, install firestops equal to the rating of the wall, floor, or ceiling, per specification section 07270, "Fireproofing".
 15. For Raceways installed outdoors:

- a. Conduit entry shall not extend from above and turn down to the equipment causing a path of moisture or liquid to follow down to the equipment.
- b. Install drip loops in liquid tight conduit connections and extend up to equipment to avoid moisture or liquid travel to the equipment.
- c. Seal all conduits with duct seal or cable seals that extend from heated to non-heated locations at both ends of all conduits.

D. Wiring Methods

1. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Engineer and receive written approval for splicing prior to installation of feeder(s). Refer to Splicing Methods listed below.
2. Do not pull conductors into raceways until raceway system, including all outlets, cabinets, bushings and fittings, is completed. Verify that all work of other trades which may cause conductor damage is completed. Use only U.L. approved cable lubricants when necessary. Do not use mechanical means to pull conductors No. 8 or smaller.
3. In general, conductors shall be the same size from the last protective device to the load.
4. All wiring systems shall be properly grounded and continuously polarized throughout, following the color coding specified. Connect branch circuit wiring at panelboards, as required, in order to provide a "balanced" three-phase load on feeders.
5. All feeder connections shall be made to bus and other equipment using solderless, pressure type terminal lugs, as manufactured by Burndy, National, O.Z., T. & B., or equal.

E. Conduit Support

1. Support adequately by malleable iron pipe clamps or other approved methods. **In exterior or wet locations and along outside wall supports shall allow not less than 1/4 inch air space between raceway and wall.** Firmly fasten raceway within 3 feet of each outlet box, junction box, cabinet or fitting. The following table lists maximum spacing between supports. Additional supports may be required due to field conditions, strength of supporting members, etc. Furnish and install such supports at no additional cost to Owner.

<u>Conduit Trade Size</u>	<u>Type of Run</u>	<u>Horizontal Spacing in Feet</u>	<u>Vertical Spacing in Feet</u>
3/4"	Concealed	7	10
1", 1-1/4"	Concealed	8	10
1-1/2" & lgr.	Concealed	10	10
3/4"	Exposed	5	7
1", 1-1/4"	Exposed	7	8
1-1/2" & lgr.	Exposed	10	10

F. Installation of Concrete Envelope

1. Wherever a cluster of four or more raceways rise out of floor exposed, provide neatly formed 6" high concrete envelope with chamfered edges around raceways.
- G. Installation of Spare Conduits
1. At each flush mounted panel-board, terminal cabinet, control cabinet, etc., provide four (4) spare three-quarter inch (3/4) raceways from panel-board, etc. to an area above the nearest accessible ceiling space and floor space in the specific room location. Make 90 degree turn above the ceiling or below the floor and cap all conduits.
 2. Where drawings indicate a "Spare" conduit, install a #14 AWG fish wire in all runs to facilitate future installation of conductors.
- H. Installation of Bushings and Grounding Bushings
1. Provide grounding type insulated bushings on all power conduits regardless of size.
 2. Provide grounding type insulated bushings on all control conduit sizes and signal conduit sizes one and one-quarter inch (1-1/4") trade size and larger.
 3. Provide standard bushings for conduits one inch (1") and smaller unless otherwise stated.
 4. Install cable seal bushings in conduits for all outdoor locations and NEMA 4X locations to prevent moisture from entering enclosures and equipment.
 5. Install cable seals in all conduits where there is a change in temperature such as transitioning from a room to the attic.
 6. Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to afford equivalent protection to conductors.
 7. Any installations not provided with these requirements shall be removed and reinstalled at no additional cost to the Owner.
- I. Myers Hubs
1. Myers hubs shall be installed on junction boxes and enclosures which do not have cast hubs in non classified areas.
- J. Expansion Fittings
1. All conduit installations where conduits extend up out of the ground at buildings, structures or equipment shall be provided with expansion fittings.
 2. Expansion/deflection type fittings shall be provided at all horizontal or vertical expansion joints, located in new or existing buildings and structures.
- K. Conduit Seals
1. Conduit seals shall be installed in all explosion proof areas Class 1 Division 1, and Class 1, Division 2 areas. The conduit seal shall be installed per the National Electric Code Article 501.15 as well as what is shown on the drawings.
 2. Upon installation of sealant, the contractor shall mark the conduit seal with glyptal or permanent marker to indicate that the conduit seal is filled properly.
- L. Link Seals
1. All penetrations through existing and new concrete floors, and walls shall be core drilled and sleeved, and installed with a link seal.
 2. Refer to all details shown on the Contract Drawings for conduit sealing fittings and weatherproof conduit seals. All conduit penetrations are required to be

provided with seals as noted on the Contract Drawings and as specified. Any installations not provided with these requirements shall be removed and reinstalled at no additional cost to the Owner.

M. Splicing Methods

1. Feeder conductors shall be continuous from point of origin to load termination without splice. If this is not practical, contact the Engineer and receive written approval for splicing prior to installation of feeder(s).
2. For splices and taps, No. 10 AWG and smaller, use solderless "Thread-On" connectors having spiral steel spring and insulated with a vinyl cap and skirt, as manufactured by 3M Co. (pre- insulated "Scotch-Lock") or Ideal ("Wing-Nuts").
3. For splices and taps, No. 8 and larger, use solderless "Split Bolt" type connector as manufactured by Anderson, Burndy, Kearney, Thomas & Betts, or equal.
4. Use cast connections, Cadweld or Thermoweld, for ground conductors.
5. Make all splices and connections in accessible boxes and cabinets only.
6. Cover uninsulated splices, joints and free ends of conductor with rubber and friction tape or PVC electrical tape. Plastic insulating caps may serve as insulation.
7. Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together. For parallel sets of conductors, match lengths of conductors as near equal as possible.
8. Branch circuit conductors installed in panelboards, and control conductors installed in control cabinets and panels shall be neatly bound together using "Ty-Raps" or equal.

- N. Installation of Ceiling Hung Devices
1. Lighting fixtures, detectors, etc., in Mechanical Equipment, Boiler and Pump Rooms shall be installed with exposed conduit after equipment, ductwork, piping, etc., are in place.
- O. Grouping of Conductors
1. Contractor may group certain wiring with the approval of the Engineer, as follows.
 - a. Power 120V may be grouped with power 120V
 - b. Control 120V may be grouped with control 120V
 - c. Control 24V may be grouped with control 24V
 - d. Instrumentation may be grouped with instrumentation
 - e. Specialty wiring may be grouped with like systems
 - f. Power wiring at 480V shall not be grouped
 - g. Fire alarm system wiring shall not be grouped with other systems

The installation shall be installed in accordance with all requirements of the NEC (including wire ampacity derating factors), manufacturer's requirements, and the Engineer. Excessive grouping which interferes with functionality and reliability will not be allowed. The wiring configuration as shown on the drawings is the baseline requirement for the work.

- P. Light Switches
1. All light switches shall be installed in close proximity of the door opening where indicated on drawings. Where lights are shown adjacent to strike side of door, locate edge of switch box approximately 6 inches from door frame.
 2. Install cover plates for all single and multi-gang switch boxes for all light switches.
- Q. Outlet Boxes
1. On termination at branch circuit outlets, leave a minimum of eight inches (8") free conductor for installation of devices and fixtures.
 2. Consider location of outlets shown on Drawings as approximate only. Study Architectural, Mechanical, Plumbing, Process, and Structural Drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between Drawings, contact Engineer for decision prior to installation. Comply with Article 314 of National Electrical Code relative to position of outlet boxes in finished ceilings and walls.
 3. Prior to installation, relocate any outlet location a distance of five feet in any direction from location indicated on Drawings if so directed by the Engineer. Prior to completion of wall construction, adjust vertical height of any outlet from height indicated if so directed by Engineer. The above modifications shall be made at no additional cost to the Owner.
 4. Where outlets at different mounting heights are indicated on Drawings adjacent to each other (due to lack of physical space to show symbol on Drawings), install outlets on a common vertical line.

5. Where switch outlets are shown adjacent to strike side of door, locate edge of outlet box approximately 3 inches from door frame.
6. Outlet boxes in separate rooms shall not be installed "back-to-back" without the approval of the Engineer.
7. Outlet boxes installed in plaster, gypsum board or wood paneled walls shall be installed with raised plaster covers or raised tile covers.
8. Outlet boxes installed in tile, brick or concrete block walls shall be installed with extra-deep type raised tile covers or shall be 3-1/2 inches deep boxes with square corners and dimensions to accommodate conductors installed.
9. Surface ceiling mounted outlet boxes shall be minimum 4 inches square, 1-1/2 inches deep, galvanized sheet metal.
10. Surface wall mounted outlet boxes shall be cast type boxes having threaded or compression type threadless hubs. Exterior boxes shall be cast type with threaded hubs and gasketed cover plates secured by non-ferrous screws.
11. Install a device cover plate over each and every outlet indicated on Drawings. Do not install plates until painting, cleaning and finishing of surfaces surrounding the outlet are complete. Cover plates shall completely cover all edges of openings in the wall around the outlet box for a neat/finished installation.

R. Junction and Pull Boxes

1. Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and as required by the National Electrical Code, Article 314.

S. Equipment Mounting Heights

1. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment base as follows: (Device base to be set at CMU joint unless otherwise noted. The Contractor shall verify all dimensions noted with the Engineer for final approval prior to performing or installing any of this work.)

a. Toggle switches (up position "on")	48"
b. Receptacle outlets (long dimension vertical,	
c. ground pole nearest floor)	16"
d. Receptacle outlets, above baseboard heaters	30" min.
e. Receptacle outlets, hazardous areas	48"
f. Receptacle outlets, at countertops	48"
g. Receptacle outlets, weatherproof, above grade	24" min.
h. Terminal cabinets, control cabinets, annunciator	
i. panels, to top of backbox	72"
j. Disconnect switches, motor starters, enclosed	
k. circuit breakers, to top of box	60"
2. Where structural or other interferences prevent compliance with mounting heights listed above, consult Engineer for review to change location before installation.

- T. Hangers and Supports
 - 1. Provide steel angles, channels and other materials necessary for the proper support and erection of motor starters, distribution panelboards, large disconnect switches, pendant-mounted lighting fixtures, etc.
 - 2. Panelboards, cabinets, large pull boxes, cable support boxes and starters shall be secured to ceiling and floor slab and not supported from conduits. Small panelboards, etc., as approved by Engineer, may be supported on walls. Racks for support of conduit and heavy electrical equipment shall be secured to building construction by substantial structural supports with PVC end caps as noted above.
 - 3. All vertical supports for stanchion mount structures and control stations shall be 4" angle channel.
 - 4. Provide PVC end caps for all protruding angles, channels, struts, etc. for personal safety for the entire project installation.
- U. Identification of Conduit Systems
 - 1. Provide lamacoid nameplates to mark intrinsically safe conduit systems for all applicable conduit systems for project.
 - 2. Refer to Section 16010 for conduit labeling requirements.
- V. Grounding Connections
 - 1. Exothermic welding connections shall be provided for underground connections.
 - 2. Mechanical fittings and irreversible compression fittings shall be provided for above ground connections.
 - 3. Make connections to equipment with mechanical connections shall be made by means of approved bronze clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A, or equal.

3.2 TESTS

- A. For testing requirements, refer to Section 16950.
- B. For grounding requirements, refer to Section 16450.

END OF SECTION

SECTION 16160CABINETS AND ENCLOSURESPART 1 - GENERAL1.1 DESCRIPTION

- A. The purpose of this Specification is to provide details of cabinets and enclosures for non-hazardous indoor and outdoor locations which will protect internal equipment from environmental conditions. This section is also to intend to provide consistency between enclosures supplied under different Divisions of this Contract. An exception is control panels provided by Division 11 and Division 13 which are specified within their specifications.

1.2 QUALITY ASSURANCE

- A. Supply cabinets and enclosures in accordance with the following:
1. Underwriter's Laboratory, Inc. listed.
 2. National Electrical Manufacturers Association Standard 250-1991.
 3. American National Standards Institute.
 4. National Electrical Code.
- B. Cabinets and enclosures supplied under this Section shall conform to the requirements of Specification Section 16010, "Quality Assurance".
- C. Stock cabinets and enclosures shall be manufactured by Hoffman Engineering Company, Saginaw Control and Engineering or approved equal. Custom fabricated enclosures shall be equal in quality, appearance and performance to stock enclosures. All enclosures shall be subject to the review of the Engineer.

1.3 RELATED WORK

- A. Additional details for panels and enclosures associated with process equipment are provided in the individual specification sections in Division 11.
- B. Additional details for panels and enclosures associated with HVAC equipment are provided in the individual specification sections in Division 15.
- C. Miscellaneous panel and enclosure auxiliary equipment, such as lights, switches, receptacles, fuses, etc. are contained in Section 16050, 16900, and as noted on the Contract Drawings.

1.4 REFERENCES

- A. ASTM C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- B. ASTM D149 - Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
- C. ASTM D256 - Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- D. ASTM D495 - Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
- E. ASTM D570 - Test Method for Water Absorption of Plastics.

- F. ASTM D638 - Test Method for Tensile Properties of Plastic.
- G. ASTM D648 - Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- H. ASTM D790 - Test Method of Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- I. ASTM D792 - Test Method for Density and Specific Gravity (Relative Density) of Plastic by Displacement.
- J. UL94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.
- K. UL508A - Industrial Control Panels.
- L. The enclosures shall meet all requirements for UL508A - Industrial Control Panels as follows:
 - 1. All components within the enclosures shall be UL Listed and Labeled.
 - 2. The enclosure and all components as an entire "assembly as a system" shall be UL Listed and Labeled as UL508A compliant.

1.5 SUBMITTALS TO THE ENGINEER

- A. Shop drawings for this section are not required. The items listed below shall be included with the specific control being submitted to show compliance with this section in order to perform a complete review for equipment being submitted.
 - 1. Provide documentation, as applicable, from a UL certified fabricator that the control panel has been tested, fabricated, and labeled as a complete functioning system and is in compliance with all UL listings and standards.
 - 2. Scaled and dimensioned enclosure layout drawings (internal and external) along with catalog cut sheets shall be provided.
 - 3. Enclosure NEMA ratings, project specific identification, where located, etc., shall be clearly and properly identified on each panels cut sheet.
 - 4. Listing of all accessories to be furnished with each panel and properly identified.
 - 5. Provide a complete wiring diagram for all items located within the enclosure such as panel lights, duplex receptacles, panel heaters, cooling fans, relays, control devices, protective devices, etc., where applicable.
 - 6. Provide heating requirement calculations for all exterior panels and panels located in unheated spaces, and cooling requirement calculations for heat dissipation from panels containing VFD's and other heat generating equipment as necessary.
 - 7. Submit all control panel faceplate arrangements for review and acceptance.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery, storage and handling of electrical/instrumentation cabinets, enclosures and equipment contained within shall be in accordance with the general conditions Specification 11000 and specification 16010.
- B. Replace or repair, to the satisfaction of the Engineer, any cabinets and enclosures which are defective or have been damaged during storage or installation, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General for all Enclosures:

1. NEMA classifications for panels and enclosures shall be as noted on Drawing E-1, unless otherwise specifically called out within the Drawings or Specifications.
2. Panels and enclosures shall be furnished factory-wired and tested with all equipment and appurtenances mounted thereon.
3. Control panels and enclosures shall be U.L. listed and labeled as a complete and functioning system.
4. Panels larger than 36-inches in any dimension shall not be wall mounted.
5. Provide two doors if panel is larger than 36-inches wide.
6. Refer to the drawings and pertinent specifications for minimum control panel faceplate requirements. In the absence of specific details, faceplates shall be arranged in such a manner as to provide a neat, workable and operator friendly panel.
7. Doors shall have side mounted, stainless steel, continuous length, piano-type hinges and pins.
8. Latches shall be T-handle or quick-release type only. Latches which require use of tools or coins for access, utilize wing-nuts, clips around the outside of enclosure etc., will not be acceptable.
9. Panels/enclosures shall be equipped with map pockets located on the inside of the door.
10. Enclosures shall be equipped with provisions for locking the access doors.
11. Enclosures shall be sized as required to contain the necessary apparatus for the particular installation except as noted on the drawings. Final panel/enclosure dimensions shall provide for easy access and workability to all internal components with ease of maintenance and future modifications considered. Conflicts with panel sizing and available spacing shall immediately be brought to the attention of the Engineer prior to proceeding.
12. Provide door and body stiffeners where necessary for a rigid enclosure. Large enclosures shall be provided with lifting eyes and, where floor-mounted, with 12-inch floor stands. No floor stands are to be provided for free-standing models.
13. Enclosures larger than 16 inch in any dimension shall utilize a three point latching system.
14. Enclosures 16 inch wide and larger shall be equipped with heavy duty, zinc plated stop arm kits to lock the external door in the open position.
15. Panel front-mounted pilot lights, selector switches, push button control stations and appurtenances shall be provided in accordance with Section 16900.
16. Where required, enclosures shall be provided with an interior panel, painted white, for mounting of internal components.

B. General NEMA Class and Requirements for Indoor Installations:

1. NEMA Type 1 Enclosures
 - a. Enclosures shall be sheet steel, 16 gauge for box widths up to and including 18", 14 gauge for box widths of 24", and 12 gauge for box

- widths of 30" and greater. Enclosures shall have continuously welded seams ground smooth; supplied with or without knockouts and shall have door and body stiffeners where necessary for a rigid enclosure.
- b. Panels/enclosures shall be factory coated inside and out with ANSI 61 gray polyester powder coating over phosphatized surfaces.
2. NEMA Type 12 Enclosures:
 - a. Enclosures shall be sheet steel, 16 gauge for box sizes up to and including 24" by 24", 14 gauge for box sizes larger than 24" by 24" up to 60" by 36", and 12 gauge for box sizes greater than 60" by 36". Free-standing enclosures shall be 12 gauge minimum. Enclosures shall have continuously welded seams, ground smooth, supplied with no holes or knockouts and a rolled lip around door and enclosure opening. Enclosures to be installed in areas with the potential for dripping liquids shall be provided with drip shields.
 - b. Provide oil-resistant door gaskets.
 - c. Enclosures shall be coated inside and out with ANSI 61 gray over phosphatized surfaces.
 3. NEMA Type 3R Enclosures:
 - a. Type 3R enclosures shall not be used to house controls or electronics that require heating. See the specific "Special Requirements" for outdoor panels below.
 - b. Enclosures shall be steel, 16 gauge for box widths up to and including 12", 14 gauge for box widths between 15" and 24", and 12 gauge for box widths of 30" and greater. Free-standing enclosures shall be 12 gauge minimum. Enclosures shall have drip shield top; seam free sides, front, and back; and furnished with knockouts or factory installed cut outs in bottom only.
 - c. Panels/enclosures shall be factory coated inside and out with prime and finish coats. Finish coat color to be ANSI 61 gray. Two prime coats shall be applied. Prime coat shall be rust inhibitive primer equal to Koppers Inertol Rust inhibitive Primer 621. Finish coat shall be compatible with prime coat and shall be an alkyd applied in two coats with a minimum dry film thickness of 1.5 mils per coat. Alkyd coating shall be equal to Koppers Glamortex 501 Enamel. Surface preparations shall be in accordance with manufacturer's requirements.
 4. NEMA Type 4 Enclosures:
 - a. Enclosures shall be sheet steel, 16 gauge for box sizes up to and including 24" by 24", 14 gauge for box sizes larger than 24" by 24" up to 60" by 36", and 12 gauge for box sizes greater than 60" by 36". Free-standing enclosures shall be 12 gauge minimum. Enclosures shall have continuously welded seams ground smooth; supplied with no holes or knockouts. Provide with door and body stiffeners as required for a rigid installation and with rolled lip around door and enclosure opening. Enclosures to be installed outdoors shall be provided with drip shields.
 - b. Provide oil-resistant, water tight door gaskets.
 - c. Enclosures shall be factory coated inside and out with prime and finish coats. Finish coat color to be ANSI 61 gray. Two prime coats shall be

applied. Primer shall be rust inhibitive primer equal to Koppers Inertol Rust inhibitive Primer 621. Finish coat shall be compatible with prime coat and shall be an alkyd applied in two coats with a minimum dry film thickness of 1.5 mils per coat. Alkyd coating shall be equal to Koppers Glamortex 501 Enamel. Surface preparations shall be in accordance with manufacturer's requirements.

5. NEMA Type 4X Enclosures:
 - a. Type 4X enclosures shall be stainless steel or aluminum. No other metals will be allowed.
 - i. Type 304 stainless steel enclosures shall be 16 gauge for box sizes up to and including 24" by 24", 14 gauge for box sizes larger than 24" by 24" up to 36" width, and 12 gauge for box widths greater than 36 inches. Free-standing enclosures shall be 12 gauge minimum.
 - ii. Aluminum enclosures shall be type 5052 H-32 aluminum, minimum 0.080-inch thick.
 - b. Metal enclosures shall have continuously welded seams, ground smoothed.
 - c. Enclosures shall be supplied with no holes or knockouts; shall have door and body stiffeners where necessary for a rigid installation and a rolled lip ground door and enclosure opening.
 - d. Enclosures to be installed outdoors shall be provided with drip shields.
 - e. Provide oil-resistant door gaskets all around door openings. All enclosure hinges, clamps, etc. shall be stainless steel.
 - f. Enclosures shall be provided unpainted, with metal enclosures having a smooth brushed finish.
- C. Special Requirements
 1. Enclosures located in unheated spaces or general outdoors
 - a. When components requiring a minimum temperature in which to operate, such as solid state devices, are to be installed inside the enclosure, the enclosure shall be NEMA 4X or NEMA 4 minimum when not available.
 - b. The enclosures shall be insulated. Insulate the inside of all exterior surfaces with 1 inch thick rigid fiberglass insulation board having a maximum thermal conductivity ("k" value) of 0.35 BTU-in/hr-ft²-°F. The insulation shall be finished with manufacturer's standard all service jacket. Coverings containing foil will not be acceptable.
 - c. Enclosures shall be equipped with a factory installed built-in heater and adjustable thermostat. Field installations after the fact will not be acceptable. The heater shall be sized to maintain the temperature inside the panel at 40°F (or higher if required) with an outside ambient temperature of -30°F and a 15 MPH wind. The heater shall include a fan to circulate the air within the enclosure to prevent hot spots. Thermostat shall measure air temperature, not surface temperature. Heater shall be similar to Hoffman Engineering Co. series D-AH, Genesis automation, or approved equal.
 - d. Provide strip heater with thermostat for condensation control.

- e. Provide heating requirement calculations for review and acceptance to be included as part of the shop drawing review for this equipment.
 - f. Enclosures shall have a lockable outer door with a separate hinged NEMA 1 dead front inner door.
 - g. The panels inner door latches shall be T-handle or quick release type only.
 - h. All control devices and the main circuit breaker operating handle shall be mounted through the interior panel door. The main circuit breaker handle shall have a lock arrangement to prevent the inner door from being opened when in the "on" position.
 - i. Enclosures 16 inch wide and larger shall be equipped with heavy duty, zinc plated stop arm kits to lock the external door in the open position.
2. Instrument and Control Panels
- a. All instrument and control enclosures shall have the proper NEMA rating for the areas in which they will be installed or as specified in Division 11.
 - b. All front-mounted instruments and devices shall be installed in such a way as to maintain the NEMA rating of the enclosure.
 - c. Panels which are to be installed outdoors shall meet the special requirements of "Outdoor Control Panels and Panels located in Unheated Spaces".
 - d. Panels shall be supplied with a GFI type duplex convenience receptacle and a panel light with an easily accessible on-off switch. The receptacle and panel light shall be provided with a separate overcurrent protective device and connected in such a manner so as to not disconnect control, instrumentation, or PLC power in the event that the GFI outlet should trip.
 - e. Panel lights for panels located in outdoor or unheated spaces shall a 32W fluorescent lamp with a low temperature starting ballast.
 - f. Panel lights for panels located in heated spaces shall be a 32 watt fluorescent lamp with protective lens. The length of the lamp shall be a minimum of 75% of the width of the enclosure.
 - g. Provide a separate, dedicated, single pole receptacle for connection of the UPS System as required. This receptacle shall be labeled - "For UPS System Only".
3. Special Cooling Requirements
- a. Enclosures which contain Variable Frequency Drives or other heat-producing equipment shall be provided with modifications and/or accessories designed to dissipate excess heat and allow for proper equipment cooling, while maintaining the enclosures NEMA rating. Following are several accessories which may be used, depending upon the ambient temperature and NEMA rating of the area installed.
 - i. Cooling fans with dust filters, for NEMA 1 enclosures.
 - ii. Heat exchangers with circulating fans and filters, for NEMA 12 enclosures.
 - iii. Air conditioners, for NEMA 12 enclosures in areas with high ambient temperatures.
 - iv. Air Conditioners, for NEMA 4X enclosures in both 4X areas and 4X-corrosive areas shall be cooled with the use of a side mounted

air conditioner. The air conditioner shall be controlled by an internal thermostat in parallel with the run contact.

- v. Air conditioners shall have a drain tubing installed in order to drain to the nearest floor drain. Tubing shall be plastic PVC flex tube or PVC schedule 40.
 - b. Cooling fans shall be wired such that they only operate when the VFD or heat producing equipment is running.
 - c. Air conditioners where used in enclosures shall operate off of an internal thermostat.
 - d. Provide heat dissipation calculations and cooling method proposal for review and acceptance to be included as part of the shop drawing review for this equipment. Design ambient air temperature shall be 95°F.
- D. Nameplate/Identification:
1. All panels/enclosures, and all contained equipment/instrumentation shall be provided with a nameplate providing project specific identification of the unit or device. Identification wording shall be as noted on the drawings. In the absence of specific identification of name tag wording, provide general descriptive information of unit function.
 2. Provide nametags as specified in 16010.
 3. Name tags shall be permanently mounted below panel mounted items (interior and exterior as appropriate), or in as appropriate location as to clearly identify its function.
- E. Control Panel Wiring:
1. All wiring shall conform to the latest requirements of NEC, all state and local code requirements, and as described on the Drawings and in the Contract specifications.
 2. All control wires internal to panels shall be minimum No. 14 AWG. Wires carrying line voltage shall be minimum No. 12 AWG. All conductors shall be copper. Wiring in close proximity to heating devices shall be Type AVA U.L. approved. All wiring shall be run in PVC wiring channels and bundled with nylon cable ties. Line voltage wiring must be run separately from control, signal and intrinsically safe wiring. PVC wiring channels shall be properly sized for the capacity of wires being installed based on the overall project needs and shall not be over filled.
 3. Bundles of wires must be secured to the panel structure every 8 inches minimum. All interior wiring will be point to point with no splices.
 4. Shielded wire shall be separated from other wires and equipment with suitable barriers and with terminal blocks for continuous shield grounding to the connecting cables.
 5. Intrinsically safe wiring shall be separated by barriers from all other wiring and shall be identified as required by the N.E.C. and installed with proper separation per U.L. 508A requirements.
 6. Wires to the front of panel devices shall be looped, extra flexible, bundled and located in a manner to prevent damage due to opening and closing the door.

7. All wires shall be marked at both ends with numbers by self-sticking wire markers or with slip-on style plastic markers. Color coding shall include the following:
 - a. Red wires - Interior control circuits
 - b. Orange wires - Interlocks powered from external sources
 - c. Blue wires - DC voltages
 - d. See Section 16010 for additional color coding.
 8. Terminals shall be arranged in alphabetic and numeric order in columns on removable subplates. A maximum of two connections shall be made to each side of a terminal, including jumpers. Provide an additional 20 percent spare terminals with the following minimum requirements:
 - a. Power terminals - 2 spares
 - b. Control terminals - 10 spares
 - c. Signal terminals - 12 spares
 9. Provide ground terminal for each panel.
 10. All control panels shall be provided with spare mountings for additional relays. Number of spare mountings will correspond to 5% of the total number of relays within each panel, with a minimum of one (1) spare mounting.
 11. All control panels shall be provided with an appropriately sized surge arrester to protect panel internals. Surge arrester shall be equal to Square D Model SDSA1175 or Model SDSA3650 (as applicable) in quality and appropriately sized for function.
 12. All control panels will be suitable for use with 120V, 1 phase power, unless noted otherwise on the Drawings. The panels shall be equipped with an internal power supply fuse or circuit breaker and a thru-the-door, lockable, disconnect switch. Fuse blocks will be provided as required to allow a separate fuse for each piece of equipment within the panel requiring power.
 13. Provide complete "As Built" wiring diagrams to be provided with the O&M manuals and in the enclosures for all control panels.
 14. All wiring entering and leaving control panels shall be terminated on field terminal blocks and labeled.
 15. Provide large letter lamacoid plastic name plate as specified in 16010 at the top center of each control panel with properly identified nametag which corresponds to the contract designation name. Verify final name designation with the Engineer prior to installation.
- F. Spare Parts/Materials:
1. Provide 1 gallon of paint for each enclosure/panel topcoat color utilized.
 2. Provide the following spare parts for each panel/enclosure provided. Spare parts shall be contained in the panel/enclosure in such a manner as to permit accessibility and prevent accidental damage without interfering with internally mounted equipment.
 - a. Provide 10 of each lamp type used.
 - b. Provide one of each type relay used.
 - c. Provide one control switch, indicating light and/or push-button of each type used.
 - d. Provide 1 set of each fuse type and size used.

- e. Provide 1 of each color and type light lens used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All interconnecting wiring between panels, unless specifically detailed otherwise on the drawings, shall be installed by the electrical contractor regardless of source of the panel itself. All conduit, wiring and installation requirements for each enclosure shall be completely and thoroughly coordinated with all applicable trades prior to equipment installation.
- B. Install enclosures in locations as shown on the Drawings.
 - 1. All floor mounted enclosures either free standing or on floor stands shall be mounted on a 4" high, concrete, maintenance pad.
 - 2. Securely fasten each floor mounted enclosure to the maintenance pad.
 - 3. Small enclosures may be supported on walls using stainless steel metal framing channels or similar hardware to provide a minimum 1/4 inch air space between enclosure and wall.
- C. Equipment Mounting
 - 1. All framing channels and mounting hardware shall be stainless steel - no exception.
 - 2. Use stainless steel fittings and hardware of the same material as the channel. All fittings supplied shall be by same manufacturer as the channel.
 - 3. Provide cross bracing as required using unistrut securely fastened to the mounting structure or building structure to provide for a rigid mounting assembly.
 - 4. The ends of all framing channels/strut shall be provided with PVC end caps for protection of personnel.
 - 5. Backboards used for mounting of equipment shall be constructed of 3/4 inch thick fiberglass, unless otherwise specified on the drawings.
 - 6. All channels or unistrut installed in such a manner that parts are located below grade shall be coated with a black bitumastic waterproofing material for the below grade portion and extending a minimum of 6 inches above grade. The exposed portion of the channel shall be taped off prior to coating for a neat, even, finished appearance.
 - 7. NEMA 4X installations require a 1/4" spacer between the enclosure and mounting support to prevent moisture from collecting.
- D. Equipment mounting heights shall be as shown on the contract drawings or the tops placed a maximum of 72 inches above finished floor or platform when the elevation is not shown.
- E. Provide special protection for all devices and terminal blocks when cutting, drilling, and/or installing any device in the control panel.
- F. All conduits entering exterior enclosures or in NEMA 4X environments shall be suitable gasketed on the outside and conduits shall be sealed (inside) using a pliable duct seal to prevent the entrance of water.
- G. All lifting eyes, hooks, brackets, devices etc., used to install, lift, transport, etc., the control panel shall be removed after installation and all resultant holes shall be plugged with threaded bolts for a finished, permanent installation. All methods of

plugging the holes shall maintain the NEMA rating of the enclosure.

3.2 TESTS

- A. Testing of the enclosures themselves is not required, however, all equipment and controls which are mounted in or on the enclosures shall be tested as a complete assembly as specified in the applicable sections of DIVISIONS 11, 14, 15 and 16.
- B. Each enclosure shall be fully tested by the manufacturer.

3.3 CLEANING

- A. Do not allow excess debris, water or other fluids to accumulate inside the enclosures during the course of construction.
- B. Upon completion of the work, remove all debris and surplus materials from inside the enclosures and leave them clean.
- C. Clean all enclosure surfaces and touch up any scratched or damaged areas to the satisfaction of the Engineer.
- D. Clean or replace all filters located in enclosures which contain ventilation fans.

END OF SECTION

SECTION 16445MODIFICATIONS TO EXISTING MOTOR CONTROL CENTERSPART 1 - GENERAL1.1 DESCRIPTION

- A. The work of this section includes the furnishing, installing, and testing of modifications to existing motor control centers as specified herein and as shown on the contract drawings as indicated on the "Single Line Diagrams".
- B. Modifications to existing motor control centers are not required to be of the same manufacturer as the motor control centers provided for the project as applicable. These devices take exception to the Quality Assurance Statement of Section 1.2.E of Specification 16010.

1.2 QUALITY ASSURANCE

- A. The equipment specified herein is based upon the first manufacturer named after the phrase "Acceptable Manufacturers". Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by that manufacturer. Equipment of other acceptable manufacturers shall be equivalent in every way to that of the equipment specified.
- B. Suppliers deemed equivalent shall be responsible to support and supply equivalent equipment which shall meet the intended design. Any extensive modifications or rework of the design drawings in order to facilitate acceptability shall be the responsibility of this Contractor at no additional cost to the Owner.
- C. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.
- D. Motor Control Center(s) shall have been tested in a high power laboratory to prove adequate mechanical and electrical capabilities. All major components shall have been individually design tested and guaranteed by the manufacturer.

1.3 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings are required for all items provided under this section. Submittals shall be provided in accordance with Sections 01340, 16010 and as specified in this section.

1.4 REFERENCE TO OTHER SECTIONS

- A. Refer to Section 16010 for identification nameplates requirements.
- B. Refer to Section 16010 for coordination, short circuit, and arc flash study requirements.

PART 2 - PRODUCTS2.1 MATERIALS

- A. Modifications to Existing Motor Control Centers:
 - 1. The modifications to the existing motor control centers and the manufacturer are shown on the contract drawings.

MODIFICATIONS TO EXISTING MOTOR CONTROL CENTERS

2. This Contractor shall visit the site to become thoroughly familiar with the work required and specified herein. All modifications shall be performed without jeopardizing the integrity of the existing equipment. All work to be performed shall be complete and shall meet with all standards and guidelines for installation to this equipment.
3. The contract drawings indicate that specific compartment section(s) are to be modified. The modifications shall include new equipment and/or modifications to existing equipment installed. Each compartment is to be replaced and/or existing equipment modified in order to retrofit the compartment sections as required by the contract documents.
4. The short-circuit ratings of all new and modified devices shall be equal to or greater than that of the existing equipment. This is to be verified by this Contractor and the information furnished and included in the shop drawing submittals for this equipment.
5. The Contractor shall be allowed to replace the sections as required in their entirety. This shall be verified with the Contractor and brought to the attention of the Engineer prior to final cost submittal.
6. Provide screwed on nameplates for all revised sections as required for all front compartment devices and as noted on contract drawings.
7. The requirements noted have been outlined for this section. If any information on existing equipment cannot be verified then this shall be brought to the attention of the Engineer and verified prior to submitting bid for this project.
8. Refer to Section 16900 for control device and equipment requirements.

PART 3 - EXECUTION3.1 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.
- B. Ground all motor control centers in accordance with the National Electric Code and as specified in section 16450.
- C. Motor control centers shall be mounted on 4" high concrete pads which shall extend 2" on exposed sides. Securely bolt each unit to its pad for proper horizontal and vertical alignment. Use shims where necessary.
- D. Install Safety Labels in compliance with NEMA 260.

3.2 TESTS

- A. Refer to Section 16950 for testing requirements.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work Included: Provide and install all grounding and appurtenances as shown on the Drawings, manufacturer's installation manuals and guidelines, and as specified herein.
- B. The Contractor is responsible to provide a complete interconnected grounding system which provides for a common potential grounding system. All components shall be bonded to the same potential via the grounding system for the entire facility. Review all connections and drawings along with requirements of the latest edition of the National Electrical Code (NEC) for final grounding requirements. A complete and integrated grounding system shall be the responsibility of the Contractor to furnish, install, and integrate into the sequence of construction for this the facility. All work shall be in compliance with NEC requirements and as indicated on the drawings.

1.2 PRODUCT HANDLING

- A. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Section 16050 - Basic Materials for material to be used under this section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Grounding electrode conductors shall be run in rigid steel conduits. All metal conduit used for the installation of the grounding electrode conductor shall be bonded with the use of a bonding bushing at both ends.
- B. Grounding conductors shall be run with feeders where shown on the drawings or hereinafter specified.
- C. Conduits stubbed-up below a motor control center shall be fitted with insulated grounding bushings and connected to the motor control center ground bus. Boxes mounted below motor control centers shall be bonded to the motor control center ground bus. The grounding wire shall be sized in accordance with article 250 of the National Electric Code.
- D. Liquid tight flexible metal conduit in sizes 1 inch and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps. Tie wraps shall be installed 12 inches apart and not more than 6 inches from ends.
- E. Connect the following equipment by separate wire or cable directly to the grounding system:

1. Frame of each transformer
 2. Neutral of each transformer for a separately derived system as defined by NEC article 250.
 3. Service entrance line compartment
 4. Low voltage switchgear
 5. Cable tray system
 6. Boiler stacks and the like
- F. Connect the following equipment by separate wire or cable to the ground bus in the distribution equipment servicing the equipment:
1. Motor Control Centers and Switchboards
 2. Panelboards
 3. 480 Volt motors
 4. Control panels
 5. Bus Duct
 6. All feeders and branch circuit installed in non-metallic raceways
 7. Receptacle circuits
- G. The following equipment shall be grounded through the metallic raceway systems with permanent and effective ground connections:
1. All metal cases and support frames
 2. Lighting system
 3. All motors
 4. Radio Antennas
- H. Bond the following N.E.C. approved electrodes together to form a ground system:
1. Metallic water main
 2. Building steel frame
 3. Steel reinforcing rods
 4. Grounding rods and plates
 5. Buried bare copper conductors
- I. Grounding electrodes shall be driven where shown on the drawings. Spacing between electrodes shall be equal to or greater than the length of the electrodes. Exposed grounding connections shall be made by means of approved bronze clamps. Exposed connections between different metals shall be sealed with No. Oxide Paint Grade A, or equal.
- M. All buried conductors shall be laid slack in trenches. The earth surrounding the cables shall be void of sharp objects which may injure the cables. Backfill material shall be natural earth. Where cables are exposed to mechanical injury they shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard. Connections shall be made as hereinbefore specified.
- N. Do not allow water main connection to be painted. If the connections are painted, they shall be disassembled and remade with new fittings.
- O. Bond and ground all conduit systems. Ground conduit system and neutral conductor of wiring system with a connection at the main electrical service switchboard.
- P. Furnish and install all main service grounding systems, building grounding systems and supplemental grounding systems as required by NEC and as shown on the drawings for a complete grounded system for the entire facility.

- Q. Equip and install all exposed "pigtails" or grounding electrode conductors with an armored sheath.
- R. Group and bond ground wires to panel boxes, light fixtures, receptacles, etc., not to system neutral.
- S. Ground shield of a twisted-pair cable at one end only, at the power source for the device or instrument.
- T. Ground all lightning arresters and exterior conduit risers.

3.2 TESTING

- A. Tests shall be performed before loaming and seeding or paving work has been performed. Refer to Section 16950 for testing requirements.

END OF SECTION

SECTION 16469VARIABLE FREQUENCY DRIVESPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide all variable frequency drives (VFD) as indicated on the "Single Line Diagram". Contractor shall coordinate variable frequency drive manufacturer selection with all equipment manufacturers.
- B. Contractor shall coordinate variable frequency drive manufacturer selection with all equipment manufacturers, and shall be solely responsible for ensuring that the individual variable frequency drives furnished are completely compatible with all requirements and intended functions of the driven equipment. The basis for design for this project is based on Allen-Bradley.
- C. Variable frequency drives which are shown to be located in a stand alone enclosure are required to be of the same manufacturer.
- D. Acceptable manufacturers are Square D, Cutler Hammer, Toshiba, or equal.

1.2 QUALITY ASSURANCE

- A. The equipment specified herein is based upon the first manufacturer named after the phrase "Acceptable Manufacturer's". Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by that manufacturer. Equipment of other acceptable manufacturers shall be equivalent in every way to that of the equipment specified.
- B. Suppliers deemed equivalent shall be responsible to support and supply equivalent equipment which shall meet the intended design. Any extensive modifications or rework of the design drawings in order to facilitate acceptability shall be the responsibility of this Contractor at no additional cost to the Owner.
- C. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.
- D. Refer to equipment manufacturer requirements under 16010, Section 1.2.

1.3 REFERENCES

- A. Institute of Electrical and Electronic Engineers (IEEE)
 1. Standard 519-1992 2014, IEEE Guide for Harmonic Content and Control
- B. Underwriters Laboratories
 1. UL508C
- C. National Electrical Manufacturer's Association (NEMA)
 1. ICS 7.0, AC Adjustable Speed Drives

1.4 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings are required for all items provided under this section. Submittals shall be provided in accordance with Sections 01340, 16010 and as specified in this section.

1.5 REFERENCES TO OTHER SECTIONS

- A. Refer to Section 16010 for identification nameplates requirements.
- B. Refer to Section 16900 for control device requirements.
- C. Refer to Section 16160 for Cabinet and Enclosures.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Variable Frequency Drives (VFD's)
 - 1. The drive shall be capable of varying the speed of a standard or inverter duty rated NEMA Design B induction motor from a virtual standstill to the standard speed of the motor. The unit shall transform input power into a variable voltage, adjustable frequency three phase output of suitable capacity and waveform.
 - 2. Input voltage shall be as indicated on the Drawings and/or as specified in the equipment specification sections. Frequency shall be 60 Hz.
 - 3. Output shall be three (3) phase voltage as indicated on the Drawings and/or as specified in the equipment specification sections.
 - 4. The drive shall be a PWM (Pulse Width Modulated) transistorized inverter.
 - 5. The drive manufacturer shall have not less than five years of experience in the manufacture of drives in the United States.
 - 6. The drives shall be rated for constant or variable torque applications (460V - 1 HP to 150 HP), depending on the individual driven load requirements. For constant torque applications, the output transistors shall be low-gain, fully rated. Derated high-gain transistors are not acceptable.
 - 7. Power Line Considerations
 - a. Each VFD or multiple sets of VFD's shall be designed and installed such that: the total harmonic distortion reflected back to the power source is a maximum of 5%, the notch depth reflected back to the power source is a maximum of 20%, and the notch area reflected back to the power source is a maximum of 22,800 volt-microseconds. The total harmonic distortion, notch depth and notch area shall be as defined by IEEE-519-2014.
 - b. Line reactors and other required devices shall be provided for individual VFD's where indicated on the Drawings and/or in the VFD schedule.
 - 8. Enclosures
 - a. Unless otherwise noted in drive schedule, all variable frequency drives and all associated equipment and control devices shall be located within or contain within their respective enclosure as shown on the Drawings. Separately submitted and mounted devices will not be accepted.
 - b. Refer to schematic diagrams and VFD schedule for further information.
 - 9. Filtering
 - a. RFI/EMI filters shall be provided by supplier and shall be rated for, and compatible with, each VFD. They shall function as a complete system. Additional line reactors beyond those shown on drawings may be required in order to comply with the above parameters.
 - b. 5% line reactors shall be mounted inside the respective VFD enclosure reactors and shall be TCI Harmonic Guard or equivalent.

- c. Harmonic matrix filters and switching capacitor shall be provided where shown on drawings. Refer to single line diagrams and schematics for additional information.
10. System Analysis
- a. The VFD supplier shall perform a computer simulated power system study to verify compliance with the parameters as stated herein. The results of this study shall be submitted to the engineer. At a minimum the submitted results of this study shall include:
 - i. A brief summary of the equations and calculation procedures used in the study.
 - ii. A results summary sheet which briefly describes the power system configuration analyzed and which states the calculated values of total harmonic distortion, notch depth and notch area.
 - iii. Computer generated graphs which illustrate the voltage and current waveforms of the power system with the VFD's operating. These waveform graphs shall directly illustrate the results of the power system computer model study.
 - iv. Detailed list of the amplitude of harmonic currents and voltages to the 50th harmonic.
 - b. The contractor shall supply the VFD supplier with all power system data required to perform the above described study. These data may include but are not limited to:
 - i. A complete one line diagram of the subject electrical distribution system. The diagram must show the lengths of all bus and cable runs, impedance values of all types of bus and cable used, and number of conductors per phase.
 - ii. Complete electrical data on all equipment shown on the one line diagram is required. At a minimum this data shall consist of: Transformers - kVA, Primary voltage, Secondary voltage, Short circuit capacity or impedance. Motors - Stator resistance, No load RMS current, No load kVA, No load kW, Locked rotor RMS current, Locked rotor kVA, Locked rotor kW, Horsepower, Base speed, Number of poles, Efficiency at relevant speeds, Power factor at relevant speeds, Full load RMS current. Generators - Short circuit capacity or Subtransient reactances (X_d), Power factor, kW, X/R Ratio.
 - iii. If the distribution system can function in more than one configuration, the configuration(s) to be analyzed shall be clearly defined. Any other information which may affect the behavior of the distribution system shall also be provided.
11. Ambient Conditions
- a. Environment - Indoors, NEMA rating to match areas as depicted on the NEMA CLASSIFICATION SCHEDULE on Drawing E-1 or as specified herein..
 - b. Ambient Temperature - 10 degrees C to 40 degrees C
 - c. Altitude - Less than 3,300 feet

- d. Relative humidity - 90% maximum
 - e. Vibration - less than .5G
12. Control System
- a. Input power:
 - i. Main circuit: 460V/60Hz or as shown on drawings
 - ii. Control circuit: no external power for input shall be required.
 - b. Tolerance: Voltage + 10%. Frequency + 2 Hz.
 - c. Control method: Sinusoidal PWM control
 - d. Output Voltage: 3PH 460 Volt.
 - e. Output Frequency: 0.01 Hz to 60 Hz
 - f. Frequency resolution: 0.01 Hz Operating panel input; 0.03 Hz Analog input; 0.01 Hz Computer interface input
 - g. Frequency accuracy: + 0.5% of max frequency at 25 deg. C + 10 deg.C
 - h. Volts/Hz characteristics:
 - i. Either constant V/f or variable V/f (user selectable)
 - ii. Base frequency adjustable from 25 Hz to 60 Hz
 - iii. Voltage boost adjustable from 0% to 30%
 - iv. Starting frequency adjustable from 0 Hz to 10 Hz
 - i. Overload current: 150% for 1 minute (constant torque applications).
 - j. Frequency command signal: 3k Potentiometer 0-10 VDC; 0-5 VDC; 4-20 mA
 - k. Frequency jump - 3-point settings: Setting jump frequency (0 to Max frequency), and width (0 to max frequency).
 - l. Upper/lower limit frequencies: Upper limit 0 to Max frequency. Lower limit 0 to upper limit.
 - m. PWM carrier frequency: Adjustable from 400Hz to 2000Hz.
13. The drive shall provide a minimum displacement power factor of 0.95 throughout the speed range.
14. Minimum lead length to motors for VFD drive without requiring an additional output filter shall be 250 feet.
15. The efficiency of the drive at full speed shall be a minimum of 98 percent.
16. The drive shall be provided with an MCP type circuit breaker to serve as a disconnect, and coordinated with the drive protective features for the motor to form a complete combination type starter/controller. If necessary, the drive shall also be provided with current limiting fuses on the input side of the drive, sized and rated as required by the drive manufacturer, so that the drive is rated for the available fault current.
17. The drive shall contain relays, push buttons, timers, and all other appurtenances necessary for the specific application as specified in the equipment specification sections, and as shown on the Electrical Drawings.
18. Operational Functions:
- a. Acceleration/deceleration times: 0.1 to 600 seconds, 2 separate acceleration and deceleration times.
 - b. Forward or reverse run can be chosen.
 - c. Jogging
 - i. Running - 0 to 20 Hz

- ii. Braking - Deceleration, DC injection, or coasting
 - d. Multispeed run: up to 7 preset speeds can be chosen.
 - e. VFD shall be capable of accepting a 4-20 mA input signal and adjusting speed accordingly.
 - f. Automatic Restart: Recovers a normal run of a coast-stopping motor.
 - g. Soft Stall: Sustains a run in overload mode. (90% - 150% adjustable)
 - h. Overload: Adjustable from 60 - 100%
 - i. Complete adjustment of parameters gives thousands of volt/frequency patterns.
19. Protective Features:
- a. Functions individually identified by 18 fault codes:
 - Overcurrent during acceleration (OC1)
 - Overcurrent during deceleration (OC2)
 - Overcurrent during run (OC3)
 - Overcurrent detected at start-up (OCA)
 - Short circuit at load (OCL)
 - Overcurrent in regenerative discharge resistor (OCr)
 - Overvoltage during deceleration (OP2)
 - Overvoltage (OP)
 - Overload (OL)
 - Overload of regenerative discharge resistor (OLr)
 - Overhead (OH)
 - Ground Fault (EF)
 - Emergency Stop (E)
 - Frequency Setting Signal Abnormality (Err.1)
 - EE Prom abnormality (EEP, EEP2, EEP3)
 - Computer link abnormality (Err.t)
 - b. Drive shall have an external fault trip input terminal.
 - c. Drive shall reset when a designated contact is closed on the terminal strip.
20. Monitor Functions
- a. The drive shall have display scaler of monitoring frequency. (Range 0.10 to 200)
 - b. The drive shall be able to monitor different parameters.
 - c. The drive shall have an LED on the front panel showing that the main DC circuit capacitor is charged.
21. Controller
- a. All parameters should be adjustable from the keypad.
 - b. One key shall toggle between panel control and terminal control.
 - c. The drive shall have a reset to factory settings.
 - d. The keypad shall match enclosure NEMA rating.
 - e. The keypad shall allow for parameters to be changed while drive is running.
 - f. Most common used parameters should be labeled on the keypad.
 - g. All front panel mounted lights shall be push to test, LED, 120 volt.
 - h. All front mounted device and top center panel shall have lamacoid nameplates throughout.

22. Variable Frequency Drive Shutdown
 - a. The drive shall be able to accept a 4th pole auxiliary contact (from a local disconnect) to be wire directly to an input of the drive. Upon opening of the auxiliary contact, the drive shall be programmed to function such that the drive stops the motor immediately rather than coasting to a stop.
23. All models shall be UL listed.
24. The drive shall be provided with thermal overload function.
25. The drive shall be provided with auxiliary run contact to indicate running status.
26. Variable frequency drive vendor must be a local distributor which has factory-trained personnel and warranty authorization; capable of testing unit(s) with motor loads.
27. Variable Frequency Drive Schedule:

Equipment Name	Motor HP	Constant or Variable Torque	Harmonic Traps/Line Reactors/ RFI/EMI/ dv/dt long lead filters	Supplier MCC Manufacturer /Electrical Contractor	Notes
Drywell Exhaust Fan EF-EG2	3	CT	ERI/EMI/Line Reactor	Electrical Contractor	See Note 1

Notes:

1. The motor rating is 2 HP however the VFD equipment supplier shall provide an oversized VFD as noted and shown on the Schedule.
28. Provide a complete VFD system and a customized and modified control panel for each pump motor installation. Refer to schematic diagram on the Contract Drawings for additional requirements.
 29. Provide each of the VFD control panels with the following:
 - a. Single VFD NEMA 12 vented and rated as depicted on drawings. This shall be single, wall mounted type enclosure control panel for the installation. No separately mounted devices and equipment outside of this enclosure.
 - b. Line reactor 5%, and RFI/EMI filter, as specified and as shown.
 - c. Through the door disconnect operator lockable in the off position.
 - d. Front panel mounted keypad, run light, speed potentiometer and all specified items and as shown on the drawings.
 - e. Provide two (2), 8 hour days of start-up and training for commissioning and final acceptance of this VFD equipment. All equipment must be pre-started, testing and certified ready for testing prior to any of these days being used. Provide a two week written schedule ahead of time to the Engineer and Owner to schedule final start-up and testing as well as training. Training will not be held the same day as start-up and shall be scheduled only upon start-up completion and acceptance. Pre-testing and check out shall not be used as any of the two (2) start-up and training time requirements.

- f. VFD shall be calibrated to the input signal based upon minimum and maximum flow settings.
- g. Provide VFD Parameter Setup and Verification. See Part 3 of this specification.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code
- B. Ground all motor control centers in accordance with the National Electric Code and as specified in section 16450.
- C. Ground all motor frames (operating on Variable Frequency Drives) and VFD shielded cable per the recommendations of the manufacturer of the Variable Frequency Drive.
- D. Install Safety Labels in compliance with NEMA 260.
- E. Inspect all bus bolts prior to energization to check for looseness developed during shipment or handling.
- F. Refer to Section 16050 for equipment mounting heights.

3.2 TESTS

- A. Refer to Section 16950 for testing requirements.
- B. VFD Start-Up, Testing and Parameter Setup and Verification
 - 1. Responsibility and Coordination: The VFD supplier/electrical subcontractor is responsible for adjusting all of the VFD parameters for a fully functional system integrated with the instrumentation and control systems for this project. The VFD supplier/electrical subcontractor is responsible for coordinating with the instrumentation subcontractor and the instrumentation programmer so the control systems function as intended as described in the instrumentation control descriptions.
 - 2. VFD Parameter Setup: Complete the VFD Parameter Setup Checklist and Verification below in the presence of the specifying engineer.
 - 3. The electrical subcontractor shall be responsible to coordinate an onsite meeting with the VFD supplier and the specifying engineer. This meeting shall take place prior to the initial startup of the equipment.

VFD PARAMETER SETUP CHECKLIST

[ENTER NAME OF FACILITY]

- 1. Ramp up speed _____
- 2. Ramp down speed _____
- 3. Min speed (Hz) _____
- 4. Max speed (Hz) _____
- 5. 4-20mA setting at min speed (mA) _____
- 6. 4-20mA setting at max speed (mA) _____
- 7. Output scale calibration _____
- 8. Auto restart after power failure (yes/no) _____
- 9. Auto restart after overcurrent fault (yes/no) _____
- 10. Speed reference (internal/external) _____
- 11. If external - signal source _____
- 12. If external - signal type _____
- 13. Restart after E-Stop (yes/no) _____
- 14. Discrete outputs - Run (yes/no) _____
- 15. Discrete outputs - Fault (yes/no) _____
- 16. Analog outputs - Amps (absolute units) _____
- 17. Analog outputs - KW (absolute units) _____
- 18. Analog outputs - Speed (Hz) _____
- 19. Analog outputs - Speed (RPM) _____
- 20. Analog inputs - 4mA set to 0Hz (yes/no) _____
- 21. Analog inputs - 20mA set to 60Hz (yes/no) _____
- 22. Analog inputs - min speed limit set (yes/no) _____
- 23. Analog inputs - max speed limit set (yes/no) _____
- 24. Voltage boost (%) _____
- 25. Starting frequency (Hz) _____
- 26. PMW carrier frequency (Hz) _____
- 27. Acceleration time (sec) _____
- 28. Deceleration time (sec) _____
- 29. Forward run (yes/no) _____
- 30. Reverse run (yes/no) _____
- 31. Overload (60%-100%) _____

VFD PARAMETER SETUP VERIFICATION

[ENTER NAME OF FACILITY]

Date: _____

General Contractor: _____

Electrical Subcontractor: _____

VFD Supplier: _____

This certifies that the VFD parameters have been coordinated per the specifications and the requirements of Section 16469.

_____	_____
(Authorized Representative of the General Contractor)	Date
_____	_____
(Authorized Representative of the Electrical Subcontractor)	Date
_____	_____
(Authorized Representative of the VFD Supplier)	Date

END OF SECTION

SECTION 16900CONTROLSPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide and install all panel and enclosure components and appurtenances as shown on the Drawings as Local Control Stations as specified herein. All components shall meet NEMA ratings as indicated on drawing E-1 for the specific area where they are to be installed.

1.2 SUBMITTALS TO THE ENGINEER

- A. Shop drawings are required for all items provided under this Section. Submittals shall be in accordance with Sections 01340 and 16010.

PART 2 - PRODUCT2.1 MATERIALS

A. Control Station Enclosures:

1. General:

- a. Control stations shall be heavy duty oil-tight/watertight type stainless steel enclosure and shall consist of operators with contact blocks and indicator lights as indicated on the contract drawings. Enclosures shall have sufficient depth to accommodate mounting four Class 9001 KA-1 contact blocks side-by-side and in tandem behind a single operator for a maximum of eight circuits, four normally open and four normally closed.
- b. Enclosures shall have the required number of holes for the number of operators pre-manufactured as shown on the contract drawings.

2. NEMA 12 and NEMA 4X

- a. Enclosures shall be 16 gauge Type 304 stainless steel gasketed enclosures.
- b. Acceptable manufacturers are Allen Bradley, General Electric, Square D, or equivalent.

3. Class I, Division I and Class 1, Division 2 Enclosures

- a. Enclosures and covers shall be shall be iron or aluminum and gasketed with pre manufactured devices installed by manufacturer.
- b. Acceptable manufactures are Cooper Cooper Crouse-Hinds Flex Station Control Stations, Allen-Bradley, Square D, or equivalent.

B. Operators:

1. General:

- a. All operators used in control stations shall be Square D type K and shall be suitable for cover mounting in a 1-7/32 inch diameter notch type cover hole and shall be held in place by the locking thrust washer. All operators shall be heavy duty oil/water tight, be 30mm in size, and maintain the NEMA rating of the enclosure.

- b. Push buttons shall have removable inserts in eight different colors for function color coding. Push-button inserts shall be removable from the front of the control station without disturbing the wiring or mounting of the control units.
 - c. Selector switches shall have removable knobs in eight different colors for function color coding. Selector switch knobs shall be removable from the front of the control station without disturbing the wiring or mounting of the control units. Operators for selector switches shall be bat wing type.
 - d. Emergency stop pushbutton operators shall be large operator head type, red mushroom-head, maintained type switch with push to open and pull to re-engage control circuit. Provide multiple output contact type as shown on the drawings.
 - e. Indicator lights shall be heavy duty, oiltight and have the following requirements:
 - i. Designed to operate at 120 volts, 60 Hz AC.
 - ii. Provided with a chrome-plated metal or anodized-aluminum mounting rings, engraved as indicated on the Drawings.
 - iii. Lens color shall be as indicated on drawings.
 - iv. Shall be 30 mm LED lamp type, with "Push to Test" requirements.
 - f. Provide legend plates which describe function of each device on control station.
2. Contact blocks used in heavy duty oil-tight control stations shall be of Square D Type K single-pole, single-throw (SPST), single-pole, double-throw (SPDT). Contact blocks shall be suitable for mounting side by side and/or in tandem to the base of the operator with these following requirements:
 - a. mounting screws shall be captive with a drilled and tapped head to permit easy tandem mounting of contact blocks.
 - b. Terminals shall be pressure wire type with a self-lifting pressure clamp that will compensate for wire of different size ranging from #12-#18 solid or stranded.
 - c. Contacts shall be double break, and silver plated.
 3. Class 1 Division 2 operators shall meet all requirements of section 2.1.B.1 with the addition of devices being hermetically sealed by the factory.
- C. Control Circuit Fuses
1. Fuses shall be 3AB ceramic body fuses rated for at least 125 volts at the current ratings shown on the Drawings. Fuse size shall be 1/4" x 1 1/4".
 2. Blow time shall be:
 - a. 110%, 4 hours minimum;
 - b. 135%, 1 hour maximum;
 - c. 200%, 15 seconds maximum for 1/8-12 amp fuses
 - d. 200%, 60 seconds maximum for 15-30 amp fuses.
 3. Fuses shall be Littlefuse, Bussmann, or approved equal.
- D. Relays
1. Industrial Control Relays - Industrial control relays shall be utilized where specifically called for on the Drawings or within the Specifications. Industrial control relays with 10 ampere contact rating shall be Square D, Class 8501 Type

- X, Allen-Bradley or approved equal. Relays with 30 ampere contact rating shall be Square D, Class 8501, Type C or equal.
2. Pilot Duty Relays - Unless specifically noted otherwise, relays shall be general purpose relays. General purpose relays shall be IDEC RH Series, 10A contact rating, 4 Form "C" contacts, Allen-Bradley or approved equal, provided with internal indicating light. Pilot duty control isolating relays for PLC inputs and outputs shall be suitable for the application, and shall be submitted for approval by Engineer.
 3. Relays shall be electrically held, electrically operated with 120 volt coils except as noted otherwise on the Drawings. Contacts shall be rated 600 volt, 10 ampere and shall be convertible from Normally Open to Normally Closed. Where relays are used to control single-phase, fractional horsepower motors, contacts shall be rated in accordance with the N.E.C. for the motor to be controlled. Where relays are not installed within system control panels, provide a suitable enclosure as specified in Section 16160, with NEMA ratings as indicated on the Drawings.
 4. Dry contacts used for instrumentation and SCADA inputs or other low current inputs, shall be bifurcated cross bar gold overlay silver and rated dry circuit. These contacts will be provided through dedicated interposing relays as shown on the schematic diagrams of the Drawings or as specified herein. Relays shall be provided with plug-in type sockets with screw terminal wiring connections to facilitate relay change out and wiring. Relays shall be Potter and Brumfield type KHAU-17A16 - 120 or 12V, IDEC, or approved equal as shown on Drawing.
- E. Fuse Blocks
1. Fuse blocks shall be rated for at least 30 amps and 300 volts. The clips shall be high tensile spring brass, electro-tin plated. The base shall be polyester, glass reinforced with a UL-94VO flammability rating.
 2. At least four spare sets of clips shall be provided on each fuse block and shall be labeled "SPARE".
 3. Fuse block switches shall be din rail mounted.
 4. Fuse blocks shall be Littlefuse Omni-block, Bussmann, or considered equal.
- F. Terminal Strips
1. Terminal strips with box type connectors shall be supplied to make all power and control connections. All terminals shall be clearly marked for easy identification. A ground terminal strip shall also be provided. At least 20 percent of terminals supplied shall be spare. All wiring shall be terminated on field terminal blocks.
- G. Control Power Transformers
1. Supply all control power transformers necessary to make panel functional. All transformers shall have both primary legs and all "hot" secondary legs fused. One secondary leg shall be grounded. Fuse sizing shall be as recommended by the equipment manufacturer for the particular installation.
 2. Final sizing of the control power transformer shall be based on the application and control equipment to be operated on this equipment. The supplier/contractor shall review all system schematics and provide the

appropriate size CPT for each application. Oversized CPT will be required where necessary for the installation.

- H. Emergency Stop Pushbuttons (E-Stops)
 - 1. Pushbutton control station shall be red, large mushroom-head maintained switch with pull-on and push-off type. Provide multiple output contact type as shown on the drawings. Device shall maintain the NEMA rating for area in which it is being installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All items incorporated into the work shall be installed in accordance with the Drawings and Specifications. Where detailed drawings or technical specifications are not provided, the items shall be installed in accordance with the manufacturer's preferred recommendations and confirming to the best practice of the trade involved.
- B. All installations shall be in accordance with the applicable sections of Division 13, 15 and 16 (where applicable).

3.2 TESTS

- A. All items shall be factory tested.
- B. Refer to section 16950 for additional testing requirements.

END OF SECTION

SECTION 16950

START-UP AND TESTING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Test and demonstrate, to the satisfaction of the Engineer, all electrical devices in accordance with the following requirements. All testing and checkout of equipment specified under this Section shall be performed by an independent testing agency. The testing agency shall be an independent and qualified field services company regularly engaged in the testing of electrical equipment and apparatus. The following company has been listed:

Electrical Engineering & Service Co., Inc.
289 Center Street
Holbrook, MA 02343
Tel: 781-767-9988
Contact: Mr. Joseph Cipolla

The testing agency noted is a qualified entity. Additional or equally qualified companies shall be considered as or equal.

- B. During the checkout and startup period, the electrical contractor shall provide sufficient personnel to aid with the start-up of all electrical equipment, to remove any faults, and to make the necessary adjustments for the proper operation of electrical equipment and installation.
- C. A 1000 volt "megger" insulation test shall be available at all times during the testing of power feeders and motor wiring and 2500 volt "megger" test for heat trace cable.
- D. All electrical equipment, wiring, switches and insulators found to be defective or to have failed due to poor workmanship shall be replaced promptly at no additional cost to the Owner.
- E. The testing agency shall be responsible for setting and adjusting all required setting to all electrical equipment based upon the final coordination, short circuit and arc flash study for the entire facility and associated building structures for the electrical distribution system. Signoff and certification sheets shall be submitted and documented for final acceptance.
- F. The contractor will not be allowed to perform any testing, set any equipment parameters or perform any megohm cable testing as this is the responsibility of a third party testing agency as specified herein.

1.2 SUBMITTALS TO THE ENGINEER

- A. Shop Drawings are required for all items provided under this section. Submittals shall be provided in accordance with Sections 01340, 16010 and as specified in this section.
- B. It should be the Contractors responsibility to provide all required forms/direction as to submittal procedures for this contract and to verify compliance prior to submitting

- to the Engineer for review.
- C. A record of all insulation values shall be properly recorded as listed in worksheet attached to the back of the section. All time intervals shown shall be recorded for each conductor being tested.
 - D. Ground testing results shall be properly recorded, witnessed, and reported to the Engineer.
 - E. All circuit breaker settings and testing shall be provided in order to check for proper cable connections, impedance testing and infra-red testing of all connections of all electrical equipment, cables, devices and distribution system equipment for the entire project at all locations.

1.3 TESTING REQUIREMENTS

- A. Prior to the start of check out and testing, insure that all equipment is properly and permanently identified according to Section 16010.
- B. Before energizing any electrical equipment or apparatus, thoroughly check all equipment for the following:
 - 1. All equipment and materials shall be clean, dry and free of foreign materials.
 - 2. Vacuum clean to make free from filings, foreign matter or other materials left inside equipment or enclosures. Particular attention shall be given to bus conductors, conductors, terminal blocks, and windings.
 - 3. Check for tools inside equipment or enclosures. All screw, bolt, and terminal connections shall be checked for tightness as specified by the equipment manufacturer.
 - 4. Check the bearings of all rotating electrical apparatus and, if required, have supplier fill with the grease or oil as recommended by the manufacturers.
 - 5. All motors, contacts, relays, bus, insulators and other electrical apparatus shall be cleaned and dried out if required and/or needed. Drying out methods will be such that the insulation temperature of the apparatus does not exceed 90°C.
- C. Prior to applying voltage to any apparatus or circuit, make insulation resistance tests and, if necessary, dry the apparatus until resistance values conform to the standards of IEEE.
- D. In case of a low resistance circuit insulation, eliminate the problem before the circuit is energized.
- E. Provide 1000 volt "Megger" insulation testing on all 600 volt feeder conductors and motor power conductors. This shall include any and all of the existing electrical feeder cables at the facility which shall remain and shall be reconnected. Motors shall be meggered from the starters.
- F. Provide 2500 volt "Megger" insulation testing for all heat trace cabling to be installed at all locations as shown on the Drawings.
- G. "Megger" test all required service feeder cables and circuit wiring at the existing facility in their entirety and submit a complete test report. Test voltage shall be applied until readings reach a constant value, and until three (3) equal readings, each one (1) minute apart, are obtained. Minimum megger reading shall be 45 megohms for feeder conductors.
- H. Panelboard line currents shall be balance to within 10% of each other.
- I. Three phase motors shall be checked for rotation and, if necessary, reverse the connections at the starter. Single phase and DC motors at motor connection box.

START-UP AND TESTING OF ELECTRICAL SYSTEMS

- J. All main plant building loops and major equipment grounds shall be tested to remote earth or directly referenced to an extremely low resistance (approximately 1 ohm) reference ground bench mark. Tests shall be made with ground testing ohm meter or "megger" approved by the Engineer for the purpose.
- K. The ground resistance of the individual networks shall be measured at two points with the cables at all the test points disconnected.
- L. Test the grounding system to assure continuity and to assure that resistance to ground does not exceed specified limits or form any ground loops.
- M. The entire grounding network resistance shall be meggered. Resistance shall not exceed 25 ohms. Drive additional ground rods if necessary.
- N. The Contractor shall provide load readings for all equipment, switchgear, motor control centers and panelboards.
- O. Set all coordination, short circuit and arc fault settings to study provided for this facility for final set up of the electrical system.
- P. Test and set all motor circuit protectors, motor overload heaters to the nameplate horsepower of the equipment; and all circuit breaker settings in all electrical equipment shall be tested and verified operational.
- Q. Adjust all settings on protective equipment and verify, check and establish with the power company that the secondary voltage is within 2% of rated voltage.
- R. Provide and check all overload relays settings and sizing for all motors and submit this data to the Engineer for final approval. This shall include settings and adjustments to MCP devices for each motor starter.
- S. The contractor shall maintain a complete marked up drawing set and all written documentation of all changes at the job site. These documents shall be made available to the Engineer at all times.

1.4 DEMONSTRATION AND START UP

- A. All equipment shall be properly identified as indicated in SECTION 16010.
- B. When directed by the Engineer, demonstrate the total system operation and make final adjustments to the system. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies and make a final demonstration as directed by the Engineer.
- C. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation of each partial or complete system installed under this Contract.
- D. Pay all charges or fees, including the cost of any special test equipment, factory engineers, etc. necessary for the proper performance of the specified tests, demonstrations, and instructions.
- E. All demonstrations and instructions shall be scheduled at the convenience of the Engineer and the Owner and shall be scheduled with at least seventy-two (72) hours written notice.
- F. Set all circuit breaker and overcurrent devices based on overall system coordination and short circuit study. Final acceptance will not be allowed until all settings and protective devices are set, checked, tested, and verified in the field in the presence of the Engineer.
- G. All control circuits shall be functionally checked to see that their operation and sequence are correct. Any adjustable switches such as float switches, limit switches

START-UP AND TESTING OF ELECTRICAL SYSTEMS

and timers shall be adjusted for proper operation.

- H. Just prior to acceptance of the lighting facilities, clean all lighting fixtures and re-lamp where required at no additional cost to the Owner.
- I. All local control stations and control panels for equipment specified in DIVISIONS 13, 15 and 16 shall be demonstrated to function properly of all items under simulated operating conditions unless otherwise specified elsewhere.

MEGGER TEST RESULTS

Project: _____ **Temperature:** _____
Date: _____ **Weather:** _____
Location: _____ **Test Equipment:** _____

Equipment/feeder Under Test: _____ **Start Time:** _____ **End Time:** _____
Test Equipment: Make: _____ **Serial No.:** _____ **Test Voltage:** _____

	0.5 min	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min	P.I.
Phase A-Gnd.												
Phase B-Gnd.												
Phase C-Gnd.												
Phase A-PhaseB												
Phase A-PhaseC												
Phase B-PhaseC												

Equipment/feeder Under Test: _____ **Start Time:** _____ **End Time:** _____

	0.5 min	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min	P.I.
Phase A-Gnd.												
Phase B-Gnd.												
Phase C-Gnd.												
Phase A-PhaseB												
Phase A-PhaseC												
Phase B-PhaseC												

*Notes: Megger test only should record 5 minutes value...
Polarization Index (P.I.) is 10 min reading divided by 1 min reading
Note: If a neutral is provided, this will also need to be tested*

END OF SECTION

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CONTRACT DRAWINGS FOR

EVERGREEN AVENUE & BLUE HILLS PUMP STATIONS HVAC IMPROVEMENTS

DECEMBER 2020

WATERFORD UTILITY COMMISSION

CHAIRMAN: PETER M. GREEN
MEMBERS: KENNETH KIRKMAN
RODNEY A. PINKHAM
STEPHEN J. NEGRI
RAYMOND L. VALENTINI
SECRETARY: AMY WINDLE

RTM

MODERATOR: THOMAS DEMBEK

BOARD OF SELECTMAN

FIRST SELECTMAN: ROBERT J. BRULE

BOARD OF FINANCE

CHAIRMAN: RON FEDOR

DRAWING INDEX

GENERAL

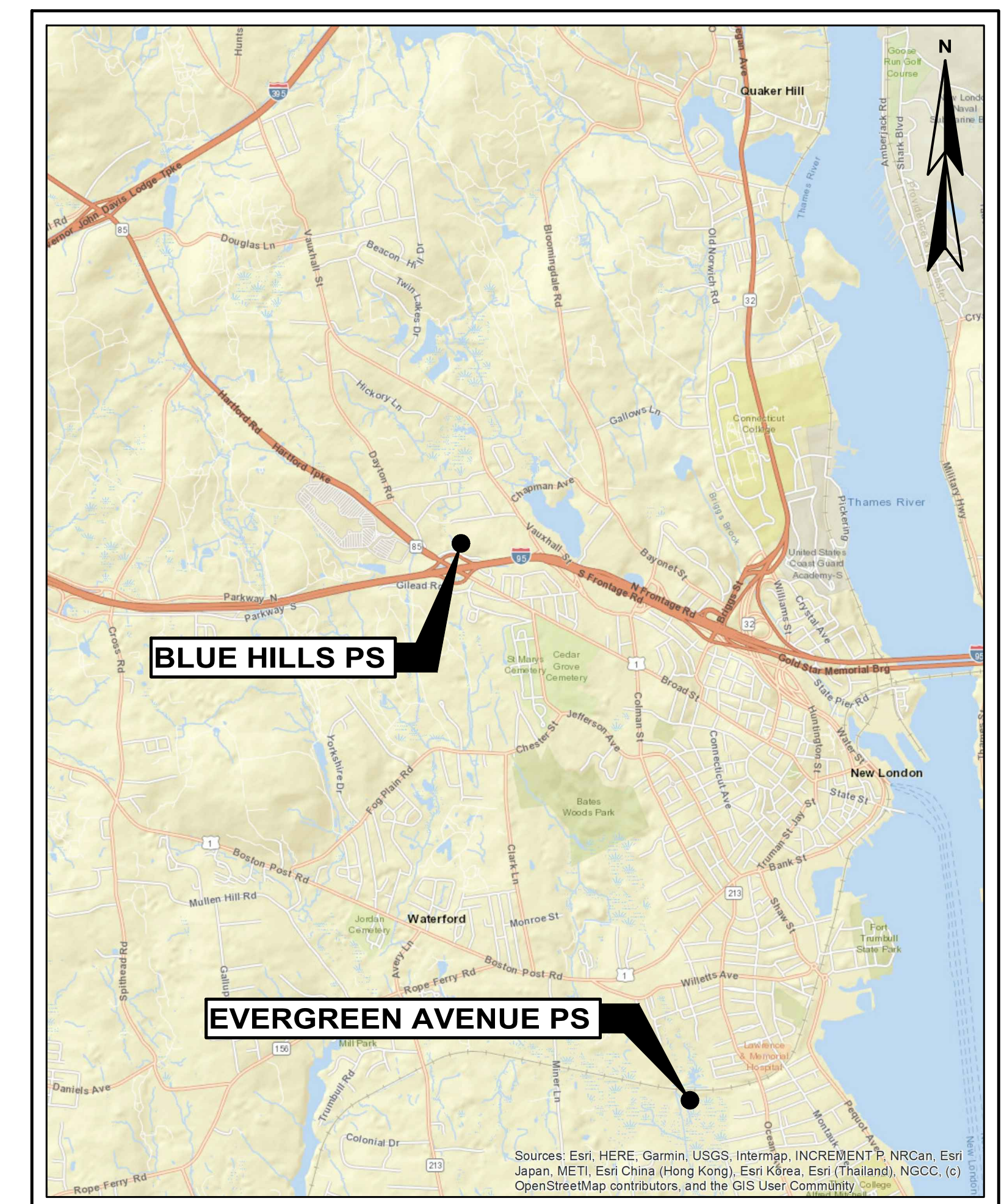
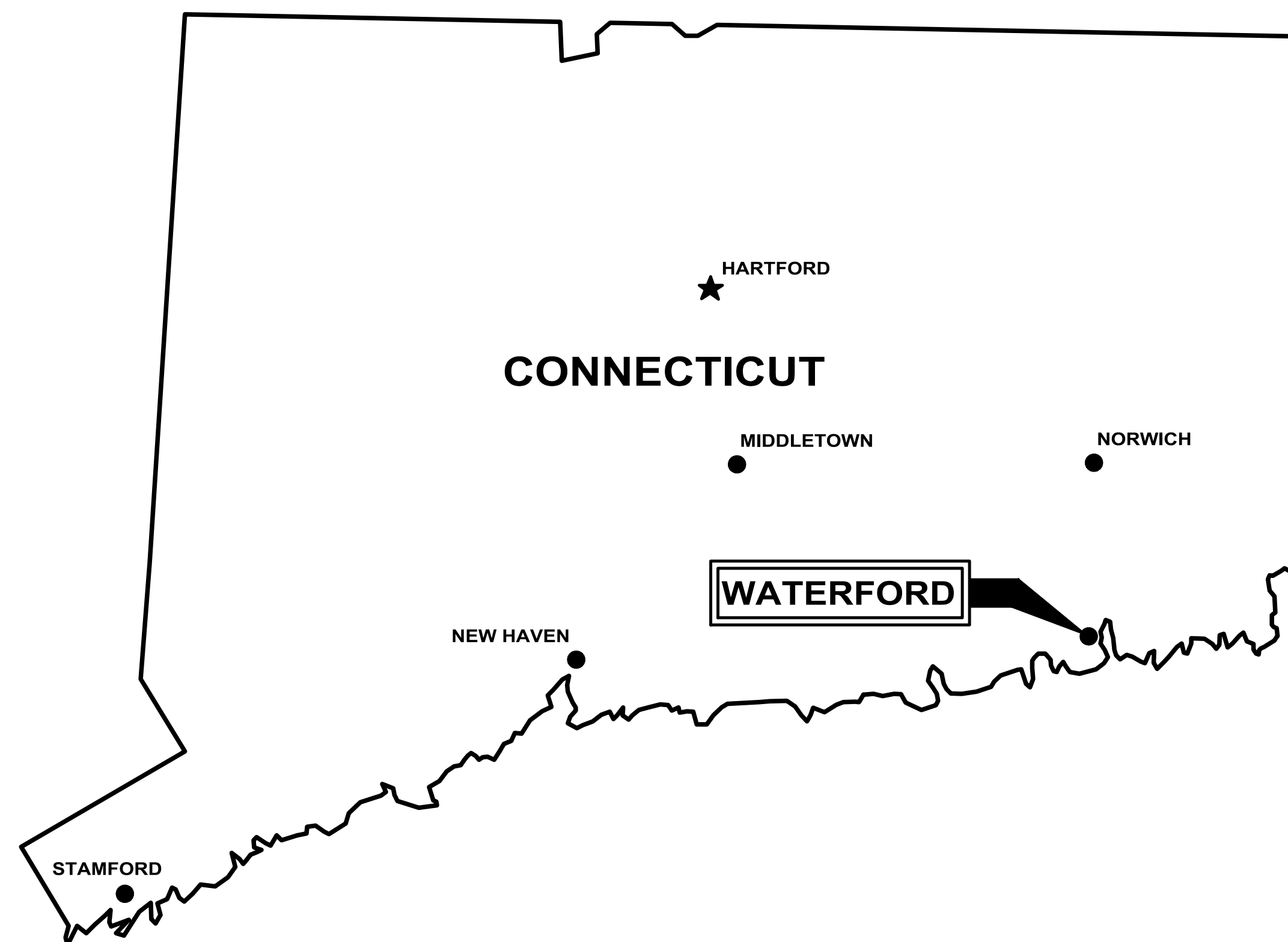
--- COVER SHEET

MECHANICAL

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LOCATION PLAN
SCALE: 1"=4,000'

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FOR REVIEW NOVEMBER 2020

FOR BIDDING DECEMBER 2020

WP PROJECT No. 20483

LEGEND

	EXISTING		NEW		RECTANGULAR SUPPLY AIR DUCT UP
					RECTANGULAR SUPPLY AIR DUCT DOWN
					RECTANGULAR RETURN OR EXHAUST AIR DUCT UP
					RECTANGULAR RETURN OR EXHAUST AIR DUCT DOWN
					SPIRAL AIR DUCT UP
					SPIRAL AIR DUCT DOWN
					RECTANGULAR-TO-SPIRAL DUCT TRANSITION
					FLEXIBLE DUCT CONNECTION
					SIDEWALL REGISTER
					DIRECTION OF AIR FLOW (S/OA)
					DIRECTION OF AIR FLOW (R/E)
					UNIT HEATER (UH)
					MOTOR OPERATED DAMPER (MOD)
					VOLUME DAMPER
					HOT WATER SUPPLY
					HOT WATER RETURN
					CIRCULATING PUMP
					MITERED ELBOW WITH TURNING VANES
					DIFFUSER DESIGNATION PER SCHEDULE AIRFLOW IN CFM
					EQUIPMENT DESIGNATION PER SCHEDULE EQUIPMENT SEQUENCE NUMBER
					POINT OF CONNECTION BETWEEN EXISTING AND NEW
					APPROX. EXTENTS OF DEMOLITION

MECHANICAL GENERAL NOTES

- ALL EQUIPMENT AND PIPING LAYOUT DIMENSIONS SHALL BE FIELD VERIFIED AND COORDINATED WITH EQUIPMENT SUPPLIED, AND/OR EXISTING CONDITIONS. SOME INFORMATION ASSOCIATED WITH EXISTING STRUCTURES, PIPING AND EQUIPMENT LOCATIONS, ELEVATIONS AND SIZES, WERE TAKEN FROM THE RECORD DRAWINGS FOR WATERFORD UTILITY COMMISSION, RECORD DRAWINGS FOR WATERFORD UTILITY COMMISSION, EVERGREEN PUMP STATION COMPREHENSIVE UPGRADE (WRIGHT-PIERCE, 2008), AND WATERFORD UTILITY COMMISSION, BLUE HILLS PUMP STATION (WRIGHT-PIERCE, 2006), WHICH ARE AVAILABLE FOR REVIEW AT THE ENGINEER'S OFFICE. CONTRACTOR SHALL VERIFY ALL DIMENSIONS IN THE FIELD AS REQUIRED PRIOR TO BEGINNING CONSTRUCTION OF NEW FACILITIES, EQUIPMENT OR PIPING THAT MAY BE AFFECTED.
- THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF ANY DIMENSIONS, LAYOUT OR ELEVATION CHANGES REQUIRED TO SUIT THE SPECIFIC EQUIPMENT BEING PROVIDED UNDER THIS CONTRACT. WHEN SUCH EQUIPMENT REQUIRES PADS, PIERS, CURBING, ETC., THAT DIFFERS FROM THAT SHOWN ON THE CONSTRUCTION DRAWINGS, THE CONTRACTOR SHALL COORDINATE THE STEEL REINFORCING SHOP DRAWINGS ACCORDINGLY.
- CONTRACTOR TO NOTE THAT ALL EXISTING INFORMATION ON THE DRAWINGS IS SHOWN WITH A LIGHTER LINE WEIGHT AND INDICATED WITH A SLANTED TYPE TEXT. THE EXCEPTION IS WHEN SCANNED IMAGES ARE UTILIZED FROM THE PREVIOUS CONSTRUCTION PROJECTS NOTED IN GENERAL NOTE No.1 ABOVE. WHEN REVIEWING DRAWINGS NOTED AS "SCANNED" UNDER DRAWING TITLE, THE CONTRACTOR SHALL IGNORE ANY REFERENCE TO PREVIOUS CONTRACT WORK. SCANNED IMAGES ARE NOT TO SCALE, HOWEVER AN APPROXIMATE SCALE MAY BE GIVEN FOR CONVENIENCE.
- ALL COMPONENTS OF THE AUTOMATIC TEMPERATURE CONTROL SYSTEM SHALL MEET THE ELECTRICAL CLASSIFICATION OF THE SPACE IN WHICH THEY ARE INSTALLED UNLESS NOTED OTHERWISE IN THE SPECIFICATIONS.
- ALL DUCTWORK AND DEVICES SHALL BE FABRICATED, REINFORCED AND INSTALLED IN ACCORDANCE WITH SMACNA (SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION) DOCUMENT "HVAC DUCT CONSTRUCTION STANDARDS METAL AND FLEXIBLE". SEAL ALL DUCT JOINTS TO SEAL CLASS "C".
- ALL PIPES SHALL BE ADEQUATELY RESTRAINED AND SUPPORTED IN ACCORDANCE WITH THE INTERNATIONAL MECHANICAL CODE.
- ALL PIPING SYSTEMS SHALL BE PRESSURE TESTED FOR TIGHTNESS IN ACCORDANCE WITH SPECIFICATION SECTION 15601. ALL LEAKS SHALL BE CORRECTED AND RETESTED UNTIL PRESSURE TEST IS SATISFACTORY PRIOR TO THE INSTALLATION OF PIPE INSULATION.
- TEST REFRIGERANT PIPING IN ACCORDANCE WITH 2015 IMC, CHAPTER 11.
- DO NOT SCALE DISTANCES OR DIMENSIONS FROM THE DRAWINGS. WRITTEN DIMENSIONS SHALL PREVAIL. REPORT ANY DISCREPANCIES IMMEDIATELY TO THE ENGINEER.
- ALL MITERED ELBOWS, AND RADIUS ELBOWS HAVING RAD<1.0xDUCT WIDTH SHALL HAVE TURNING VANES INSTALLED.

ABBREVIATIONS

A	AMPERE	L	LOUVER
ABV	ABOVE	LAT	LEAVING AIR TEMPERATURE
ACH	AIR CHANGES PER HOUR	LRA	LOCKED ROTOR AMPS
AD	ACCESS DOOR	LWT	LEAVING WATER TEMPERATURE
AFF	ABOVE FINISH FLOOR	MAU	MAKE-UP AIR UNIT
AFG	ABOVE FINISH GRADE	MAX	MAXIMUM
AHU	AIR HANDLING UNIT	MBH	BTUH x 1000
APD	AIR PRESSURE DROP	MFR	MANUFACTURER
AS	AIR SEPARATOR	MIN	MINIMUM
ATC	AUTOMATIC TEMPERATURE CONTROL	MOC	MAXIMUM OVERCURRENT PROTECTION
B	BOILER	MOD	MOTOR OPERATED DAMPER
BHP	BRAKE HORSEPOWER	N/A	NOT APPLICABLE
BOD	BOTTOM OF DUCT	NTS	NOT TO SCALE
BOE	BOTTOM OF EQUIPMENT	OA	OUTSIDE AIR
BTU	BRITISH THERMAL UNIT	OAT	OUTSIDE AIR TEMPERATURE
BTUH	BRITISH THERMAL UNITS PER HOUR	OED	OPEN END DRAIN, OPEN END DUCT
CL	CENTERLINE	PD	PRESSURE DROP
CFM	CUBIC FEET PER MINUTE	R	RETURN
CG	COMBUSTIBLE GAS	RAD	RADIUS
D	DAMPER	RLA	RUNNING LOAD AMPS
DB	DRY BULB	RPM	REVOLUTIONS PER MINUTE
DIA, Ø	DIAMETER	S	SUPPLY
DN	DOWN	SC	SENSIBLE COOLING
DX	DIRECT EXPANSION	SCH	SCHEDULE
E	EXHAUST	SF	SUPPLY FAN
EAT	ENTERING AIR TEMPERATURE	SMACNA	SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
EER	ENERGY EFFICIENCY RATIO	SS	STAINLESS STEEL
EF	EXHAUST FAN	TC	TOTAL COOLING
EFF	EFFICIENCY	TOD	TOP OF DUCT
EL	ELEVATION	TOE	TOP OF EQUIPMENT
ESP	EXTERNAL STATIC PRESSURE	TSTAT	THERMOSTAT
ET	EXPANSION TANK	TV	TURNING VANES
EWT	ENTERING WATER TEMPERATURE	TYP	TYPICAL
F	DEGREES FAHRENHEIT	UH	UNIT HEATER
FAT	FINAL AIR TEMPERATURE	V	VOLTS
FC	FLEXIBLE CONNECTION	VD	VOLUME DAMPER
FLA	FULL-LOAD AMPS	VFD	VARIABLE FREQUENCY DRIVE
FPF	FINS PER FOOT	W/	WITH
HP	HORSEPOWER (SCHEDULES)	WB	WET BULB
HWR	HOT WATER RETURN	WC	WATER COLUMN
HWS	HOT WATER SUPPLY		
IN	INCHES		

DESIGN CRITERIA

OUTSIDE DESIGN TEMPERATURE	
WINTER (ASHRAE 99.6%)	11.4°F
SUMMER (ASHRAE 0.4%)	87.9°F DB/73.1°F WB
INSIDE DESIGN TEMPERATURE WINTER/SUMMER	
PROCESS AREAS	55°F/AMBIENT
ELECTRICAL ROOMS	55°F/85°F
VENTILATION RATES - REFER TO DRAWINGS	
RELATIVE HUMIDITY - REFER TO DRAWINGS	

APP'D	DATE
DAD	12-20
SUBMISSIONS/REVISIONS	
NO	CONTRACT DRAWINGS

DESIGNED BY: RTG	NO
CAD CORR: BBB	NO
CD: BBB	NO
CHECKED BY: NSB	NO
DATE: NOVEMBER 2020	NO
APPROVED BY: RTG	NO
DATE: DECEMBER 2020	NO
PROJECT NO.: 20483	NO



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WATERFORD UTILITY COMMISSION
EVERGREEN AVENUE &
BLUE HILLS PUMP STATIONS
HVAC IMPROVEMENTS

MECHANICAL NOTES, LEGEND, ABBREVIATIONS, AND DESIGN DATA

DRAWING
M-1

PACKAGED AIR HANDLING UNIT SCHEDULE																									
UNIT NO.	LOCATION SERVED	CFM	MIN OA	ESP IN WC	BTUH INPUT	BTUH OUTPUT	THERMAL EFFICIENCY	DX COOLING (100% OA)					DX COOLING (75% RECIRC)					REFRIG TYPE	ELECTRICAL					REMARKS	NOTES
								EAT DB/WB	LAT DB/WB	REHEAT MBH	FAT DB/WB	MBH TC/SC	EAT DB/WB	LAT DB/WB	REHEAT MBH	FAT DB/WB	MBH TC/SC		HP	VOLTS	PHASE	MCA	MOCP		
AHU-EG1	EVERGREEN PS DRY WELL	3400	850/3400	1.25	300,000	240,000	80%	87.4/73.3	64.8/63.2	19.5	70.6/64.5	124.79/85.15	78.1/65.5	56.3/54.8	39.1	66.4/57.3	110.54/81.67	410A	3	460	3	35.8	40	REZNOR YHDA-120 OR EQUIVALENT	1-14

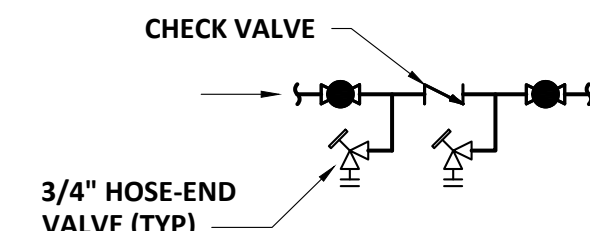
- NOTES: 1. FACTORY MOUNTED AND WIRED VARIABLE FREQUENCY DRIVE
 2. 316 STAINLESS STEEL HEAT EXCHANGER
 3. INDIRECT FIRED NATURAL GAS, 5:1 MODULATING
 4. INTEGRAL OUTSIDE AIR AND RETURN DAMPERS
 5. HOT GAS BYPASS
 6. 4" MERV 8 PLEATED FILTERS
 7. FACTORY MOUNTED AND WIRED NON-FUSED DISCONNECT SWITCH
 8. 120V NON-POWERED CONVENIENCE OUTLET
 9. FILTER DIFFERENTIAL PRESSURE SENSOR
 10. 36" HIGH SIDE DISCHARGE CURB
 11. PHASE / VOLTAGE MONITOR
 12. REMOTE DISPLAY / CONTROL / SENSOR MODULE WITH TEMPERATURE AND DEHUMIDIFICATION CONTROLS
 13. HIGH CAPACITY REHEAT PUMP
 14. ADJUSTABLE CONSTANT VOLUME FAN CONTROL

INDIRECT GAS FIRED MAKE UP AIR UNIT SCHEDULE																									
UNIT NO.	LOCATION SERVED	CFM	MIN OA	ESP IN WC	BTUH INPUT	BTUH OUTPUT	THERMAL EFFICIENCY	DX COOLING (100% OA)					DX COOLING (75% RECIRC)					REFRIG TYPE	ELECTRICAL					REMARKS	NOTES
								EAT DB/WB	LAT DB/WB	REHEAT MBH	FAT DB/WB	MBH TC/SC	EAT DB/WB	LAT DB/WB	REHEAT MBH	FAT DB/WB	MBH TC/SC		HP	VOLTS	PHASE	MCA	MOCP		
MUA-EG1	EVERGREEN PS WET WELL	3350	3350	1.25	225,000	180,000	80%												3	480	3	6.6	10	REZNOR RDH-225 OR EQUIVALENT	1-9

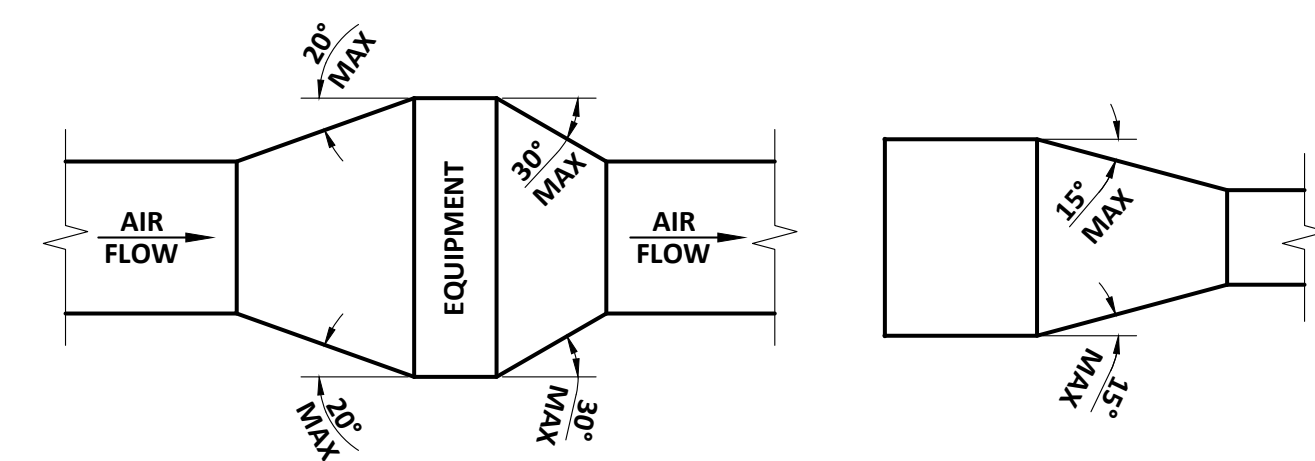
- NOTES: 1. 409 STAINLESS STEEL HEAT EXCHANGER
 2. 4:1 MODULATION
 3. LOW LEAKAGE MOTORIZED SUPPLY DAMPER
 4. BAFLED INTAKE HOOD
 5. 4" MERV 8 FILTERS
 6. DOUBLE WALL INSULATED CABINET
 7. FACTORY MOUNTED AND WIRED DISCONNECT SWITCH
 8. FILTER PRESSURE SWITCH
 9. DISCHARGE AIR TEMPERATURE CONTROL

FAN SCHEDULE														
UNIT NO.	LOCATION SERVED	CFM	T.S.P. IN WC	FAN RPM	SONES	DRIVE TYPE	TYPE	MOTOR DATA				NEMA	REMARKS	NOTES
								HP	RPM	VOLTS	PHASE			
EF-EG1	EVERGREEN PS WET WELL	3350	0.968	1180	15.5	BELT	CENTRIFUGAL SIDEWALL	1-1/2	1725	460	3	7	GREENHECK CUBE-180-15 OR EQUIVALENT PRODUCT	2,4,5,7,10
EF-EG2	EVERGREEN PS DRY WELL	3200	1.25	1500	18.3	DIRECT	INLINE CENTRIFUGAL	2	1725	460	3	4X	GREENHECK SQ-160-A OR EQUIVALENT PRODUCT	1,5,12
EF-BH1	BLUE HILLS PS DRY WELL	2900	1	1114	14.3	DIRECT	CENTRIFUGAL UPBLAST	1	1725	460	3	4X	GREENHECK CUBE-180-VGD-10 OR EQUIVALENT PRODUCT	1,3,6,9,13

- NOTES: 1. PERMATECTOR OR EQUIVALENT FINISH.
 2. HI-PRO POLYESTER OR EQUIVALENT FINISH.
 3. MOTOR OPERATED DAMPER (FINISH SAME AS FAN).
 4. GRAVITY OPERATED DAMPER.
 5. FACTORY MOUNTED AND WIRED DISCONNECT SWITCH.
 6. ELECTRONICALLY COMMUTATED MOTOR.
 7. ADJUSTABLE PULLEY, SPARE BELTS
 8. FACTORY MOUNTED AND WIRED POTENTIOMETER DIAL.
 9. FACTORY MOUNTED AND WIRED TWO-SPEED CONTROLLER.
 10. EXPLOSION PROOF MOTOR, SPARK RESISTANT CONSTRUCTION.
 11. BOLTED ACCESS DOOR
 12. PROVIDE WITH VFD RATED TEFC MOTOR WITH SHAFT GROUNDING PROTECTION.
 13. PROVIDE TRANSITION CURB AS NECESSARY FOR MOUNTING ON EXISTING CURB.

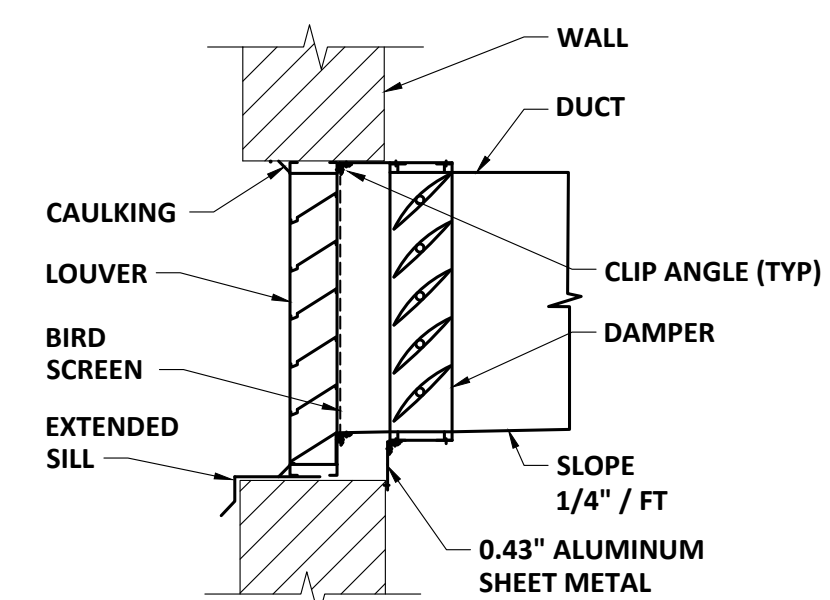


GLYCOL FILL STATION DETAIL
NTS



TYPICAL DUCTWORK TRANSITION
NTS

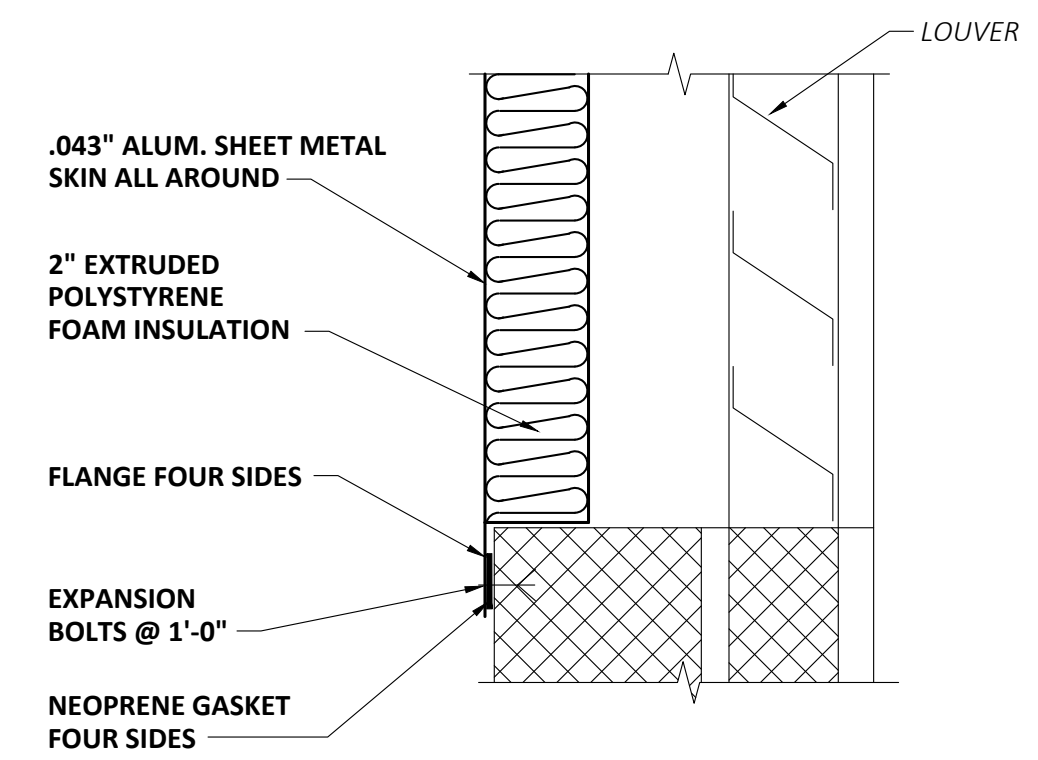
NOTE: UNLESS OTHERWISE INDICATED ON PLANS, MAXIMUM ANGLES SHOWN SHALL APPLY



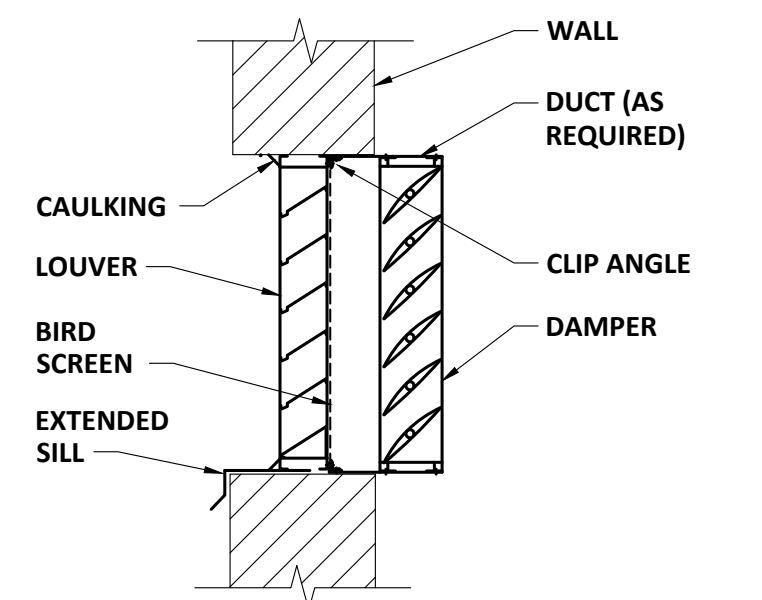
LOUVER INSTALLATION DETAIL
NTS

LOUVER AND DAMPER SCHEDULE								
UNIT NO.	LOCATION SERVED	DIMENSIONS (IN)			MIN. FREE AREA SQFT.	TYPE	REMARKS	NOTES
		WIDTH	HEIGHT	DEPTH				
D-EG1	EVERGREEN PS WET WELL	24	18	5	-	OPPOSED	GREENHECK VCD-43 OR EQUIVALENT PRODUCT	-
D-EG2	EVERGREEN PS WET WELL	8	8	5	-	PARALLEL	GREENHECK VCD-43 OR EQUIVALENT PRODUCT	-
D-BH1	BLUE HILLS PS DRY WELL	24	18	5	-	OPPOSED	GREENHECK VCD-23 OR EQUIVALENT PRODUCT	-

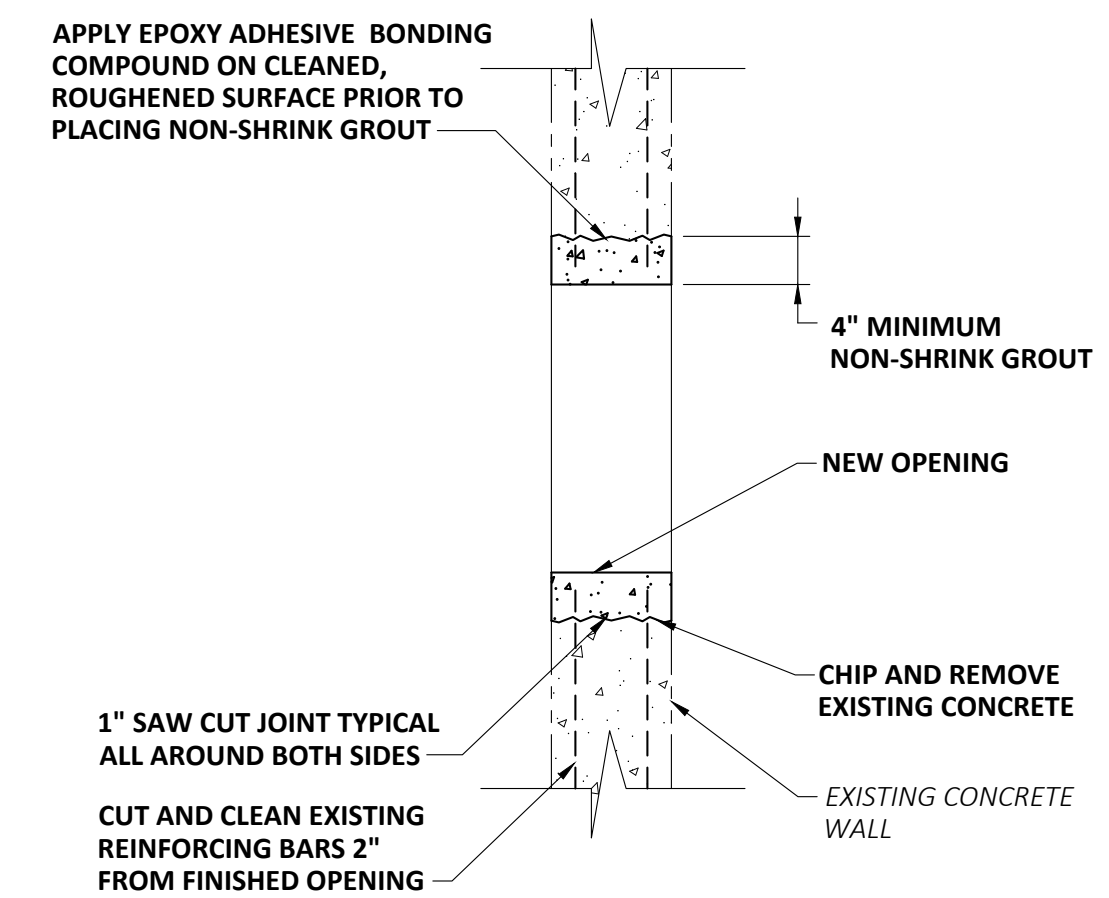
REGISTERS, GRILLES, AND DIFFUSERS SCHEDULE								
TAG	FACE SIZE WxH (IN)	NECK SIZE WxH (IN)	CFM	MAX ΔP IN WC	NC RATING	TYPE	REMARKS	NOTES
S-1	16x16	14x14	580	0.04	17	SUPPLY REGISTER	NAILOR S1DV-OA OR EQUIVALENT PRODUCT	-
S-2	12x12	10x10	330	0.05	17	SUPPLY REGISTER	NAILOR S1DV-OA OR EQUIVALENT PRODUCT	-



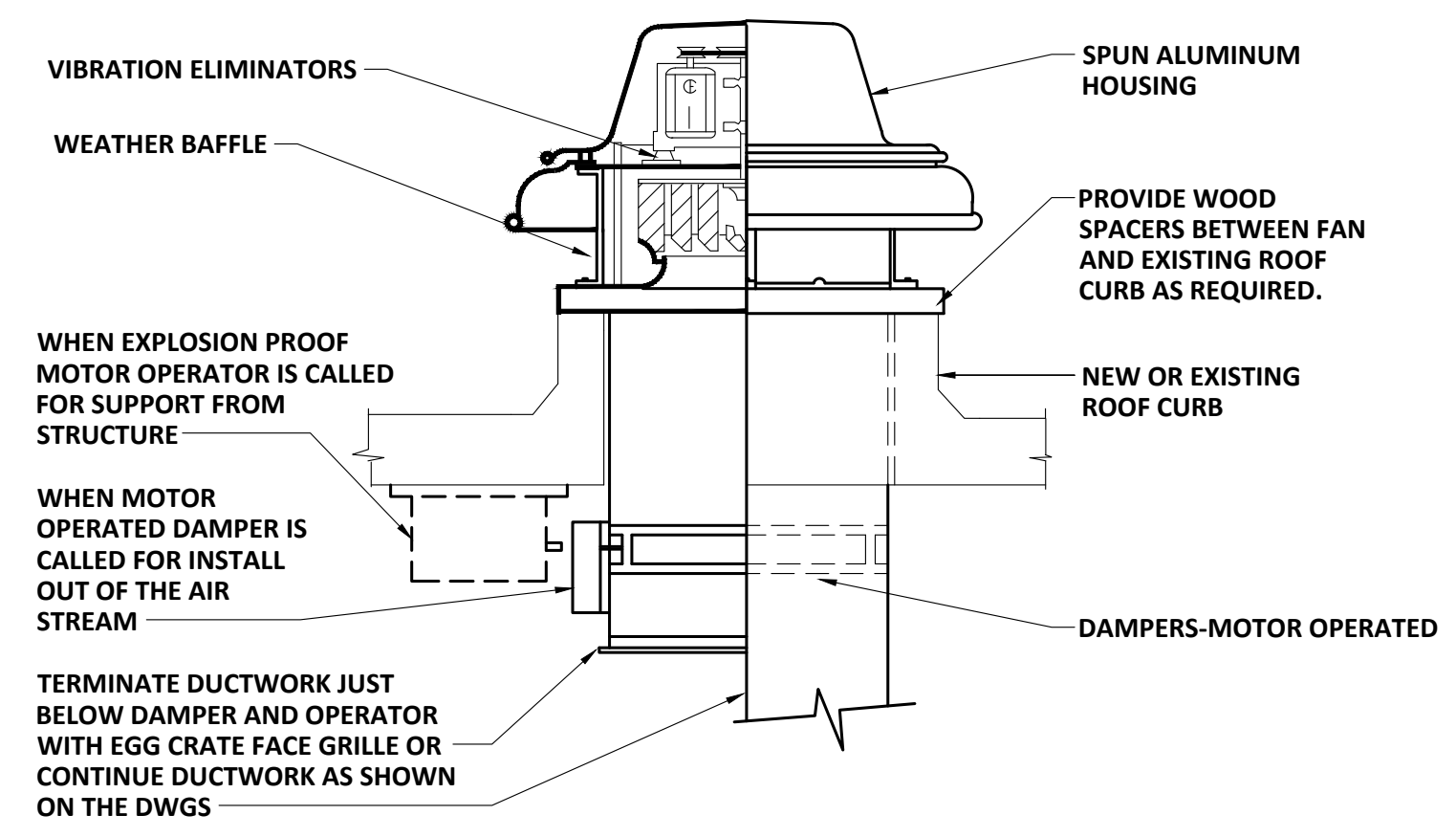
LOUVER BLANK-OFF PANEL
NTS



LOUVER & DAMPER DETAIL
NTS



OPENING IN EXISTING WALL
NTS



CENTRIFUGAL ROOF VENTILATOR DETAIL
NTS

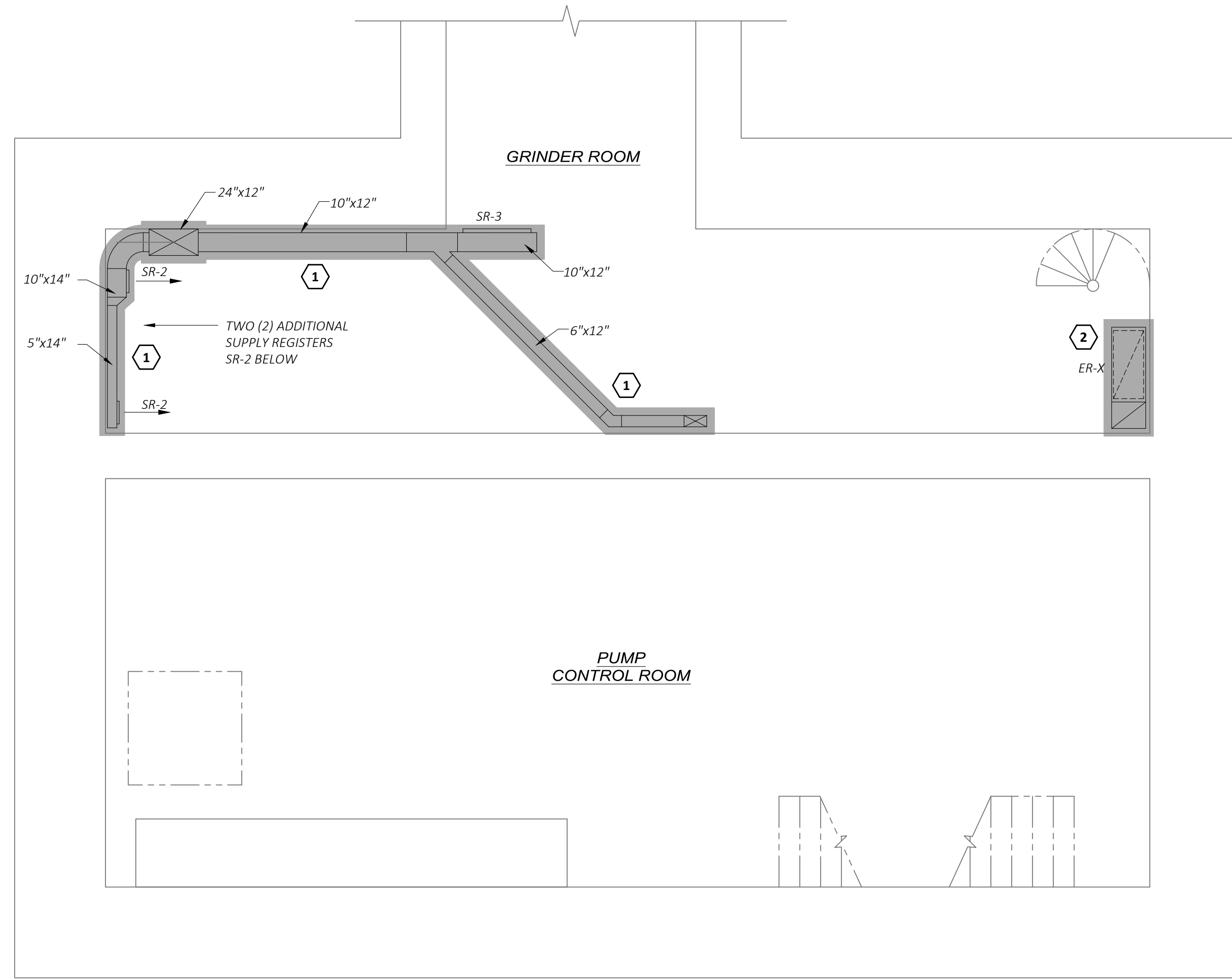
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DESIGNED BY: RTG
 CAD CORP.: BBB
 CHECKED BY: NSB
 DATE: NOVEMBER 2020
 APPROVED BY: RTG
 DATE: DECEMBER 2020
 PROJECT NO.: 20488

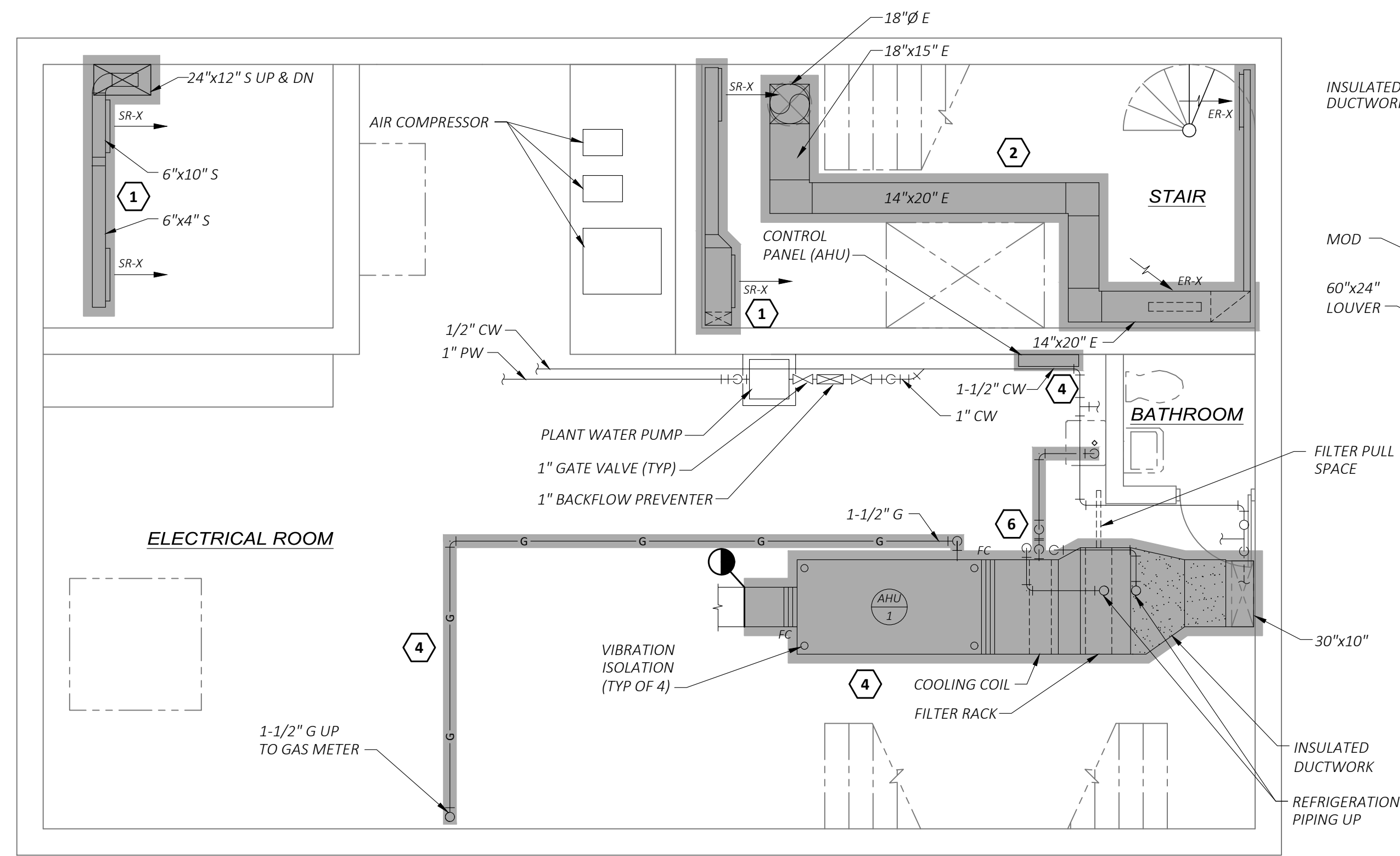
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 MECHANICAL EQUIPMENT SCHEDULES & DETAILS

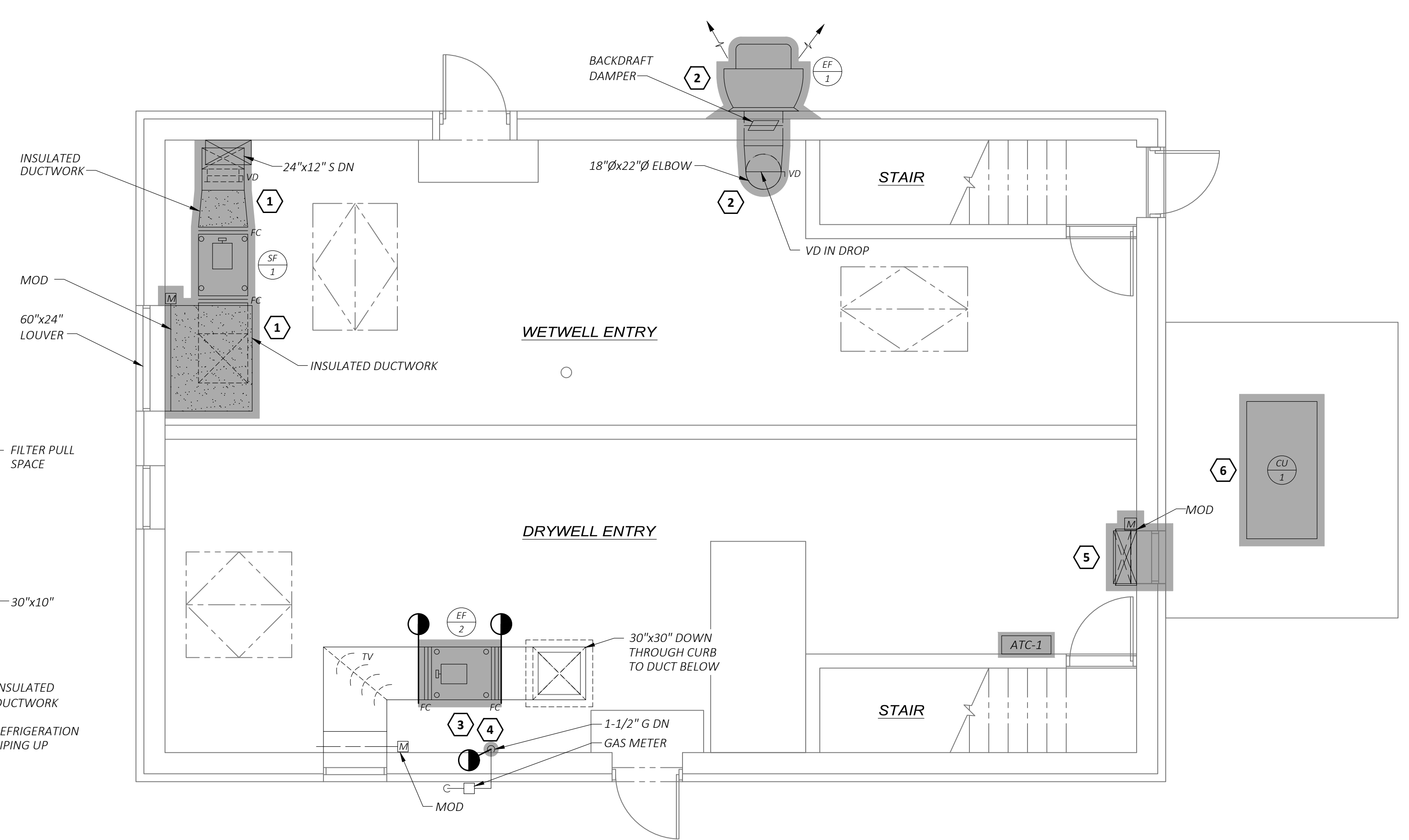
DRAWING
M-2



PUMP CONTROL ROOM & GRINDER ROOM DEMOLITION PLAN
SCALE: 1/4"=1'-0"



ELECTRICAL ROOM DEMOLITION PLAN
SCALE: 1/4"=1'-0"



ENTRY LEVEL DEMOLITION PLAN
SCALE: 1/4"=1'-0"

DEMOLITION NOTES:

- 1 REMOVE/DEMOLISH EXISTING SUPPLY FAN IN ITS ENTIRETY INCLUDING, BUT NOT LIMITED TO; FAN, SUPPORTS, WIRING & CONTROLS. DEMOLISH ALL ASSOCIATED DUCTWORK AND APPURTENANCES. BLANK OFF EXISTING LOUVER.
- 2 REMOVE/DEMOLISH EXISTING EXHAUST FAN IN ITS ENTIRETY INCLUDING, BUT NOT LIMITED TO; FAN, SUPPORTS, WIRING & CONTROLS. DEMOLISH ALL ASSOCIATED DUCTWORK AND APPURTENANCES.
- 3 REMOVE/DEMOLISH EXISTING EXHAUST FAN IN ITS ENTIRETY INCLUDING, BUT NOT LIMITED TO; FAN, SUPPORTS, WIRING & CONTROLS. CUT BACK DUCTWORK AS NECESSARY FOR INSTALLATION OF NEW FAN.
- 4 REMOVE/DEMOLISH EXISTING DIRECT GAS FIRED AIR HANDLER IN ITS ENTIRETY INCLUDING, BUT NOT LIMITED TO; UNIT, SUPPORTS, WIRING & CONTROLS. DEMOLISH ASSOCIATED DUCTWORK, PIPING, AND APPURTENANCES TO POINTS INDICATED.
- 5 REMOVE/DEMOLISH EXISTING LOUVER AND ASSOCIATED DUCTWORK AND APPURTENANCES. COORDINATE INFILL OF EXISTING OPENING WITH GENERAL CONTRACTOR.
- 6 REMOVE/DEMOLISH DEHUMIDIFICATION COIL AND ASSOCIATED CONDENSING UNIT IN THEIR ENTIRETY, INCLUDING BUT NOT LIMITED TO; EQUIPMENT, REFRIGERANT PIPING, SUPPORTS, WIRING, & CONTROLS.

DRAWING NOTES:

1. FOR MECHANICAL NOTES, LEGEND AND ABBREVIATIONS, REFER TO DRAWING M-1.

NO	DATE	BY	REVISIONS
1	12-20	DAD	CONTRACT DRAWINGS

DESIGNED BY: RTG	NO
CAD CORP: BBB	NO
CD: BBB	NO
CHECKED BY: NSR	NO
DATE: NOVEMBER 2020	NO
APPROVED BY: RTG	NO
DATE: DECEMBER 2020	NO
PROJECT NO.: 20483	NO

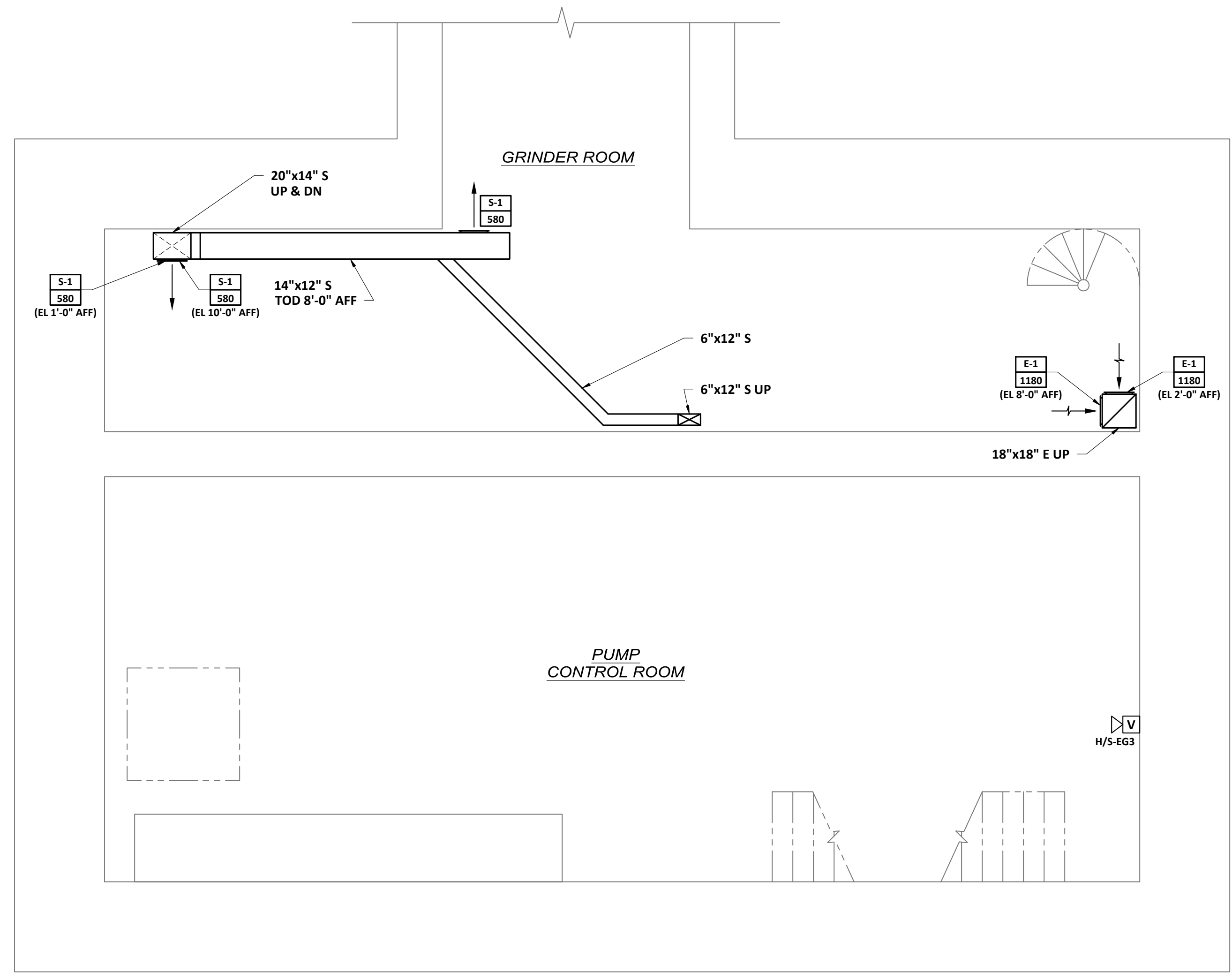


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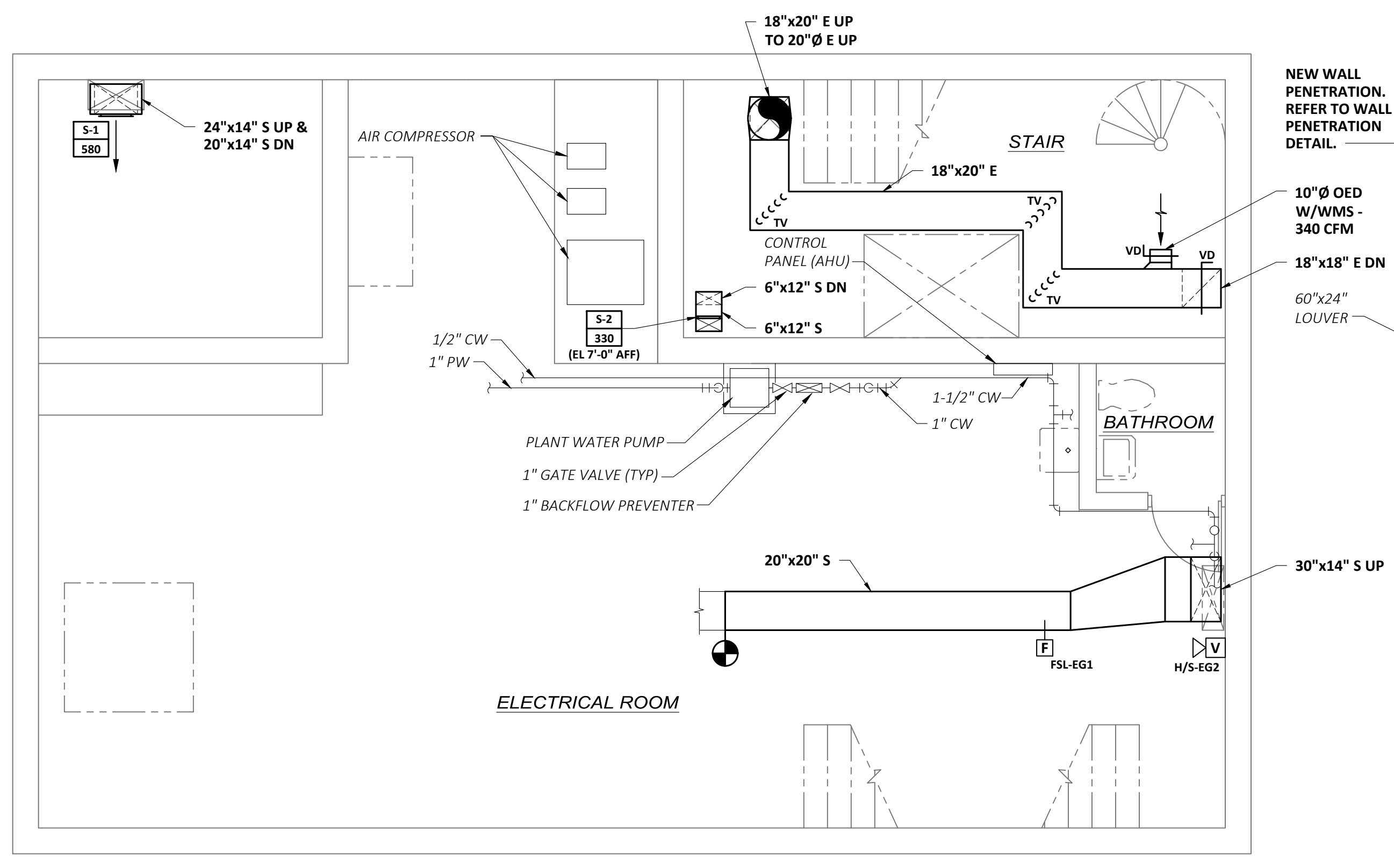
WATERFORD UTILITY COMMISSION
EVERGREEN AVENUE & BLUE HILLS PUMP STATIONS
HVAC IMPROVEMENTS

EVERGREEN PUMP STATION
DEMOLITION PLANS

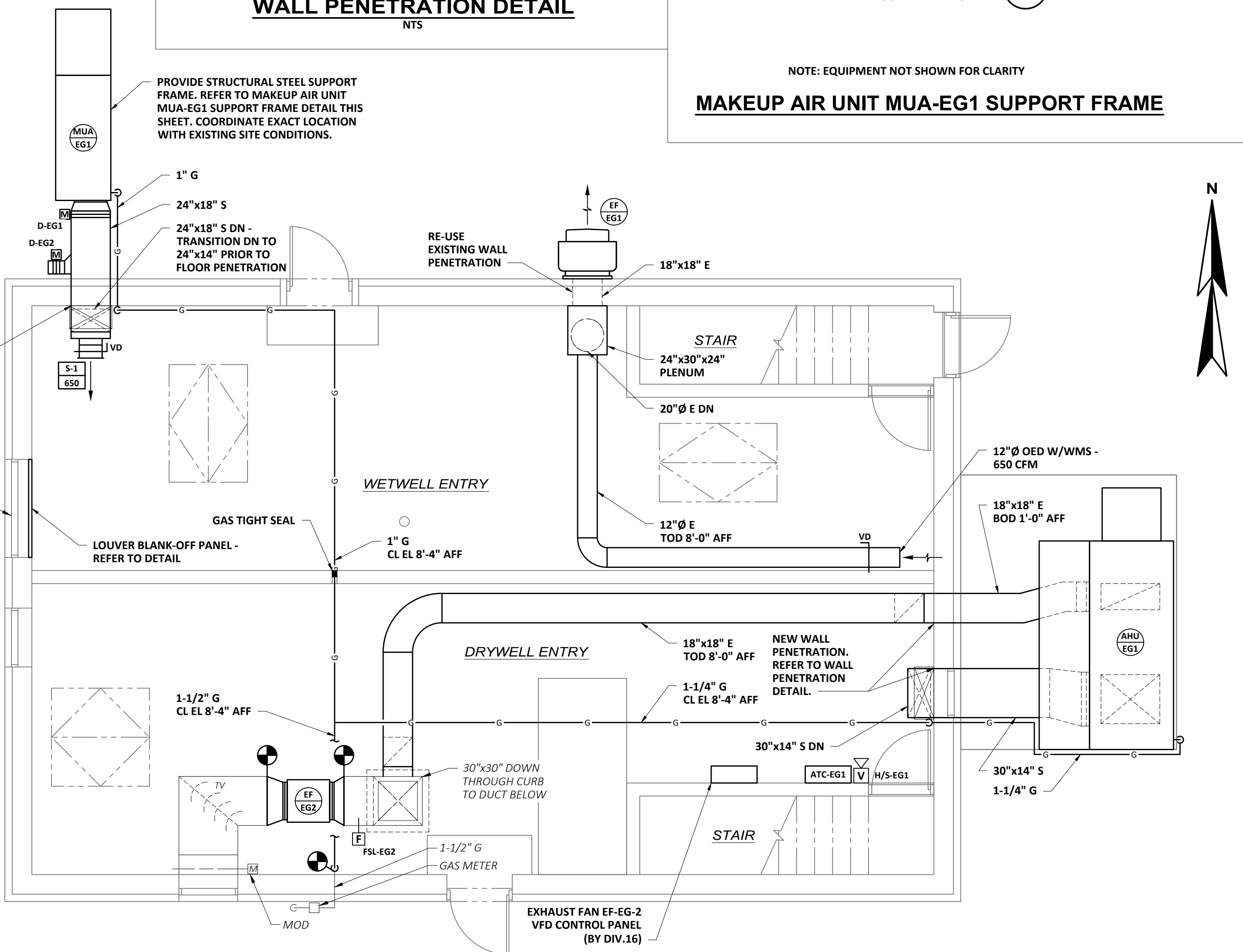
DRAWING
M-3



PUMP CONTROL ROOM & GRINDER ROOM MODIFICATIONS PLAN
SCALE: 1/4"=1'-0"



ELECTRICAL ROOM MODIFICATIONS PLAN
SCALE: 1/4"=1'-0"



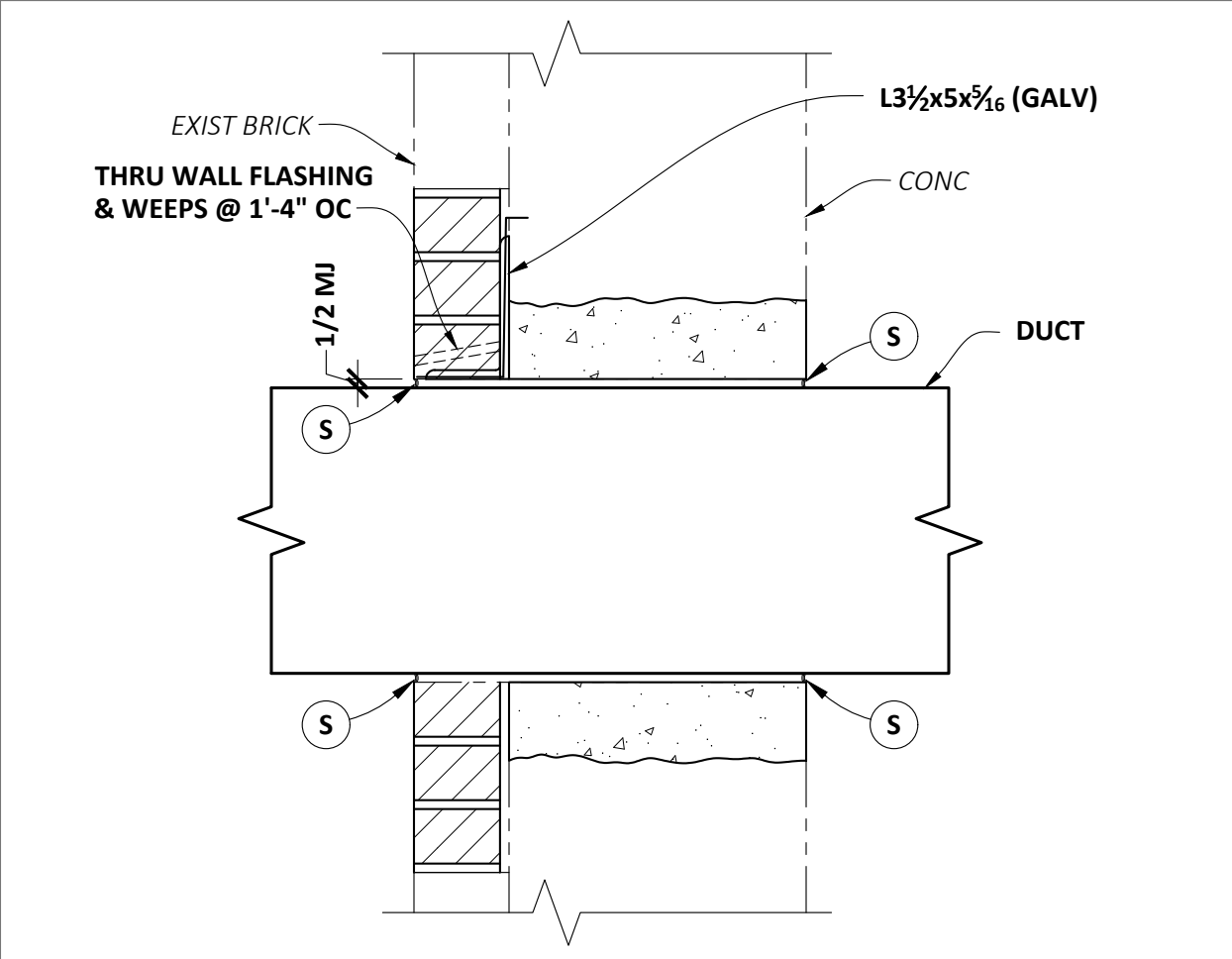
ENTRY LEVEL MODIFICATIONS PLAN
SCALE: 1/4"=1'-0"

STRUCTURAL NOTES:

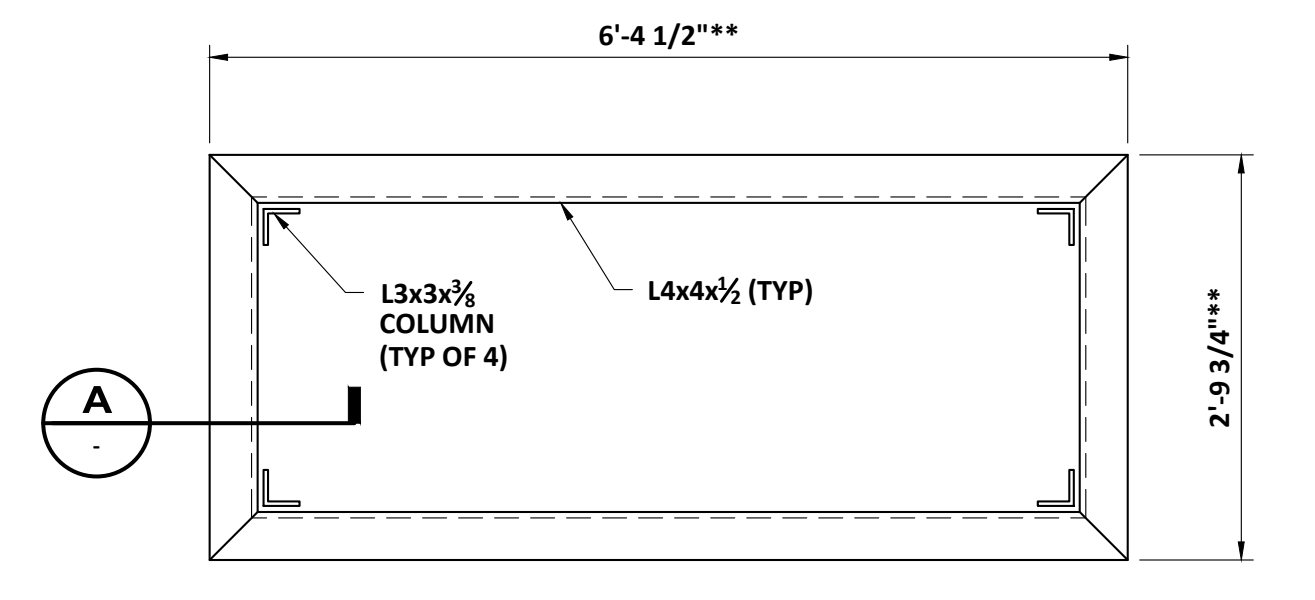
GENERAL NOTES:
1. ** INDICATES THAT THE GENERAL CONTRACTOR SHALL COORDINATE EXACT DIMENSION AND/OR ELEVATION BASED ON EQUIPMENT SUPPLIED. ALL CHANGES SHALL BE REVIEWED WITH NO EXCEPTIONS TAKEN BY THE ENGINEER.

STRUCTURAL STEEL NOTES:

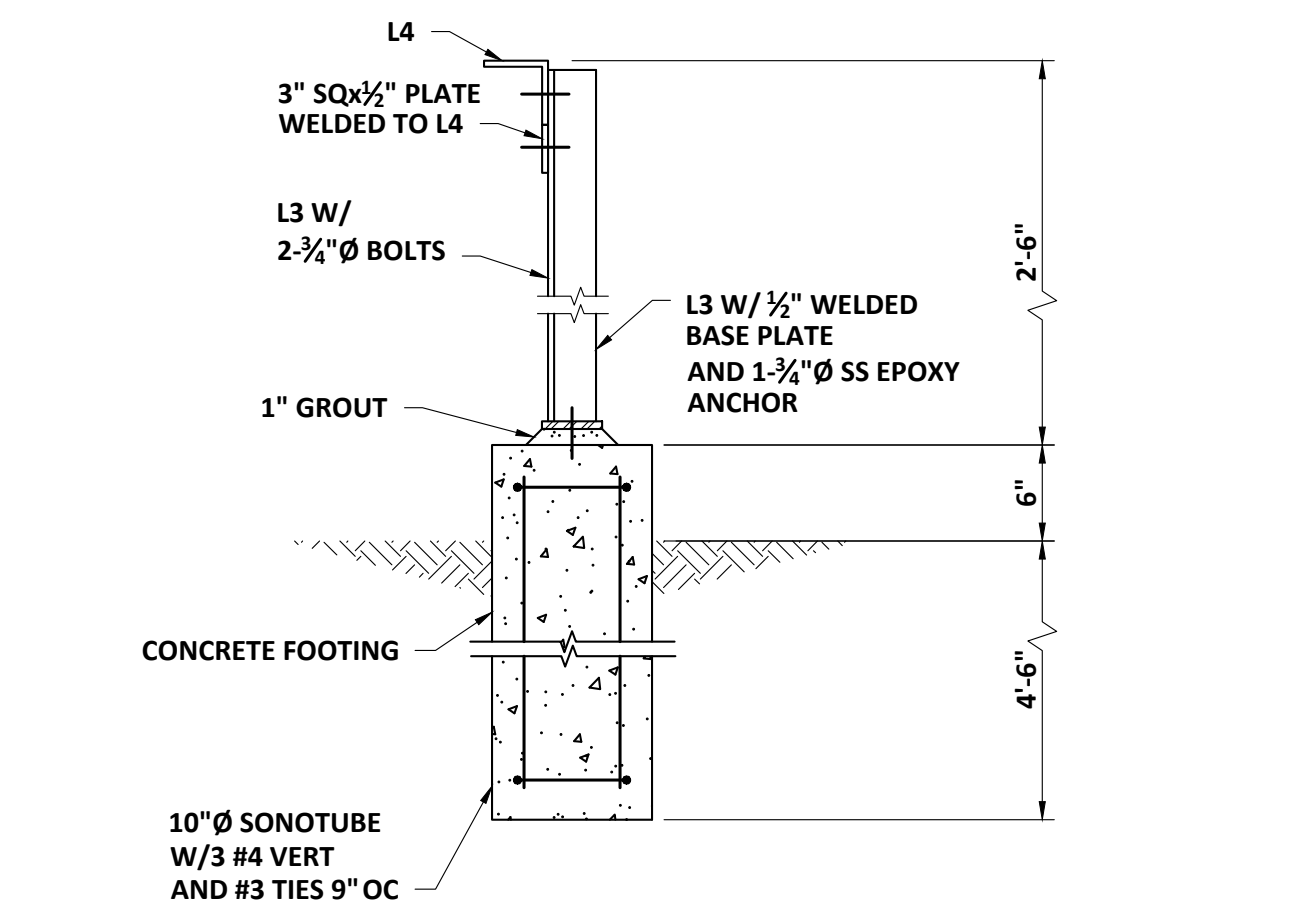
- STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING:
 - CHANNELS AND ANGLES - ASTM A36 (GRADE 36)
 - PLATES - ASTM A572 (GRADE 50)
- FIELD CONNECTIONS SHALL BE BY ASTM A325-N HIGH STRENGTH BOLTS EXCEPT AS NOTED. BOLTS SHALL BE 3/4" IN 13/16" HOLES EXCEPT AS NOTED. ALL BOLTED CONNECTIONS SHALL BE CONSIDERED "SNUG TIGHTENED" UNLESS SPECIFICALLY INDICATED AS "SLIP-CRITICAL". WHERE FIELD WELDING IS REQUIRED DUE TO MISMATCHED BOLT HOLES OR OTHER FIELD MODIFICATIONS, SUBMIT DETAILS TO THE ENGINEER FOR REVIEW.



WALL PENETRATION DETAIL
NTS



PLAN
SCALE: 3/4"=1'-0"



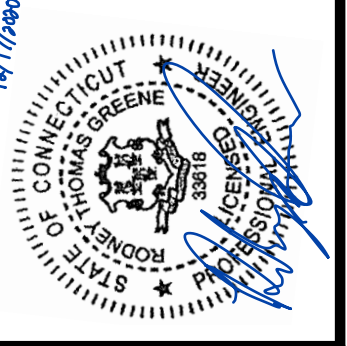
DETAIL
SCALE: 1"=1'-0"

NOTE: EQUIPMENT NOT SHOWN FOR CLARITY
MAKEUP AIR UNIT MUA-EG1 SUPPORT FRAME

DRAWING NOTES:
1. FOR MECHANICAL NOTES, LEGEND AND ABBREVIATIONS, REFER TO DRAWING M-1.

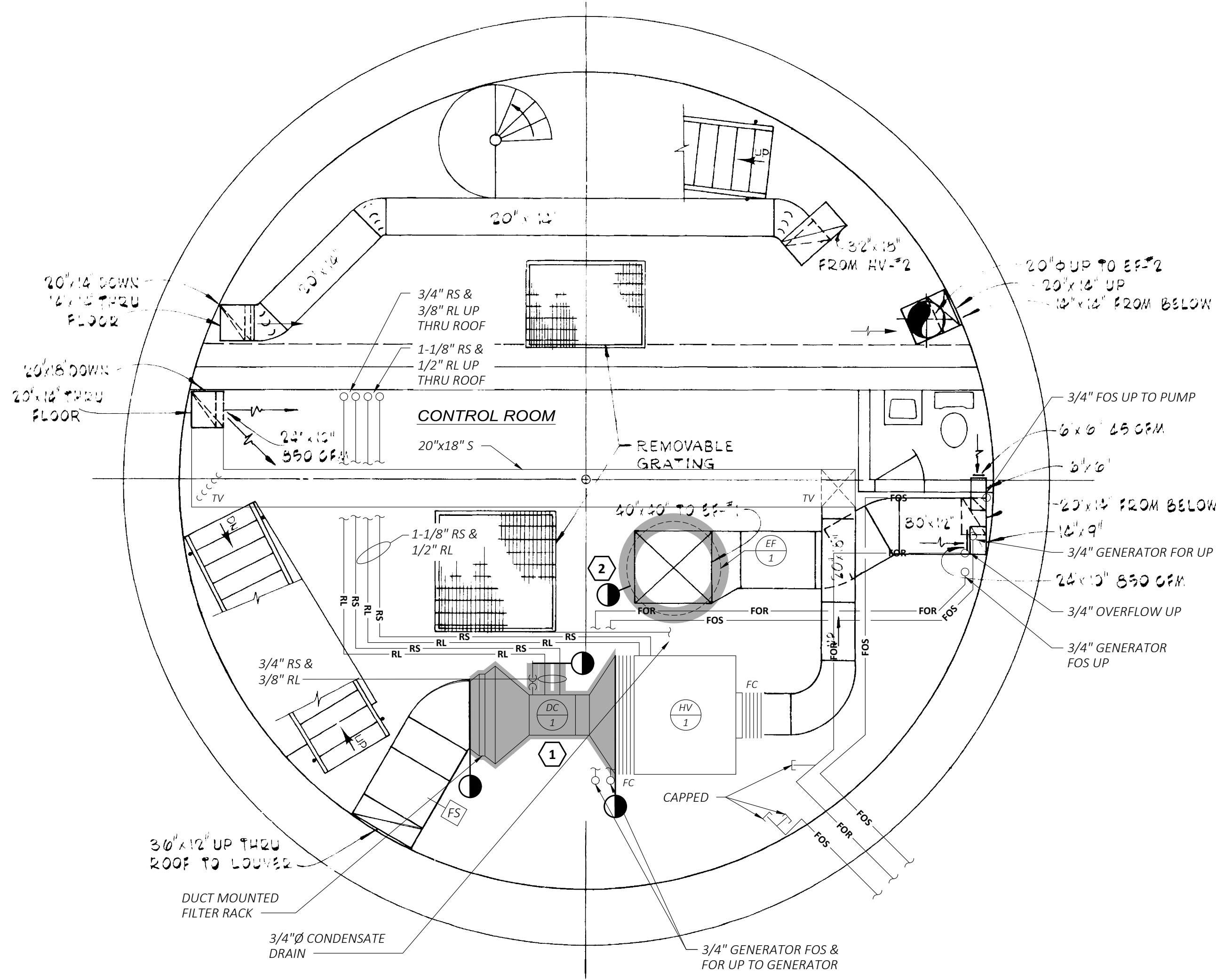
APP'D	DATE	REVISIONS
DAD	12-20	
CONTRACT DRAWINGS		
NO		

DESIGNED BY:	RTG
CAD CORP.:	BBB
CHECKED BY:	NSB
DATE:	NOVEMBER 2020
APPROVED BY:	RTG
DATE:	DECEMBER 2020
PROJECT NO.:	204883

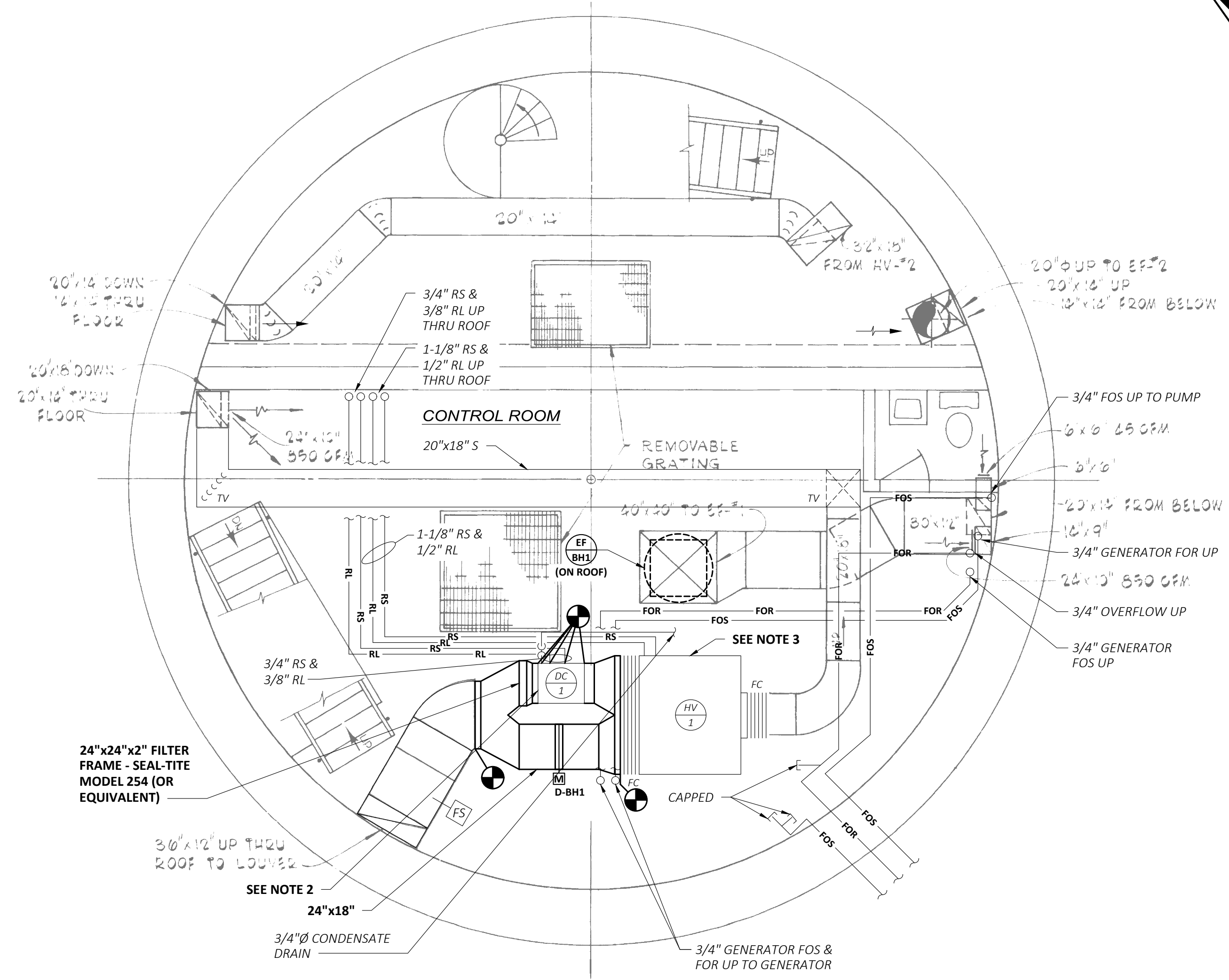


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HVAC IMPROVEMENTS
EVERGREEN PUMP STATION
MODIFICATIONS PLANS & DETAILS



CONTROL LEVEL - DEMOLITION PLAN
 SCALE: "SCANNED"
 (APPROXIMATELY: 1/4"=1'-0")



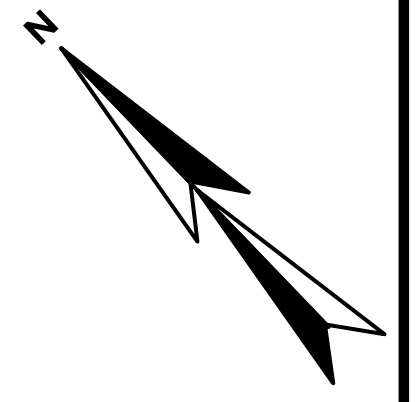
CONTROL LEVEL - MODIFICATIONS PLAN
 SCALE: "SCANNED"
 (APPROXIMATELY: 1/4"=1'-0")

DEMOLITION NOTES:

- 1 TEMPORARILY REMOVE EXISTING DEHUMIDIFICATION COIL (DC-1) AND STORE FOR REINSTALLATION. RECOVER REFRIGERANT AND CUT BACK EXISTING PIPING AND ASSOCIATED APPURTENANCES AS NECESSARY TO SERVE NEW LOCATION. DEMOLISH ASSOCIATED DUCTWORK AND APPURTENANCES TO POINTS INDICATED; CLEAN AND PREPARE FOR CONNECTION TO NEW.
- 2 REMOVE/DEMOLISH EXISTING ROOF MOUNTED EXHAUST FAN ABOVE, INCLUDING BUT NOT LIMITED TO: FAN, WIRING, & CONTROLS. EXISTING DUCTWORK AND ROOF CURB TO REMAIN.

DRAWING NOTES:

1. FOR MECHANICAL NOTES, LEGEND AND ABBREVIATIONS, REFER TO DRAWING M-1.
2. REINSTALL DEHUMIDIFICATION COIL DC-1. RECONNECT CONDENSATE DRAIN AND REFRIGERANT PIPING. RECHARGE SYSTEM WITH R-410A.
3. REPLACE EXISTING HV-1 MOTOR WITH NEW TWO-SPEED MOTOR (460V, 3PH, 2HP). REPLACE EXISTING MOTOR STARTER WITH TWO-SPEED MOTOR STARTER. PROVIDE WIRING TO ATC-1 FOR FAN SPEED CONTROL PER SEQUENCES OF OPERATION.
4. MODIFY EXISTING CONTROLS AS NECESSARY TO ACHIEVE THE SEQUENCES OF OPERATION LOCATED IN SPECIFICATIONS SECTION 15604.



NO	DATE	DESCRIPTION
1	12-20-20	ISSUED FOR PERMIT
2		
3		
4		

DESIGNED BY: RTG	BBB
CAD CORP: BBB	BBB
CHECKED BY: NSB	NSB
DATE: NOVEMBER 2020	
APPROVED BY: RTG	RTG
DATE: DECEMBER 2020	
PROJECT NO: 20483	



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 HVAC IMPROVEMENTS

BLUE HILLS PUMP STATION
 DEMOLITION & MODIFICATIONS PLANS

DRAWING
 M-5

POWER

- DESCRIPTION
200/3 UNFUSED SAFETY SWITCH, RATING AS NOTED
POLES AMPERES
30/15/3 FUSED SAFETY SWITCH, RATING AS NOTED
POLES FUSE AMPERE RATING SWITCH AMPERE RATING
MAGNETIC MOTOR STARTER, RATING AS NOTED NEMA SIZE
COMBINATION TYPE MAGNETIC MOTOR STARTER, RATING AS NOTED
LCS PUSHBUTTON OR LOCAL CONTROL STATION
MAINTAINED RED MUSHROOM-HEAD EMERGENCY STOP P.B.
SOLENOID
RELAY
MOD MOTOR OPERATED DAMPER
LIGHTING OR POWER CONTACTOR
CB ENCLOSED CIRCUIT BREAKER
T THERMOSTAT
C COOLING ONLY
F FREEZESTAT
D DUCT-MOUNTED
UTILITY METER
PANELBOARD, SURFACE MTD.
PANELBOARD, FLUSH MTD.
EQUIPMENT, TERMINAL, OR CONTROL CABINET
MOTOR
TRANSFORMER
PAD MOUNTED TRANSFORMER
EWH ELECTRIC WATER HEATER
H ELECTRICAL HANDHOLE
JUNCTION BOX
PRESSURE SWITCH
ELECTRIC ACTUATED VALVE
P PHOTOELECTRIC CELL
MS MANUAL MOTOR STARTER
FI FIROMATIC SWITCH

SINGLE LINE DIAGRAM

- DESCRIPTION
SAFETY DISCONNECT SWITCH
TRANSFORMER
CURRENT TRANSFORMER
POTENTIAL TRANSFORMER
100AF FRAME SIZE
70AT CIRCUIT BREAKER TRIP AMPS
SURGE CAPACITOR
LIGHTNING ARRESTER
COMBINATION MOTOR STARTER AND BREAKER
AUTOTRANSFORMER-TYPE MOTOR STARTER
REVERSING MOTOR STARTER
TWO-SPEED TWO-WINDING MOTOR STARTER
REDUCED VOLTAGE SOLID-STATE MOTOR STARTER
DELTA CONNECTION
WYE CONNECTION
GROUND CONNECTION
MOTOR (HP AS SHOWN)
GENERATOR
TRANSFER SWITCH
EMERGENCY STOP MUSHROOM SWITCH (RED)
SPD SURGE PROTECTION DEVICE
METER
A - AMMETER
V - VOLTMETER
W - WATTMETER
WH - WATT HOURMETER
KWH - KILOWATT HOUR
VAR - VAR METER
HZ - FREQUENCY METER
PF - POWER FACTOR METER

LIGHTING FIXTURES

- DESCRIPTION
FLUORESCENT FIXTURE, 2x4 SURFACE TROFFER TYPE
FITURE (M) SWITCH (a) CIRCUIT (3)
FLUORESCENT FIXTURE, STRIP, OPEN REFLECTOR, ENCLOSED OR WRAPAROUND TYPE
INCANDESCENT WALL MOUNTED FIXTURE
INCANDESCENT CEILING FIXTURE
INCANDESCENT LIGHT WITH GLOBE AND GUARD
H.I.D. WALL MOUNTED FIXTURE
H.I.D. CEILING FIXTURE
EXIT SIGN, CEILING MOUNTED ARROW INDICATES EGRESS DIRECTION SHADING INDICATES SIGN FACE
EXIT SIGN, WALL MOUNTED SHADING INDICATES SIGN FACE
EMERGENCY LIGHTING BATTERY UNIT WITH 2 LAMP HEADS
REMOTE EMERGENCY LIGHTING 1 OR 2 LAMP HEADS
POLE MOUNTED SITE LIGHT

GROUNDING

- DESCRIPTION
GROUND ROD
EXOTHERMIC WELD CONNECTION
BOLTED CONNECTION
BARE COPPER CONDUCTOR RUN EXPOSED
BARE COPPER CONDUCTOR EMBEDDED IN CONCRETE OR BURIED

SCHEMATIC DIAGRAM

- DESCRIPTION
MANUAL MOTOR STARTER, O/L, RIL FRACTIONAL H.P.
CONTROL RELAY
MOTOR CONTACTOR
CONTACT NORMALLY OPEN
CONTACT NORMALLY CLOSED
OVERLOAD HEATER ELEMENT
SINGLE POLE SINGLE THROW SWITCH
SELECTOR SWITCH
START PUSHBUTTON, MOMENTARY CONTACT
STOP PUSHBUTTON, MOMENTARY CONTACT
RED MUSHROOM-HEAD MAINTAINED-TYPE EMERGENCY STOP PUSHBUTTON
LIMIT SWITCH
TEMPERATURE SWITCH
FLOAT SWITCH
PRESSURE SWITCH
TIMED CONTACT
PILOT LIGHT, LETTER INDICATES COLOR
GREEN
RED
AMBER
FUSE
CONNECTION POINT FOR EXTERNAL DEVICE
INTERNAL CONNECTION POINT

FIRE ALARM SYSTEM

- DESCRIPTION
MANUAL PULL STATION
AUDIO/VISUAL ALARM STATION (ADA COMPLIANT)
VISUAL ALARM (ADA COMPLIANT)
SMOKE DETECTOR
HEAT DETECTOR TEMP RATING
DUCT-MOUNTED SMOKE DETECTOR, REMOTE ALARM & TEST
FIRE ALARM SYSTEM CONTROL PANEL
SPRINKLER SYSTEM TAMPER SWITCH
FIRE ALARM ANNUNCIATOR
SPRINKLER SYSTEM FLOW SWITCH
FIRE ALARM REMOTE POWER SUPPLY
FIRE ALARM SYSTEM "MONITOR MODULE"
FAULT ISOLATING MODULE
REMOTE TEST STATION
INTEGRAL LIGHTNING CIRCUIT PROTECTOR

TELEPHONE/PAGING/INTERCOM SYSTEM

- DESCRIPTION
PAGING SPEAKER, CEILING MTD.
PAGING HORN, WALL MTD.
TELEPHONE OUTLET RJ11
TELEPHONE RJ11/DATA RJ45
WALL MOUNTED
PAGING HANDSET, WALL MOUNTED

WIRING DEVICES

- DESCRIPTION
20 AMPERE, 120 VOLT DUPLEX RECEPTACLE
GFI 20 AMPERE, 120 VOLT DUPLEX RECEPTACLE
INDICATES INCHES AFF MOUNTING HEIGHT
WEATHERPROOF
ISOLATED GROUND COUNTER TOP
20 AMPERE, 120 VOLT QUAD RECEPTACLE
20 AMPERE, 120 VOLT SINGLE RECEPTACLE
CLOCK OUTLET
SINGLE SPECIAL PURPOSE RECEPTACLE INDICATES AMPERE SIZE
PLUGMOLD
S SINGLE POLE WALL SWITCH
DP DOUBLE POLE SWITCH
3 THREE WAY SWITCH
4 FOUR WAY SWITCH
P NEON PILOT LIGHT
WP WEATHERPROOF
K KEY OPERATED
EP EXPLOSION PROOF
D DIMMER SWITCH
T MOTOR RATED
EM EMERGENCY SHUT-OFF

WIRING

- DESCRIPTION
WIRING, CONCEALED IN FINISHED AREAS, EXPOSED WHERE PERMITTED BY SPECIFICATIONS
WIRING INSTALLED IN OR BELOW FLOOR SLAB
HOME RUN TO DEVICE (EUB, ATC, ETC.)
HOME RUN (NO. REFERS TO CONDUIT AND WIRE SCHEDULE)
DC WIRING
CONDUIT AND WIRE
CONDUIT DOWN
CONDUIT UP
INDICATES THE CIRCUIT # OF THE RESPECTIVE PANELBOARD REFERENCED. SEE GENERAL NOTES 6 AND 26 FOR CONDUIT AND WIRING REQUIREMENTS

SECURITY SYSTEM

- DESCRIPTION
SECURITY ALARM CONTROL PANEL
SECURITY SYSTEM FUNCTION KEYPAD WEATHERPROOF
DOOR CONTACT OVERHEAD DOOR TYPE
GLASS BREAK CONTACT, GLASS MOUNTED TYPE
INFRARED INTRUDER SENSOR
AREA GLASS BREAK DETECTOR

NEMA CLASSIFICATIONS FOR ELECTRICAL EQUIPMENT AND ENCLOSURES

(UNLESS OTHERWISE NOTED - SEE NOTE BELOW)

LOCATION

Table with columns: ROOM NAME, NEMA RATING. Includes WETWELL SIDE, DRYWELL SIDE, and GENERAL OUTDOORS.

EVERGREEN PUMP STATION

Table with columns: ROOM NAME, NEMA RATING. Includes DRYWELL ENTRY, WETWELL ENTRY, ELECTRICAL ROOM, BATHROOM, WETWELL STAIRS, PUMP CONTROL ROOM, GRINDER ROOM, PUMP ROOM, WETWELL NO. 1, WETWELL NO. 2, and GENERAL OUTDOORS.

NOTE:

THE AREAS NOTED SHALL BE RATED AS INDICATED, EXCEPT THAT EQUIPMENT SUCH AS MOTOR CONTROL CENTERS, SWITCHBOARDS, AND TRANSFORMERS SHALL BE RATED AS SPECIFIED. PANELBOARDS AND TRANSFORMERS SHALL BE, AT A MINIMUM, RATED NEMA 12 IF NOT SPECIFIED.

** = TANKS, WETWELLS, STRUCTURES, ROOF

Table with columns: LOCATION, NEMA RATING. Includes INTERIOR - ALL LOCATIONS, WITHIN 36 INCHES RADIUS OUTSIDE WETWELL OPENINGS (HATCH, VENT, DOOR, ETC.), and ADDITIONAL 24 INCHES RADIUS AROUND ENVELOPE NOTED ABOVE (VENTS ONLY).

** CONDUIT INSTALLATION SCHEDULE

Table with columns: AREA NEMA RATING PER E-1, CONDUIT REQUIRED IN EXPOSED AREAS, CONDUIT REQUIRED IN NON EXPOSED AREAS, CONDUITS EMERGING FROM GRADE OR SLAB 12" AFF.

** SEE SPECIFICATIONS FOR FURTHER INFORMATION
* SIGNAL CONDUITS BELOW GRADE SHALL BE RGS

NOTE:
1. ALL SYMBOL LISTS SHALL BE CONSIDERED AS APPLICABLE TO ALL ELECTRICAL DRAWINGS FOR THIS PROJECT. SYMBOLS SHOWN ON THIS SHEET ARE FOR REFERENCE ONLY AND DO NOT INDICATE THEIR INCORPORATION IN THE DESIGN.

Table with columns: APP'D, DATE, SUBMISSIONS/REVISIONS, CONTRACT DRAWINGS. Includes dates 12-20 and 12-20.

DESIGNED BY: ADAM CAB CORP.
CHECKED BY: ADAM CAB CORP.
DATE: NOVEMBER 2020
APPROVED BY: CLARE DATE: DECEMBER 2020
PROJECT NO.: 20488



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WATERFORD UTILITY COMMISSION
EVERGREEN AVENUE & BLUE HILLS PUMP STATIONS HVAC IMPROVEMENTS
ELECTRICAL LEGEND AND NEMA SCHEDULE
DRAWING E-1

ABBREVIATIONS

Table with 2 columns: Abbreviation and Description. Includes entries for AMPERE, ALTERNATING CURRENT, CONTROL RELAY, ABOVE FINISHED FLOOR, etc.

GENERAL DEMOLITION NOTES:

- 1. THE EXISTING ELECTRICAL DRAWINGS FOR THIS PROJECT ARE BASED ON INFORMATION PRESENTED IN THE AS-BUILT CONTRACT DRAWINGS PROVIDED FOR THIS PROJECT. GENERAL CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS AND ELEVATIONS AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES.

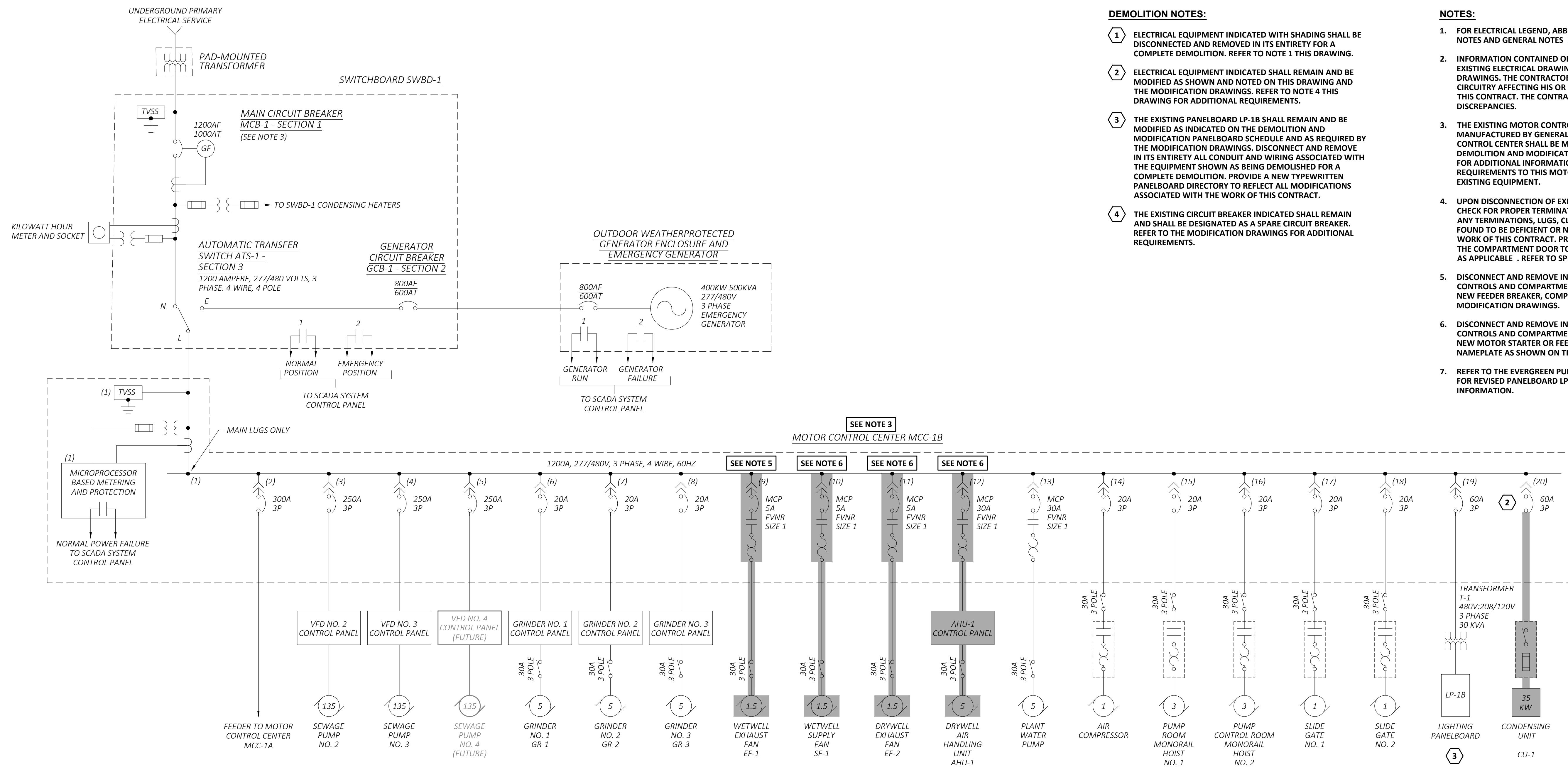
GENERAL NOTES

- 1. ALL CONDUIT AND EQUIPMENT SHALL BE INSTALLED AND GROUNDED IN ACCORDANCE WITH THE RULES AND REGULATIONS OF THE CURRENT NATIONAL ELECTRICAL CODE.
- 2. CONDUIT RUNS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT AND STRUCTURES.

- 27. POWER CONDUITS FOR THREE PHASE AND SINGLE PHASE CIRCUITS (DESIGNATED WITH "P" NUMBERS) ARE SHOWN ON POWER PLANS, WITH CONDUIT SIZES AND WIRING INFORMATION INDICATED IN THE CONDUIT AND WIRE SCHEDULES.
- 28. CONTROL AND INSTRUMENTATION SIGNAL CONDUITS (DESIGNATED WITH "C" AND "S" NUMBERS OR, ALTERNATIVELY, INDICATED BY WAY OF A LEGEND) ARE SHOWN ON CONTROL AND INSTRUMENTATION WIRING DIAGRAMS, WITH CONDUIT SIZES AND WIRING INFORMATION INDICATED EITHER IN THE LEGEND OR IN CONDUIT AND WIRE SCHEDULES.

NOTE: 1. ALL GENERAL NOTES, AND ABBREVIATIONS SHALL BE CONSIDERED AS APPLICABLE TO ALL ELECTRICAL DRAWINGS FOR THIS PROJECT. ABBREVIATIONS SHOWN ON THIS SHEET ARE FOR REFERENCE ONLY AND DO NOT INDICATE THEIR INCORPORATION IN THE DESIGN.

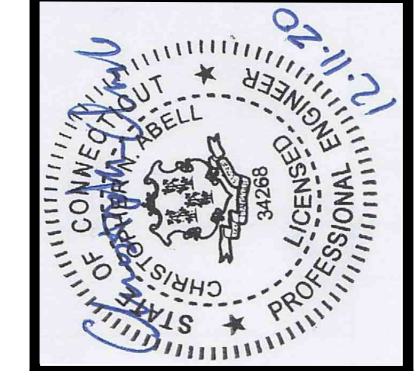
Project information block including: WATERFORD UTILITY COMMISSION, EVERGREEN AVENUE & BLUE HILLS PUMP STATIONS HVAC IMPROVEMENTS, DRAWING E-2, and Wright-Pierce logo.



- DEMOLITION NOTES:**
- 1 ELECTRICAL EQUIPMENT INDICATED WITH SHADING SHALL BE DISCONNECTED AND REMOVED IN ITS ENTIRETY FOR A COMPLETE DEMOLITION. REFER TO NOTE 1 THIS DRAWING.
 - 2 ELECTRICAL EQUIPMENT INDICATED SHALL REMAIN AND BE MODIFIED AS SHOWN AND NOTED ON THIS DRAWING AND THE MODIFICATION DRAWINGS. REFER TO NOTE 4 THIS DRAWING FOR ADDITIONAL REQUIREMENTS.
 - 3 THE EXISTING PANELBOARD LP-1B SHALL REMAIN AND BE MODIFIED AS INDICATED ON THE DEMOLITION AND MODIFICATION PANELBOARD SCHEDULE AND AS REQUIRED BY THE MODIFICATION DRAWINGS. DISCONNECT AND REMOVE IN ITS ENTIRETY ALL CONDUIT AND WIRING ASSOCIATED WITH THE EQUIPMENT SHOWN AS BEING DEMOLISHED FOR A COMPLETE DEMOLITION. PROVIDE A NEW TYPED PANELBOARD DIRECTORY TO REFLECT ALL MODIFICATIONS ASSOCIATED WITH THE WORK OF THIS CONTRACT.
 - 4 THE EXISTING CIRCUIT BREAKER INDICATED SHALL REMAIN AND SHALL BE DESIGNATED AS A SPARE CIRCUIT BREAKER. REFER TO THE MODIFICATION DRAWINGS FOR ADDITIONAL REQUIREMENTS.

- NOTES:**
- 1 FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
 - 2 INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
 - 3 THE EXISTING MOTOR CONTROL CENTER MCC IS A EVOLUTION SERIES E9000 AS MANUFACTURED BY GENERAL ELECTRIC CORPORATION. THE EXISTING MOTOR CONTROL CENTER SHALL BE MODIFIED AS SHOWN ON THIS DRAWING AND THE DEMOLITION AND MODIFICATION DRAWINGS. REFER TO THE CONTRACT DRAWINGS FOR ADDITIONAL INFORMATION ON DEMOLITION AND MODIFICATION REQUIREMENTS TO THIS MOTOR CONTROL CENTER AND ASSOCIATED CONNECTED EXISTING EQUIPMENT.
 - 4 UPON DISCONNECTION OF EXISTING CABLES/BUSSING, CLEAN, INSPECT, CLEAN AND CHECK FOR PROPER TERMINATIONS TO EXISTING EQUIPMENT WHICH IS TO REMAIN. ANY TERMINATIONS, LUGS, CLAMPS, ETC., WHICH REQUIRE REPLACEMENT OR ARE FOUND TO BE DEFICIENT OR NOT SERVICEABLE, SHALL BE PROVIDED AS PART OF THE WORK OF THIS CONTRACT. PROVIDE NEW LAMACOID NAMEPLATE ON THE FRONT OF THE COMPARTMENT DOOR TO READ "SPARE CIRCUIT BREAKER" OR "SPARE STARTER" AS APPLICABLE. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
 - 5 DISCONNECT AND REMOVE IN ITS ENTIRETY THE EXISTING MOTOR STARTER, CONTROLS AND COMPARTMENT DOOR FOR A COMPLETE DEMOLITION. PROVIDE A NEW FEEDER BREAKER, COMPARTMENT DOOR AND NAMEPLATE AS SHOWN ON THE MODIFICATION DRAWINGS.
 - 6 DISCONNECT AND REMOVE IN ITS ENTIRETY THE EXISTING MOTOR STARTER, CONTROLS AND COMPARTMENT DOOR FOR A COMPLETE DEMOLITION. PROVIDE A NEW MOTOR STARTER OR FEEDER BREAKER, CONTROLS, COMPARTMENT DOOR AND NAMEPLATE AS SHOWN ON THE MODIFICATION DRAWINGS.
 - 7 REFER TO THE EVERGREEN PUMP STATION CONDUIT AND WIRE SCHEDULE DRAWING FOR REVISED PANELBOARD LP-1B SCHEDULE AND FINAL ESTIMATED DEMAND LOAD INFORMATION.

APP'D	DATE
DAD	12-20
SUBMISSIONS/REVISIONS	
NO	DATE
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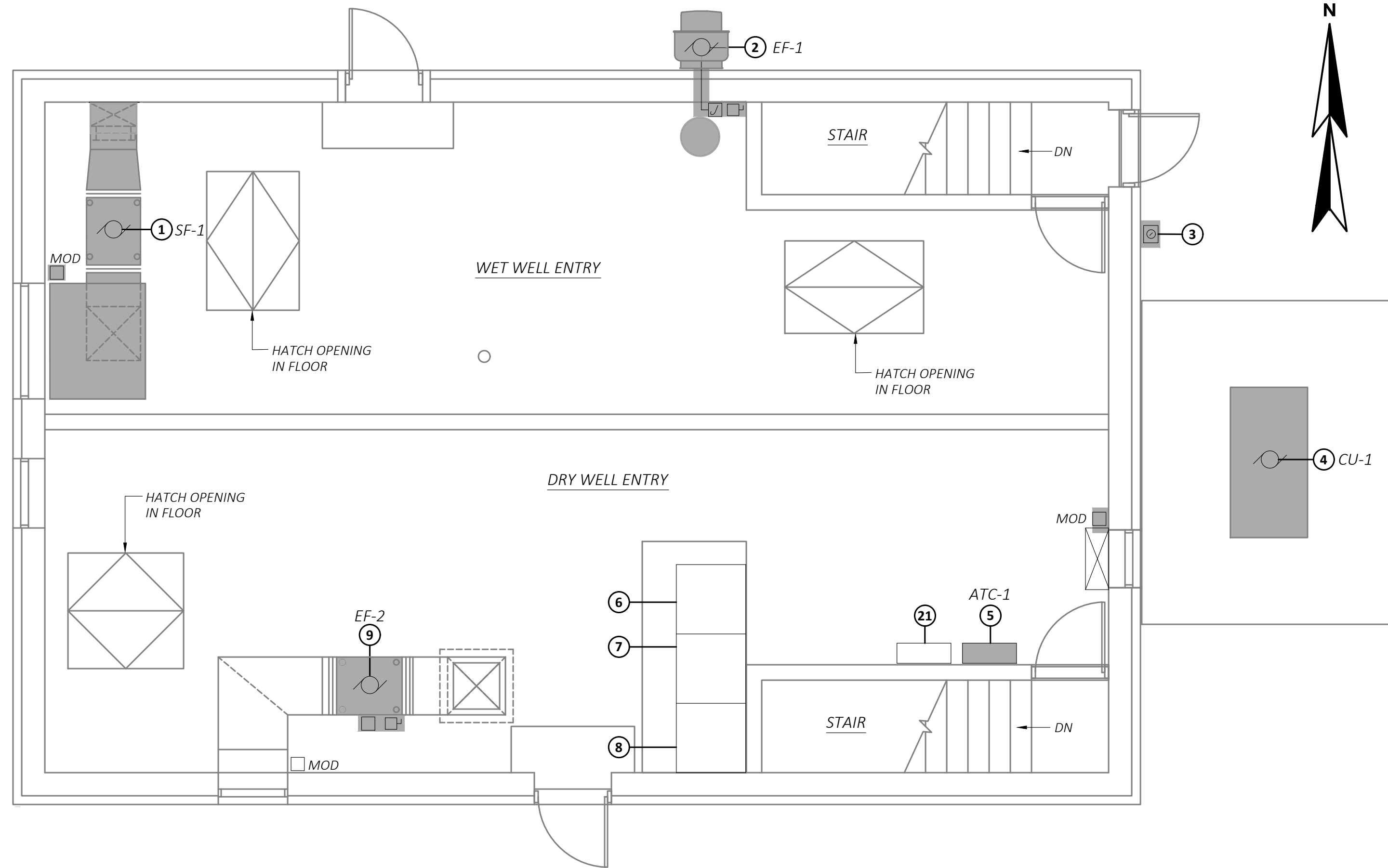
PANEL LOCATION: ELECTRICAL ROOM		FEEDER POINT: TRANSFORMER T-1						
VOLTAGE: 120/208		MOUNTING: SURFACE						
PHASE: 3		BUS RATING: 100 AMPS						
WIRE: 4		MAIN TYPE: X MCR 100 TRIP AMPS						
AIC: 10000								
CKT NO.	AMPS	NO. POLES	DESCRIPTION	PHASE LOAD (VA)	DESCRIPTION	NO. POLES	AMPS	CKT NO.
1	20	1	LIGHTING - UPPER GRADE LEVEL		RECEPTACLES - GRINDER ROOM	1	20	2
3	20	1	LIGHTING - ELECTRICAL ROOM		LIGHTING - GRINDER ROOM	1	20	4
5	20	1	RECEPTACLES - UPPER GRADE LEVEL		LIGHTING - GRINDER ROOM	1	20	6
7	20	1	LIGHTING - PUMP CONTROL ROOM		RECEPTACLES - ELECTRICAL AND PUMP ROOM	1	20	8
9	20	1	PUMP ROOM - LIGHTING		RECEPTACLES - ELECTRICAL AND PUMP ROOM	1	20	10
11	20	1	RELAY CONTROL PANEL		RECEPTACLES - ELECTRICAL AND PUMP ROOM	1	20	12
13	20	1	AHU-1 REMOTE CONTROL PANEL		EXTERIOR LIGHTING FIXTURES	1	20	14
15	30	1	SUMP PUMP		RECEPTACLES - SAMPLER AND SINK	1	20	16
17	20	1	SPARE		PUMP CONTROL PANEL	1	30	18
19	20	1	SPARE		HOT WATER HEATER	1	30	20
21	20	1	TELEMETRY CONTROL PANEL		EMERGENCY LIGHTING AND EXIT SIGNAGE	1	20	22
23	50	3	FEEDER TO GENERATOR ENCLOSURE PANELBOARD		SPARE	1	20	24
25					OUTSIDE POLE MOUNTED LIGHTING	1	20	26
27					SPARE	1	30	28
29	30	1	AUTOMATIC TEMPERATURE CONTROL PANEL ATC-1		SPARE	1	20	30
31	20	1	SPARE		SPARE	1	20	32
33	20	1	SPARE		SPARE	1	20	34
35	20	1	SPARE		SPARE	1	20	36
37	20	1	SPARE		SPARE	1	20	38
39	20	1	SPARE		SPARE	1	20	40
41	20	1	SPARE		SPARE	1	20	42
SUB-TOTAL								
TOTAL								

**EVERGREEN PUMP STATION
 MOTOR CONTROL CENTER MCC-1B
 SINGLE LINE DIAGRAM - DEMOLITION**
 NTS

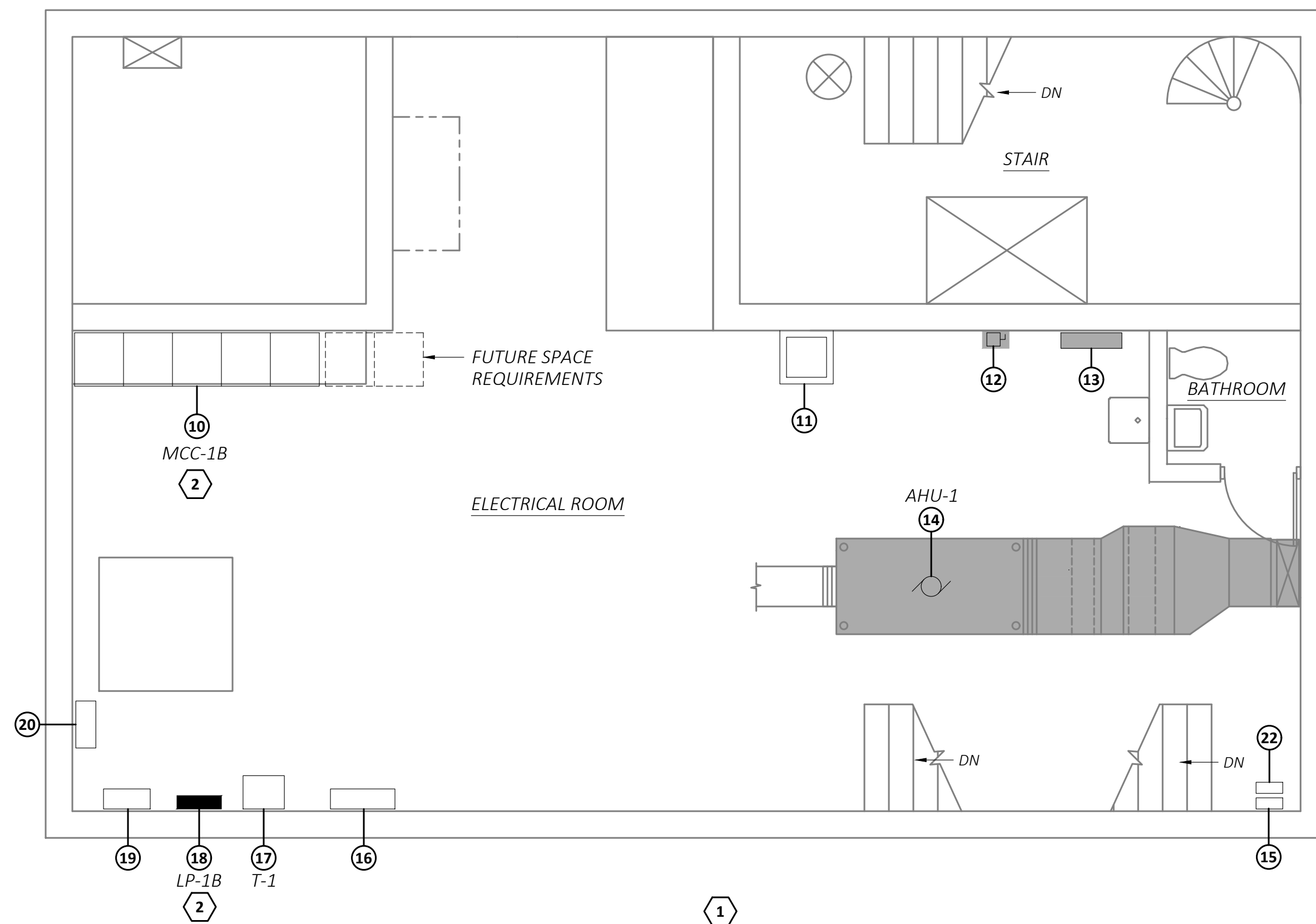
1	3	6	20	SPACE
		7	12	16
		8	13	17
2	5	9	14	18
		10	15	19
			SPACE	SPACE

**MOTOR CONTROL CENTER MCC-1B
 FRONT ELEVATION - DEMOLITION**
 NTS

WATERFORD UTILITY COMMISSION
 EVERGREEN AVENUE &
 BLUE HILLS PUMP STATIONS
 HVAC IMPROVEMENTS
 EVERGREEN PUMP STATION
 MOTOR CONTROL CENTER MCC-1B SINGLE LINE DIAGRAM - DEMOLITION



SEE NOTES THIS DRAWING
EVERGREEN PUMP STATION
ENTRY LEVEL FLOOR PLAN - DEMOLITION
 SCALE: 1/4"=1'-0"



SEE NOTES THIS DRAWING
EVERGREEN PUMP STATION
ELECTRICAL ROOM FLOOR PLAN - DEMOLITION
 SCALE: 1/4"=1'-0"

NOTES:

- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
- INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.

DEMOLITION NOTES:

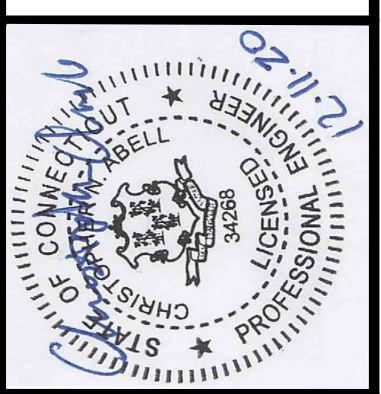
- ELECTRICAL EQUIPMENT INDICATED WITH SHADING SHALL BE DISCONNECTED AND REMOVED IN ITS ENTIRETY FOR A COMPLETE DEMOLITION. REFER TO NOTE 1 THIS DRAWING.
- ELECTRICAL EQUIPMENT INDICATED SHALL REMAIN AND BE MODIFIED AS SHOWN AND NOTED ON THE DEMOLITION AND MODIFICATION DRAWINGS.

EQUIPMENT LEGEND:

- SUPPLY FAN SF-1 TO BE REMOVED
- EXHAUST FAN EF-1 TO BE REMOVED
- WETWELL FANS HAND-OFF-AUTO SELECTOR SWITCH TO BE REMOVED
- CONDENSER UNIT CU-1 TO BE REMOVED
- AUTOMATIC TEMPERATURE CONTROL PANEL ATC-1 TO BE REMOVED
- AUTOMATIC TRANSFER SWITCH ATS-1
- GENERATOR CIRCUIT BREAKER GCB-1
- MAIN CIRCUIT BREAKER MCB-1
- EXHAUST FAN EF-2 TO BE REMOVED
- MOTOR CONTROL CENTER MCC-1B TO BE REMOVED
- PLANT WATER PUMP
- AIR HANDLING UNIT DISCONNECT SWITCH TO BE REMOVED
- AIR HANDLING UNIT AHU-1 REMOTE CONTROL PANEL TO BE REMOVED
- AIR HANDLING UNIT AHU-1 TO BE REMOVED
- GAS DETECTION SYSTEM CONTROL PANEL (DRYWELL) (BELOW)
- TELEMETRY CONTROL PANEL
- TRANSFORMER T-1
- PANELBOARD LP-1B TO BE MODIFIED
- TELEPHONE INTERFACE CABINET
- TELEMETRY TERMINAL CABINET
- GAS DETECTION RELAY CONTROL PANEL
- GAS DETECTION SYSTEM CONTROL PANEL (WETWELL) (ABOVE)

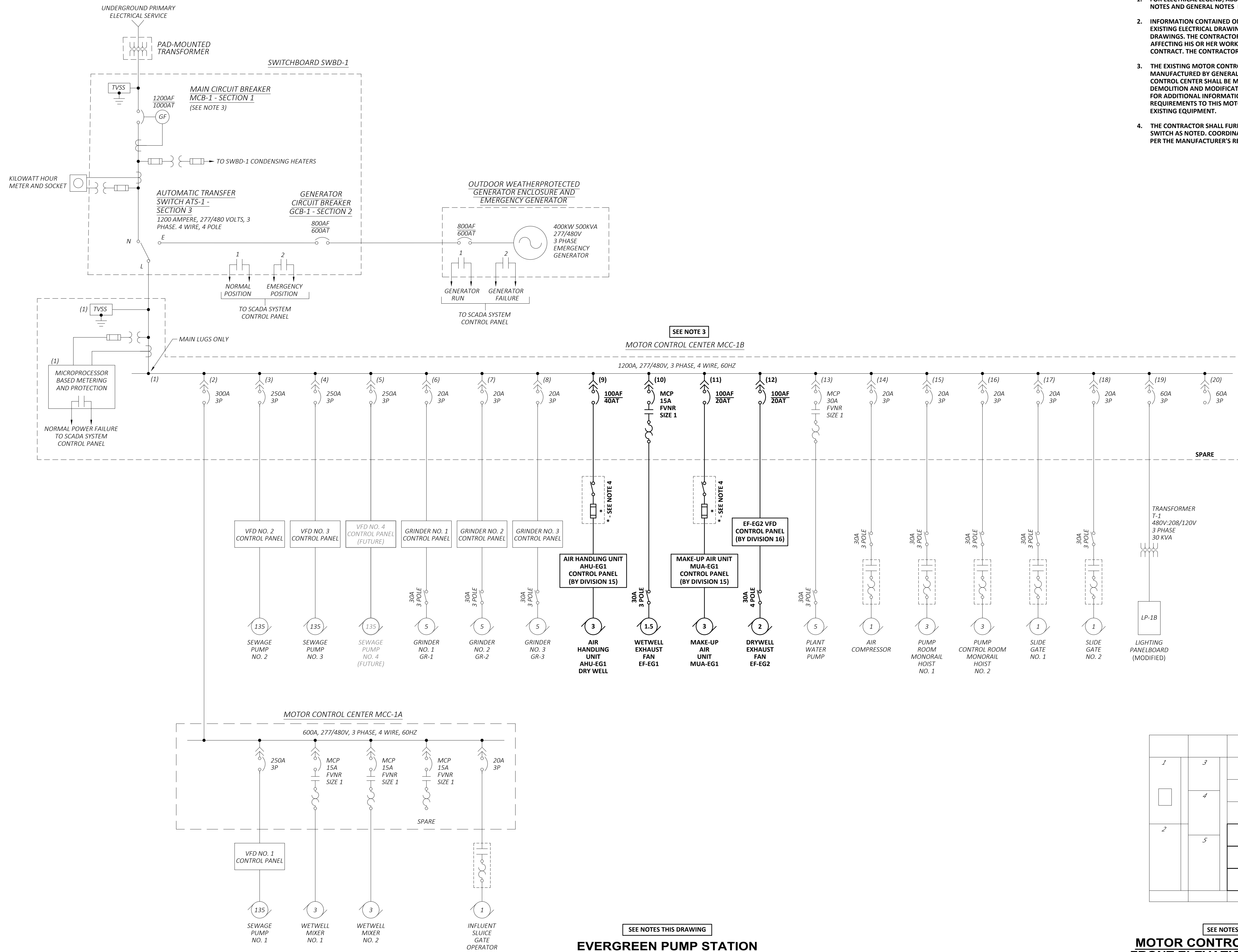
NO	CONTRACT DRAWINGS	DATE
1		12-20

DESIGNED BY: A.DAM	CAD CORP.: BBB	CREATED BY: A.DAM	DATE: NOVEMBER 2020
APPROVED BY: C.ABE	DATE: DECEMBER 2020	PROJECT NO.: 20483	



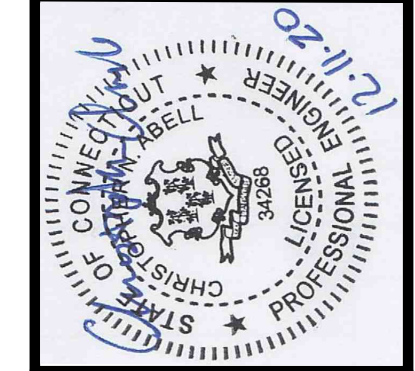
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 HVAC IMPROVEMENTS
 EVERGREEN PUMP STATION
 ENTRY AND ELECTRICAL ROOM FLOOR PLANS - DEMOLITION



- NOTES:**
- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
 - INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
 - THE EXISTING MOTOR CONTROL CENTER MCC IS A EVOLUTION SERIES E9000 AS MANUFACTURED BY GENERAL ELECTRIC CORPORATION. THE EXISTING MOTOR CONTROL CENTER SHALL BE MODIFIED AS SHOWN ON THIS DRAWING AND THE DEMOLITION AND MODIFICATION DRAWINGS. REFER TO THE CONTRACT DRAWINGS FOR ADDITIONAL INFORMATION ON DEMOLITION AND MODIFICATION REQUIREMENTS TO THIS MOTOR CONTROL CENTER AND ASSOCIATED CONNECTED EXISTING EQUIPMENT.
 - THE CONTRACTOR SHALL FURNISH AND INSTALL A 3 POLE, FUSED, DISCONNECT SWITCH AS NOTED. COORDINATE, FURNISH AND INSTALL FUSES SIZED AS REQUIRED PER THE MANUFACTURER'S REQUIREMENTS FOR THIS EQUIPMENT.

APP'D	DATE
DAD	12-20
SUBMISSIONS/REVISIONS	
NO	CONTRACT DRAWINGS
DESIGNED BY: A.DAM	
CAD CORP.: BBB	
CD: D.GU	
CHECKED BY: A.DAM	
DATE: NOVEMBER 2020	
APPROVED BY: C.ABE	
DATE: DECEMBER 2020	
PROJECT NO.: 20488	



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 EVERGREEN PUMP STATION
 MOTOR CONTROL CENTER MCC-1B & MCC-1A SINGLE LINE DIAGRAMS - MODIFICATIONS
DRAWING
 E-5

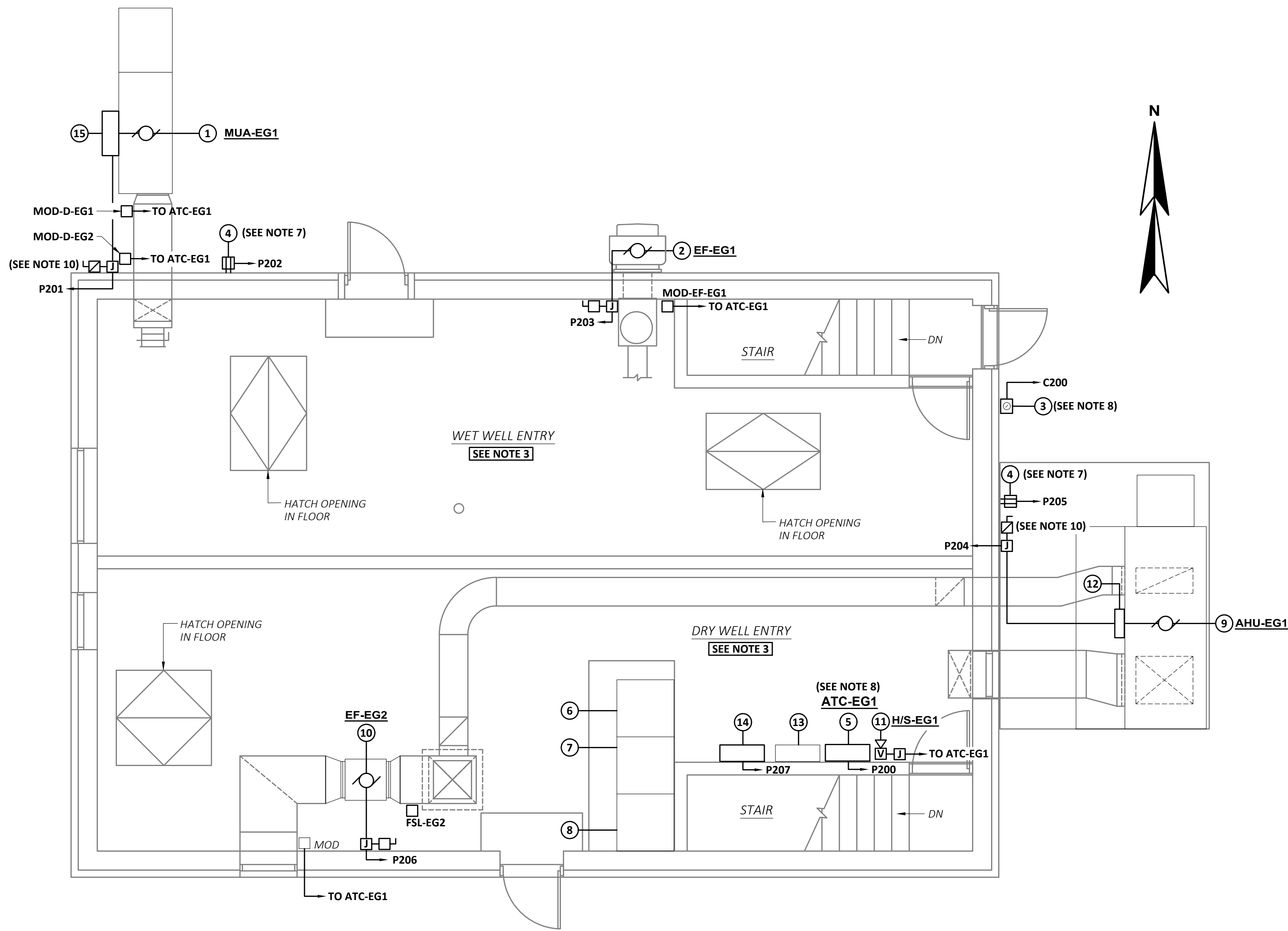
EVERGREEN PUMP STATION
MOTOR CONTROL CENTERS MCC-1A AND MCC-1B
SINGLE LINE DIAGRAMS - MODIFICATIONS
 NTS

MOTOR CONTROL CENTER MCC-1B
FRONT ELEVATION - MODIFICATIONS
 NTS

1	3	6	20	SPACE
	4	7	12	16
		8	13	17
2		9	14	18
	5	10	15	19
		11	SPACE	SPACE

SEE NOTES THIS DRAWING

SEE NOTES THIS DRAWING



SEE NOTES THIS DRAWING
EVERGREEN PUMP STATION
ENTRY LEVEL FLOOR PLAN - MODIFICATIONS
 SCALE: 1/4"=1'-0"

NOTES:

- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
- INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
- FOR CLARITY PURPOSES NOT ALL OF THE EXISTING ELECTRICAL EQUIPMENT LOCATED ON THESE FLOOR PLANS HAS BEEN SHOWN. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO COORDINATE ALL NEW INSTALLATIONS WITH THE EXISTING AND NEW EQUIPMENT, DEVICES, DUCTWORK, LIGHTING, ETC., FOR A NEAT AND COMPLETE INSTALLATION.
- CIRCUIT NUMBERS INDICATED ON THIS DRAWING REFER TO PANELBOARD LP-1B LOCATED IN THE ELECTRICAL ROOM, UNLESS OTHERWISE NOTED.
- FOR PANELBOARD SCHEDULES REFER TO THE CONTRACT DRAWINGS.
- FOR CONDUIT AND WIRING SCHEDULES REFER TO THE CONTRACT DRAWINGS.
- PROVIDE A WEATHER-PROOF, 120V, 20 AMPERE, GFCI TYPE DUPLEX MAINTENANCE RECEPTACLE WITH A WEATHER-PROOF WHILE-IN-USE TYPE COVER NEXT TO THE MECHANICAL EQUIPMENT INDICATED. LOCATE THE RECEPTACLE A MINIMUM OF 4'-0" ABOVE FINISHED GRADE.
- UNLESS OTHERWISE INDICATED, REFER TO THE HVAC BLOCK DIAGRAM DRAWING FOR CONDUIT AND WIRE REQUIREMENTS ASSOCIATED WITH THIS EQUIPMENT.
- THE LOCATION OF THE AIR HANDLING CONTROL PANEL AHU-EG1 HAS BEEN SHOWN DIAGRAMMATICALLY FOR REFERENCE ONLY. THE CONTROL PANEL AND ITS LOCATION ON THE UNIT SHALL BE PROVIDED BY DIVISION 15. THE ELECTRICAL CONTRACTOR SHALL COORDINATE ALL FINAL LOCATIONS OF ELECTRICAL EQUIPMENT AND CONNECTIONS WITH DIVISION 15 FOR A FINAL INSTALLATION.
- THE CONTRACTOR SHALL FURNISH AND INSTALL A FUSED DISCONNECT SWITCH AS NOTED. COORDINATE, FURNISH AND INSTALL FUSES SIZED AS REQUIRED PER THE MANUFACTURER'S REQUIREMENTS FOR THIS EQUIPMENT.
- THE LOCATION OF THE MAKE-UP AIR UNIT CONTROL PANEL MUA-EG1 HAS BEEN SHOWN DIAGRAMMATICALLY FOR REFERENCE ONLY. THE CONTROL PANEL AND ITS LOCATION ON THE UNIT SHALL BE PROVIDED BY DIVISION 15. THE ELECTRICAL CONTRACTOR SHALL COORDINATE ALL FINAL LOCATIONS OF ELECTRICAL EQUIPMENT AND CONNECTIONS WITH DIVISION 15 FOR FINAL INSTALLATION.

EQUIPMENT LEGEND:

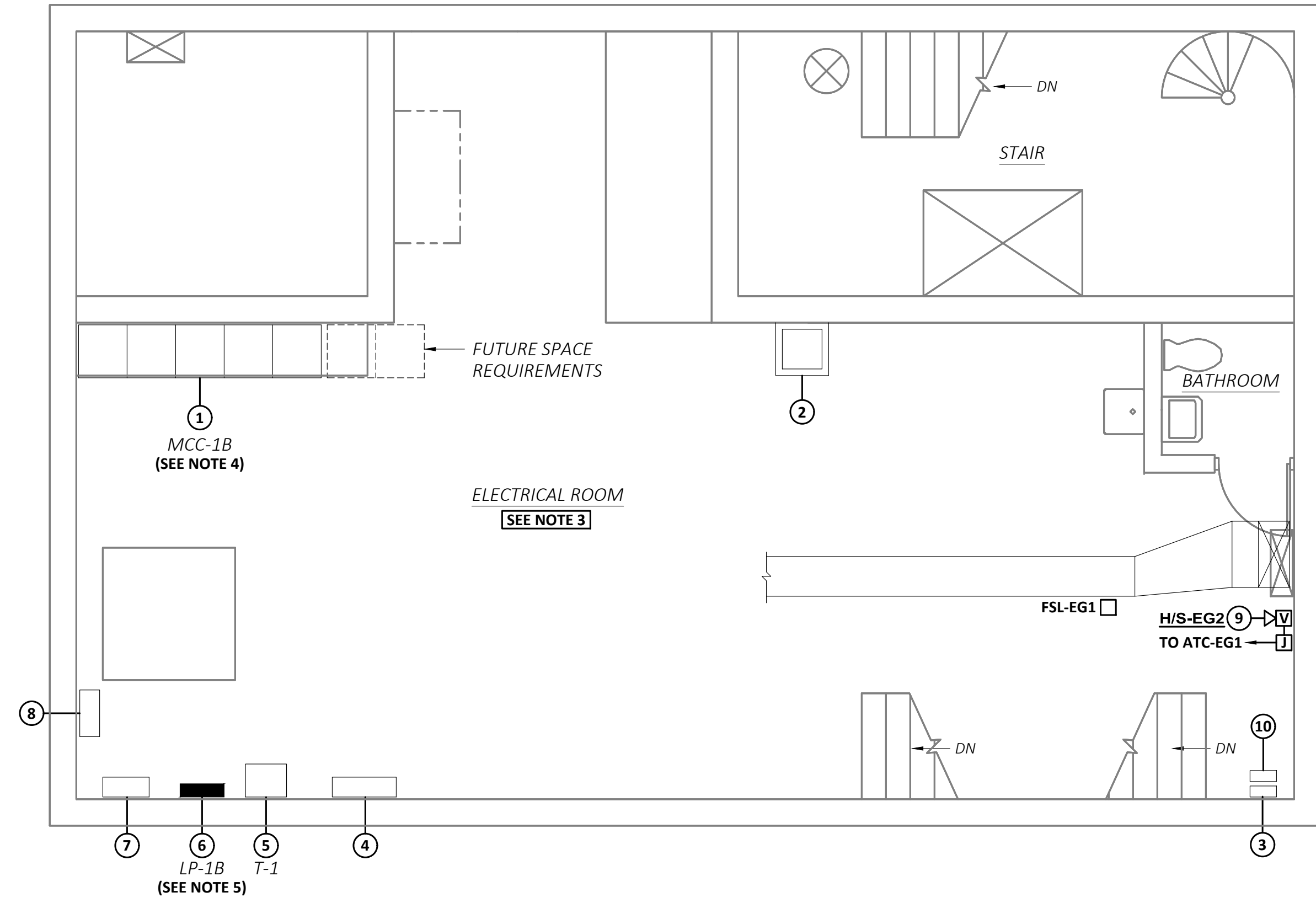
- MAKE-UP AIR UNIT MUA-EG1
- EXHAUST FAN EF- EG1
- HAND-OFF-AUTO SELECTOR SWITCH FOR WETWELL AREA VENTILATION
- DUPLEX MAINTENANCE RECEPTACLE - SEE NOTE 7
- AUTOMATIC TEMPERATURE CONTROL PANEL ATC-EG-1 - BY DIVISION 15
- AUTOMATIC TRANSFER SWITCH ATS-1
- GENERATOR CIRCUIT BREAKER GCB-1
- MAIN CIRCUIT BREAKER MCB-1
- AIR HANDLING UNIT AHU-EG1
- EXHAUST FAN EF-EG2
- ALARM LIGHT AND HORN
- AIR HANDLING UNIT AHU-EG1 CONTROL PANEL - BY DIVISION 15 (SEE NOTE 9)
- GAS DETECTION RELAY CONTROL PANEL
- EXHAUST FAN EF-EG2 VFD CONTROL PANEL (BY DIVISION 16)
- MAKE-UP AIR UNIT MUA-EG1 CONTROL PANEL (BY DIVISION 15) - SEE NOTE 11

APP'D	DATE
DAD	12-20
SUBMISSIONS/REVISIONS	
CONTRACT DRAWINGS	
NO	DESCRIPTION
DESIGNED BY: A.DAM	CAD CORP: BBB
CREATED BY: A.DAM	DATE: NOVEMBER 2020
APPROVED BY: C.ABE	DATE: DECEMBER 2020
PROJECT NO.:	20883

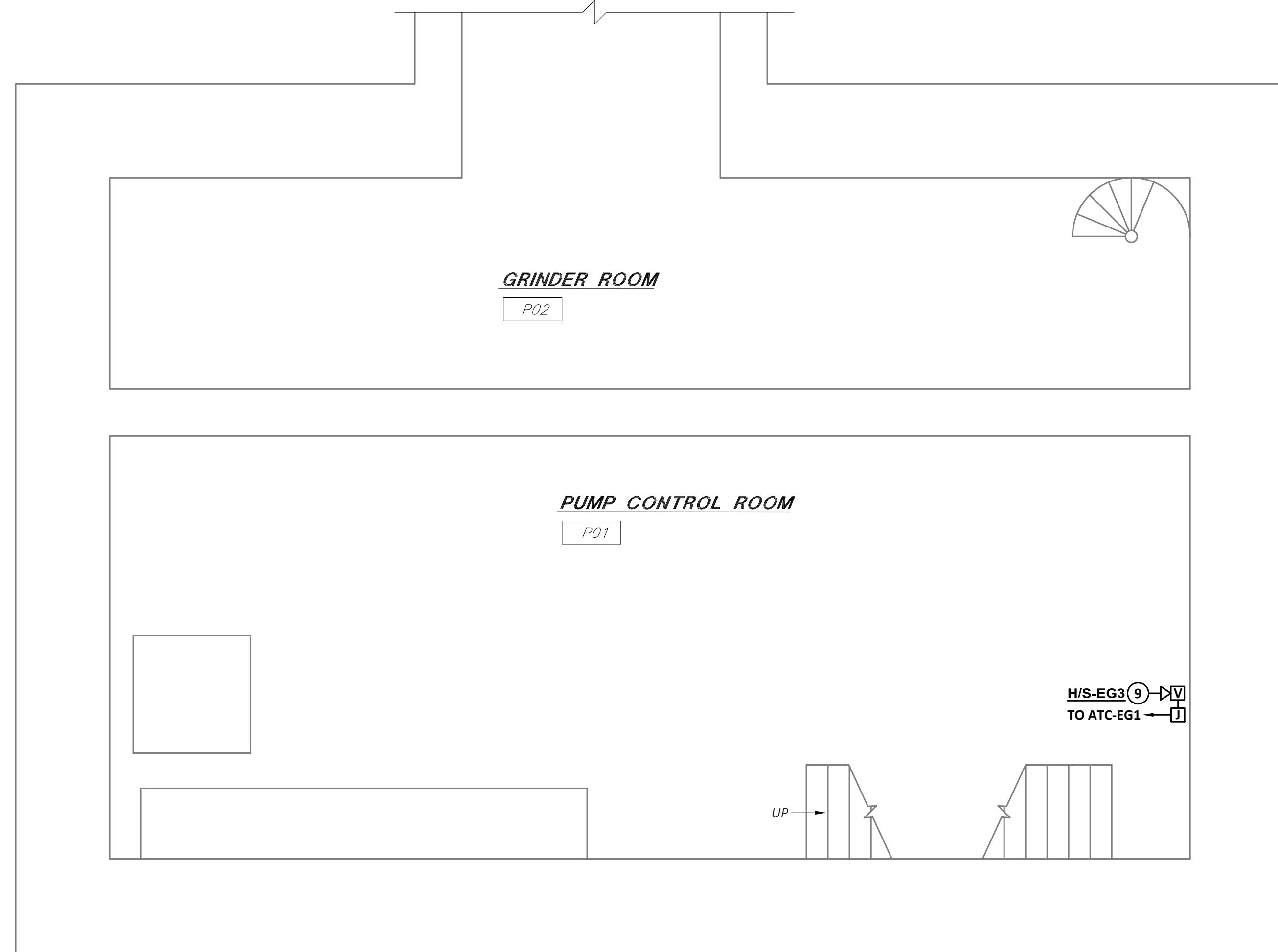
WATERFORD UTILITY COMMISSION
EVERGREEN AVENUE & BLUE HILLS PUMP STATIONS
HVAC IMPROVEMENTS

EVERGREEN PUMP STATION
 ENTRY LEVEL FLOOR PLAN - MODIFICATIONS

DRAWING
 E-6



SEE NOTES THIS DRAWING
**EVERGREEN PUMP STATION
 ELECTRICAL ROOM FLOOR PLAN - MODIFICATIONS**
 SCALE: 1/4"=1'-0"



SEE NOTES THIS DRAWING
**EVERGREEN PUMP STATION
 PUMP CONTROL AND GRINDER ROOM FLOOR PLAN - MODIFICATIONS**
 SCALE: 1/4"=1'-0"

NOTES:

- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
- INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
- FOR CLARITY PURPOSES NOT ALL OF THE EXISTING ELECTRICAL EQUIPMENT LOCATED ON THESE FLOOR PLANS HAS BEEN SHOWN. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO COORDINATED ALL NEW INSTALLATIONS WITH THE EXISTING AND NEW EQUIPMENT, DEVICES, DUCTWORK, LIGHTING, ETC., FOR A NEAT AND COMPLETE INSTALLATION.
- FOR MODIFICATION REQUIREMENTS ASSOCIATED WITH THIS EQUIPMENT, REFER TO THE EVERGREEN PUMP STATION MOTOR CONTROL CENTER MCC-1B AND MCC-1A SINGLE LINE DIAGRAMS - MODIFICATIONS DRAWING.
- FOR MODIFICATION REQUIREMENTS ASSOCIATED WITH THIS EQUIPMENT, REFER TO THE EVERGREEN PUMP STATION PANELBOARD AND CONDUIT AND WIRING SCHEDULE DRAWING.

EQUIPMENT LEGEND:

- ① MODIFIED MOTOR CONTROL CENTER MCC-1B
- ② PLANT WATER PUMP
- ③ GAS DETECTION SYSTEM CONTROL PANEL (DRYWELL) (BELOW)
- ④ TELEMETRY CONTROL PANEL
- ⑤ TRANSFORMER T-1
- ⑥ MODIFIED PANELBOARD LP-1B
- ⑦ TELEPHONE INTERFACE CABINET
- ⑧ TELEMETRY TERMINAL CABINET
- ⑨ ALARM LIGHT AND HORN
- ⑩ GAS DETECTION SYSTEM CONTROL PANEL (WETWELL) (ABOVE)

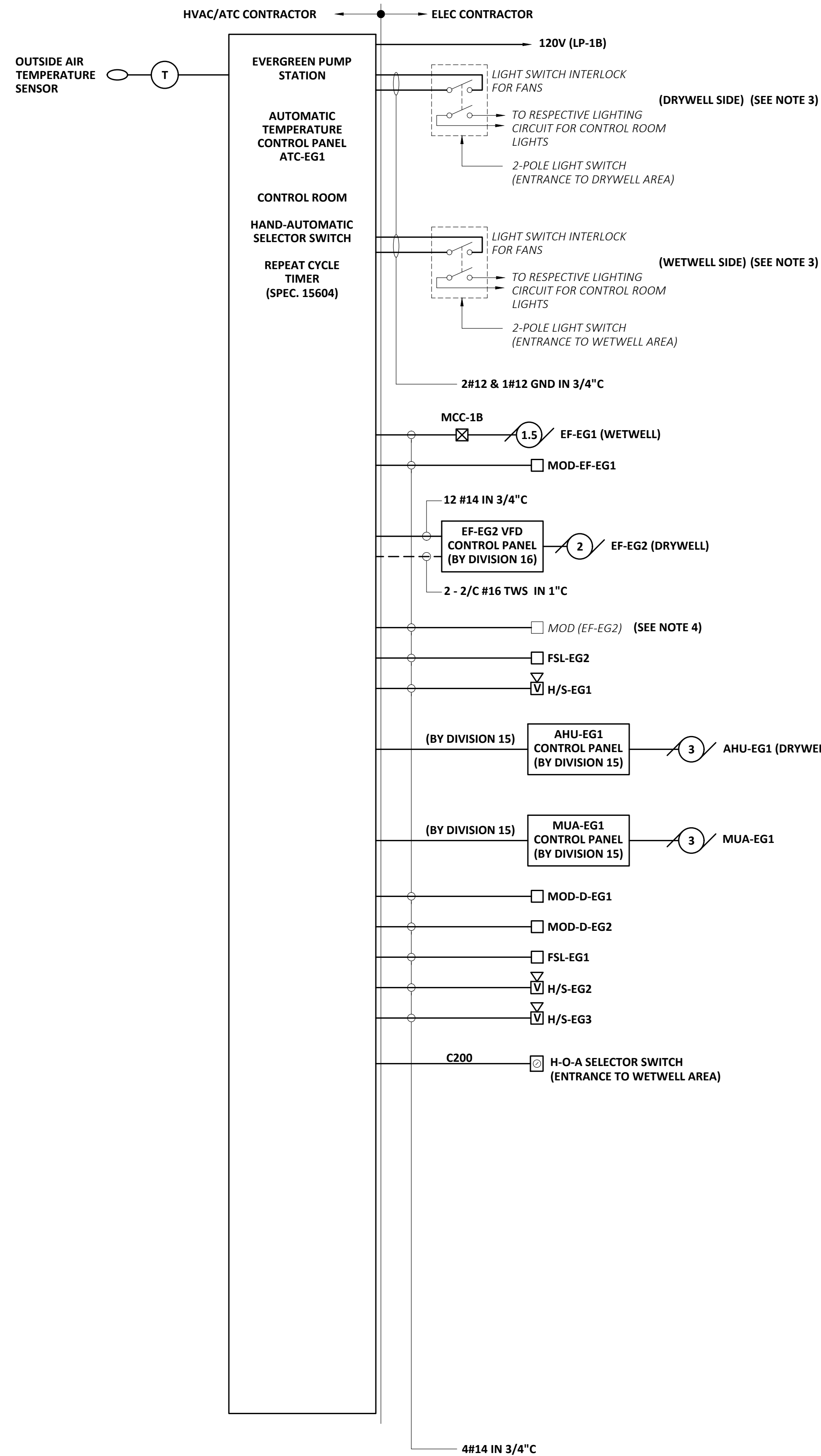
NO	CONTRACT DRAWINGS	DATE
1	ADAM	12-20
2	BBB	
3	D GU	
4	ADAM	
5	NOVEMBER 2020	
6	CABE	
7	DECEMBER 2020	
8	20483	

DESIGNED BY: ADAM
 CAD CORP: BBB
 CD: D GU
 CHECKED BY: ADAM
 DATE: NOVEMBER 2020
 APPROVED BY: CABE
 DATE: DECEMBER 2020
 PROJECT NO.: 20483

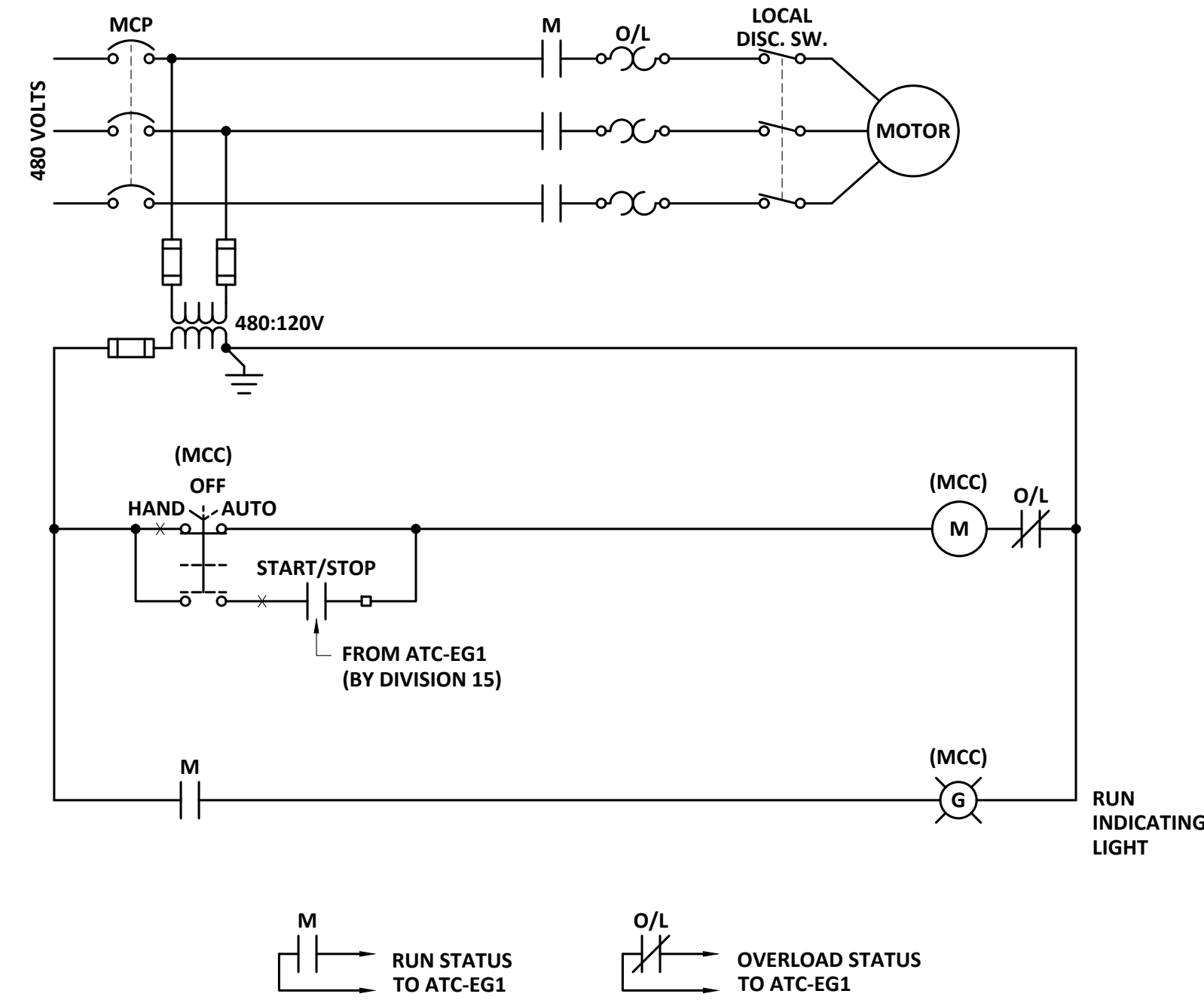


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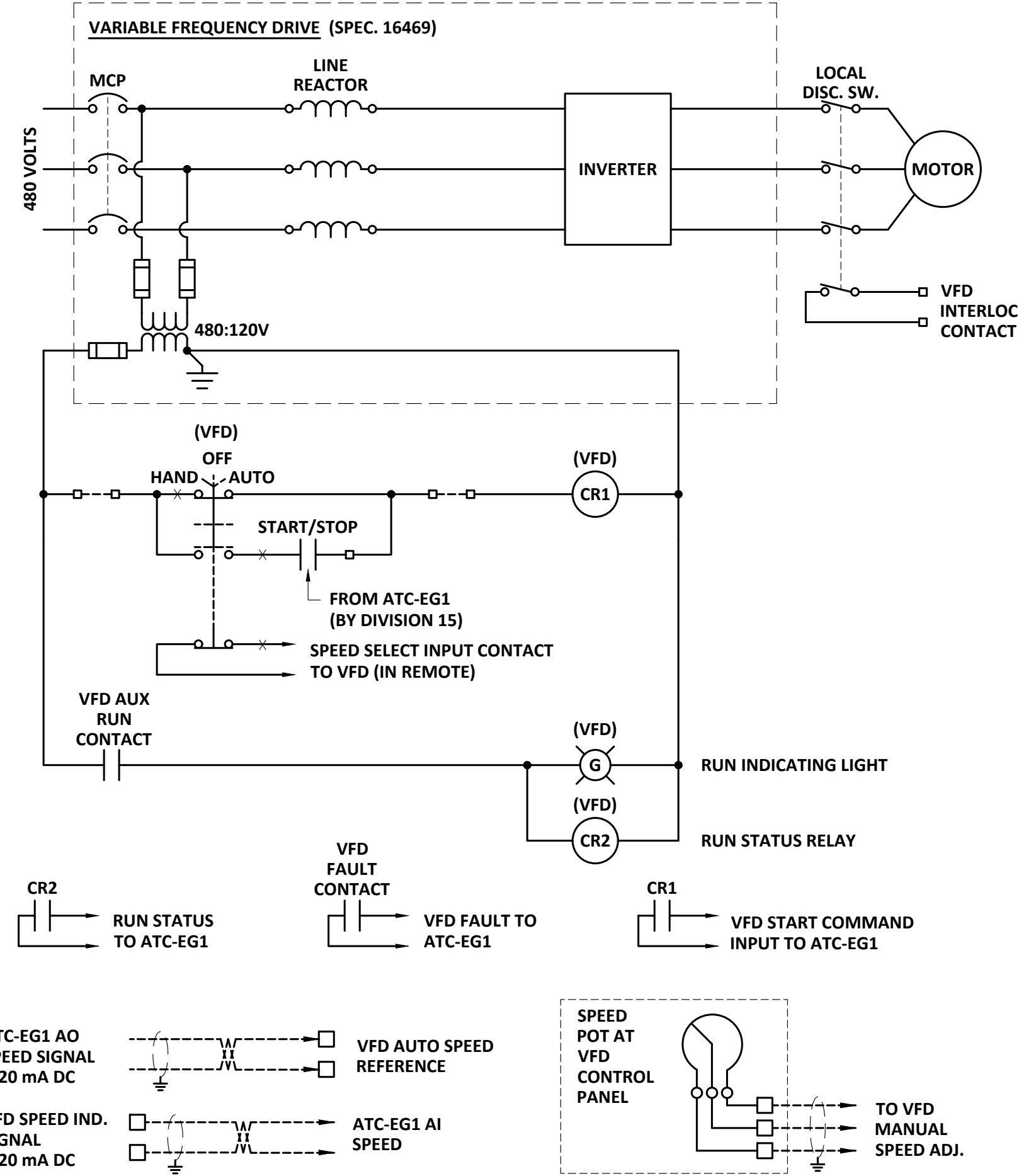
WATERFORD UTILITY COMMISSION
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 BLUE HILLS PUMP STATIONS
 HVAC IMPROVEMENTS
 EVERGREEN PUMP STATION
 ELECTRICAL, PUMP CONTROL AND GRINDER ROOM FLOOR PLAN - MODIFICATIONS
DRAWING
 E-7



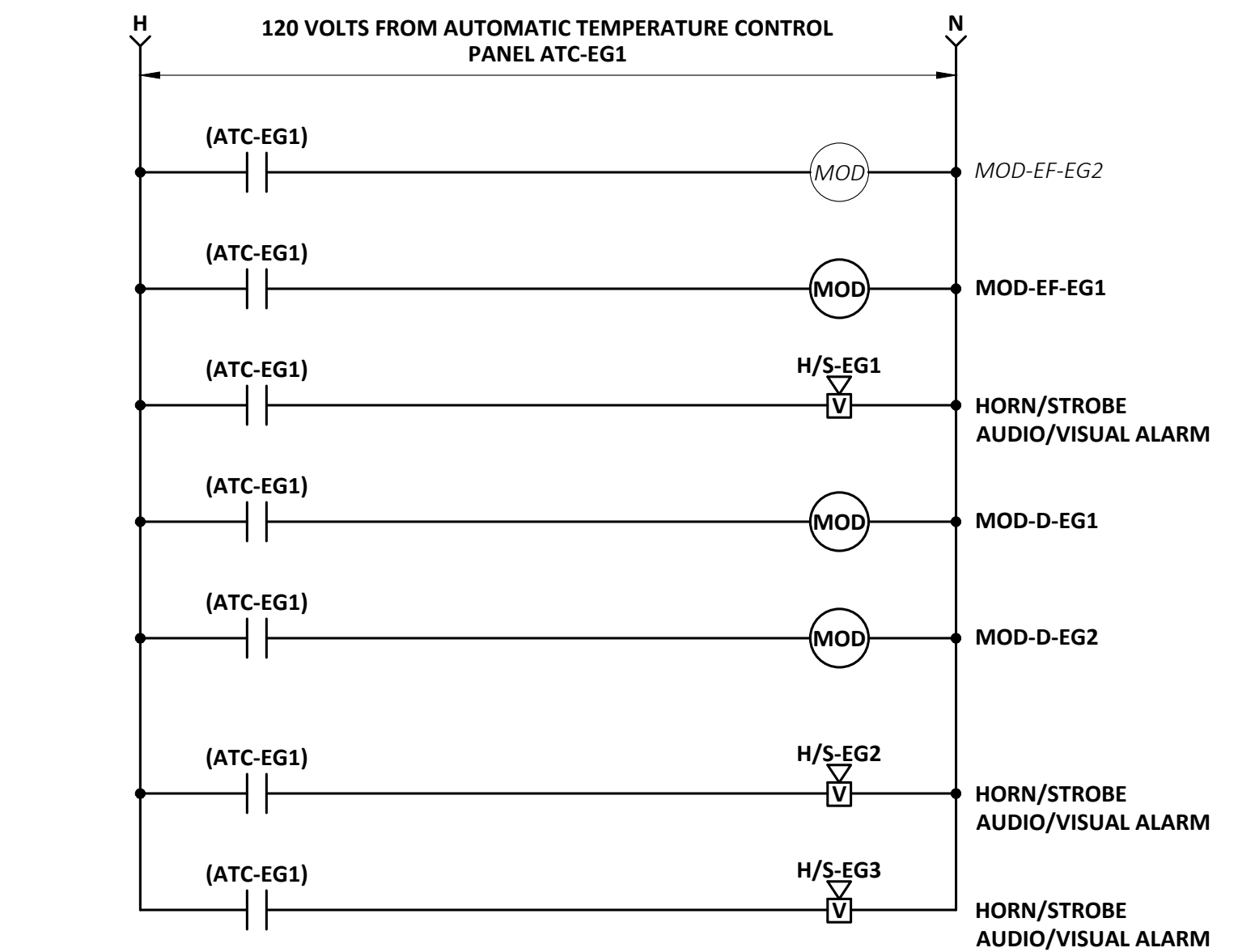
**EVERGREEN PUMP STATION
H&V WIRING DIAGRAM**
NTS



**SCHEMATIC DIAGRAM
WETWELL EXHAUST FAN EF-EG1**
NTS



**SCHEMATIC DIAGRAM
DRYWELL EXHAUST FAN EF-EG2**
NTS



**PARTIAL SCHEMATIC DIAGRAM
FOR AUTOMATIC TEMPERATURE CONTROL
PANEL ATC-EG1**
NTS
SEE NOTE 2

- NOTES:**
1. FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
 2. THIS IS A PARTIAL SCHEMATIC DIAGRAM WHICH SHOWS THE POWER FEED AND CONTROL OF THE EQUIPMENT NOTED BEING FED FROM AUTOMATIC TEMPERATURE CONTROL PANEL ATC-EG1 AT THIS LOCATION.
 3. PRESENTLY THESE EXISTING SWITCH INTERLOCKS ARE WIRED TO THE EXISTING AUTOMATIC TEMPERATURE CONTROL PANEL ATC-1 WHICH IS TO BE DEMOLISHED. THE CONTRACTOR IS RESPONSIBLE TO PROVIDE NEW CONDUIT AND WIRING FROM THIS EXISTING SWITCH INTERLOCK TO THE NEW ATC-EG1. DEMOLISH AND REMOVE ALL EXISTING CONDUIT AND WIRING TO EXISTING AUTOMATIC TEMPERATURE CONTROL PANEL ATC-1 IN ITS ENTIRETY FOR A COMPLETE DEMOLITION.
 4. THE CONTRACTOR IS RESPONSIBLE TO PROVIDE NEW CONDUIT AND WIRING TO ATC-EG1 FROM THE EXISTING MOTOR OPERATED DAMPER. THIS WAS ORIGINALLY WIRED TO ATC-1 WHICH IS TO BE DEMOLISHED.

NO	DATE	DESCRIPTION
1	12-20	CONTRACT DRAWINGS

DESIGNED BY: A.DAM	CAD CORP: BBB	DATE: NOVEMBER 2020
CREATED BY: A.DAM	DATE: NOVEMBER 2020	DATE: DECEMBER 2020
PROJECT NO.: 20488		

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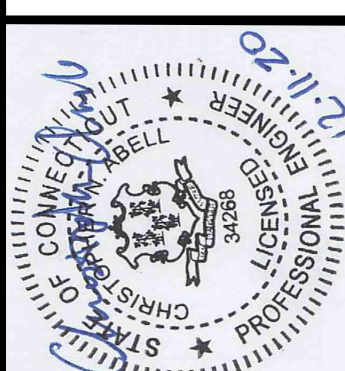

WATERFORD UTILITY COMMISSION
EVERGREEN AVENUE &
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HVAC IMPROVEMENTS
EVERGREEN PUMP STATION
SCHEMATIC DIAGRAMS

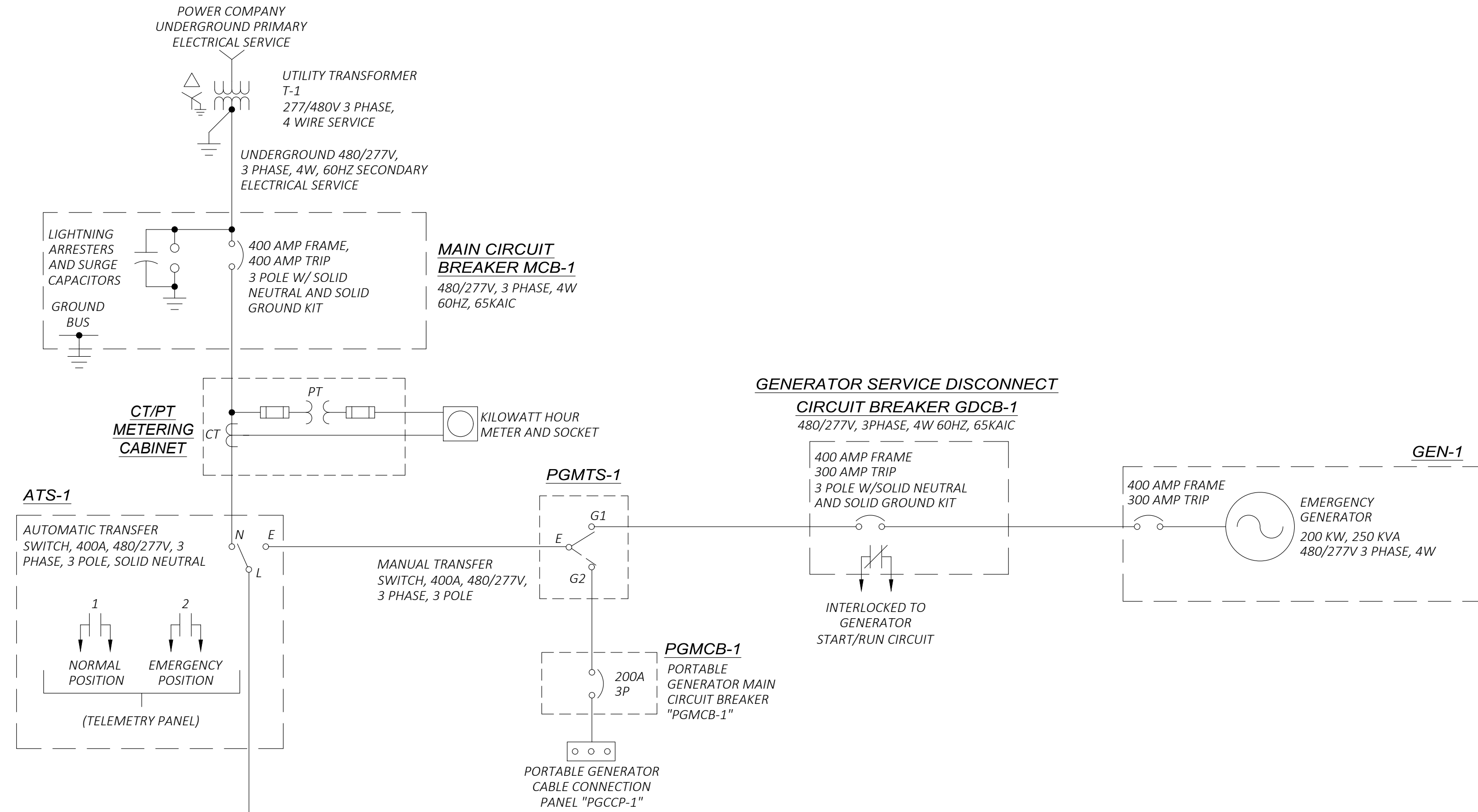
DRAWING
E-8

EVERGREEN PUMP STATION CONDUIT AND WIRE SCHEDULE						
CONDUIT NO	CONDUIT SIZE	CONDUCTOR		DESTINATION		REMARKS
		SIZE		FROM	TO	
P200	3/4"	2 #10 AND 1 #10 GND		AUTOMATIC TEMP. CONTROL PANEL ATC-EG1	PANELBOARD LP-1B	
P201	3/4"	3 #12 AND 1 #12 GND		MAKE-UP AIR UNIT MUA-EG1	MOTOR CONTROL CENTER MCC-1B	
P202	3/4"	2 #12 AND 1 #12 GND		HVAC MAINTENANCE RECEPTACLE (MUA-EG1)	PANELBOARD LP-1B	
P203	3/4"	3 #12 AND 1 #12 GND		EXHAUST FAN EF-EG1	MOTOR CONTROL CENTER MCC-1B	
P204	1"	3 #8 AND 1 #10 GND		AIR HANDLING UNIT AHU-EG1	MOTOR CONTROL CENTER MCC-1B	
P205	3/4"	2 #12 AND 1 #12 GND		HVAC MAINTENANCE RECEPTACLE (AHU-EG1)	PANELBOARD LP-1B	
P206	1-1/4"	4/C #12 SHIELDED VFD CABLE		EXHAUST FAN EF-EG2	EXHAUST FAN EF-EG1 VFD CONTROL PANEL	
P207	1"	3 #10 AND 1 #10 GND		EXHAUST FAN EF-EG1 VFD CONTROL PANEL	MOTOR CONTROL CENTER MCC-1B	
C200	3/4"	8#14		WETWELL ENTRANCE H-O-A SELECTOR SWITCH	AUTOMATIC TEMP. CONTROL PANEL ATC-EG1	

PANEL LOCATION: ELECTRICAL ROOM		PANELBOARD LP-1B		FEEDER POINT: TRANSFORMER T-1						
VOLTAGE: 120/208		MOUNTING: SURFACE		BUS RATING: 100 AMPS						
PHASE: 3		MLO		TRIP AMPS						
WIRE: 4		X		100						
AIC: 10000										
CKT NO.	AMPS	NO. POLES	DESCRIPTION	PHASE LOAD (VA)			DESCRIPTION	NO. POLES	AMPS	CKT NO.
				A	B	C				
1	20	1	LIGHTING - UPPER GRADE LEVEL	1000			RECEPTACLES - GRINDER ROOM	1	20	2
3	20	1	LIGHTING - ELECTRICAL ROOM	1200			LIGHTING - GRINDER ROOM	1	20	4
5	20	1	RECEPTACLES - UPPER GRADE LEVEL	800			LIGHTING - GRINDER ROOM	1	20	6
7	20	1	LIGHTING - PUMP CONTROL ROOM	1000			RECEPTACLES - ELECTRICAL AND PUMP ROOM	1	20	8
9	20	1	PUMP ROOM - LIGHTING	800			RECEPTACLES - ELECTRICAL AND PUMP ROOM	1	20	10
11	20	1	RELAY CONTROL PANEL	400			RECEPTACLES - ELECTRICAL AND PUMP ROOM	1	20	12
13	20	1	SPARE	800			EXTERIOR LIGHTING FIXTURES	1	20	14
15	30	1	SUMP PUMP	600			RECEPTACLES - SAMPLER AND SINK	1	20	16
17	20	1	SPARE	1800			PUMP CONTROL PANEL	1	30	18
19	20	1	SPARE	600			HOT WATER HEATER	1	30	20
21	20	1	TELEMETRY CONTROL PANEL	1200			EMERGENCY LIGHTING AND EXIT SIGNAGE	1	20	22
23	50	3	FEEDER TO GENERATOR ENCLOSURE PANELBOARD	3000			SPARE	1	20	24
25				3500			OUTSIDE POLE MOUNTED LIGHTING	1	20	26
27				400			AUTOMATIC TEMPERATURE CONTROL PANEL ATC-EG1	1	30	28
29	30	1	SPARE	3500			HVAC MAINTENANCE RECEPTACLE (MUA-EG1)	1	20	30
31	20	1	HVAC MAINTENANCE RECEPTACLE (AHU-EG1)	2500			SPARE	1	20	32
33	20	1	SPARE	200			SPARE	1	20	34
35	20	1	SPARE				SPARE	1	20	36
37	20	1	SPARE				SPARE	1	20	38
39	20	1	SPARE				SPARE	1	20	40
41	20	1	SPARE				SPARE	1	20	42
SUB-TOTAL				11500	12600	7700				
TOTAL						31800				
ESTIMATED DEMAND LOAD				31.8		KVA				
DEMAND LINE CURRENT				88		AMP				

- NOTES:**
- FOR LEGEND AND GENERAL NOTES, REFER TO DRAWINGS E-1 AND E-2.
 - ALL MOTOR FEEDER WIRING ORIGINATING FROM VARIABLE FREQUENCY DRIVE (VFD) PANELS SHALL BE INSTALLED IN RIGID GALVANIZED STEEL CONDUIT OR PVC-COATED RIGID STEEL CONDUIT, IN ACCORDANCE WITH THE NEMA CLASSIFICATIONS INDICATED ON DRAWING E-1.
 - ALL INSTRUMENTATION SIGNAL CABLES (IN CONDUITS WITH "S" NUMBERS) SHALL BE INSTALLED IN RIGID GALVANIZED STEEL CONDUIT, IMC, OR PVC-COATED RIGID STEEL CONDUIT, IN ACCORDANCE WITH NEMA RATING OF THE AREA OF INSTALLATION AS INDICATED ON DRAWING E-1. REFER TO SPECIFICATION SECTION 16050 FOR FURTHER INFORMATION.

DESIGNED BY: A.DAM CAD CORP.: BBB D.G.U.	CREATED BY: A.DAM DATE: NOVEMBER 2020	APPROVED BY: C.ABE DATE: DECEMBER 2020	PROJECT NO.: 20483	NO.	SUBMISSIONS/REVISIONS	APP'D	DATE
						DAD	12-20
							
WATERFORD UTILITY COMMISSION EVERGREEN AVENUE & BLUE HILLS PUMP STATIONS HVAC IMPROVEMENTS				EVERGREEN PUMP STATION CONDUIT AND WIRE SCHEDULE			
DRAWING				F-9			



SPACE	MLO	9	15	20
SPACE	4	10	16	21
1	5	11	17	22
	6	12	18	23
2	7	13	19	SPACE
3	8	14	SPACE	24

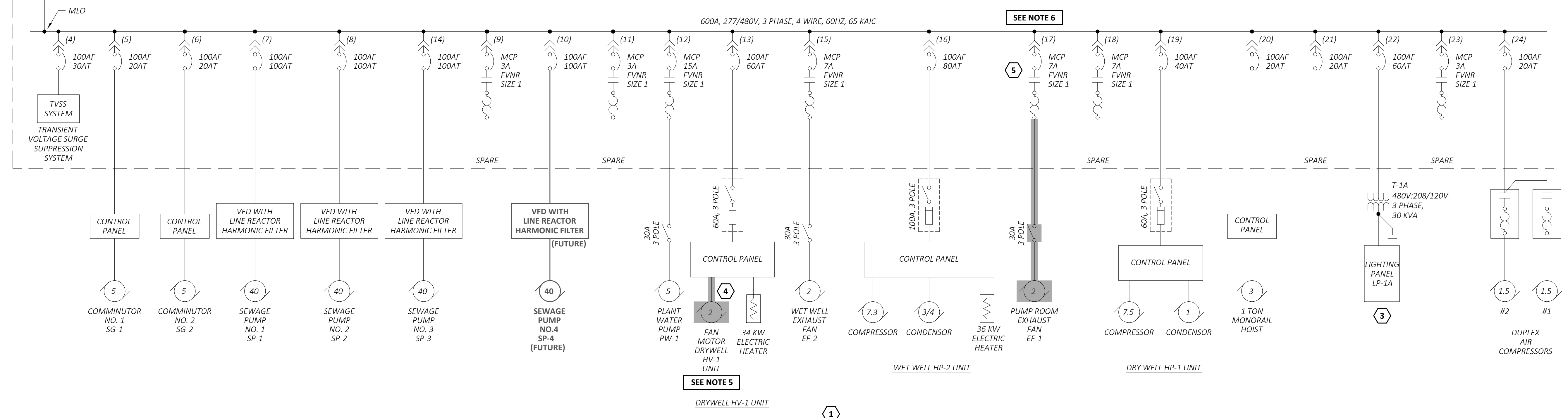
SEE NOTES THIS DRAWING
MOTOR CONTROL CENTER MCC-1
 FRONT ELEVATION
 NTS

SEE NOTE 6

- NOTES:**
- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
 - INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
 - THE EXISTING MOTOR CONTROL CENTER MCC-1 IS A FREEDOM SERIES 2100 AS MANUFACTURED BY CUTLER-HAMMER CORPORATION. THE EXISTING MOTOR CONTROL CENTER SHALL BE MODIFIED AS SHOWN ON THIS DRAWING AND THE DEMOLITION AND MODIFICATION DRAWINGS. REFER TO THIS DRAWING AND THE CONTRACT DRAWINGS FOR ADDITIONAL INFORMATION ON DEMOLITION AND MODIFICATION REQUIREMENTS TO THIS MOTOR CONTROL CENTER AND ASSOCIATED CONNECTED EXISTING EQUIPMENT.
 - UPON DISCONNECTION OF EXISTING CABLES/BUSSING, CLEAN, INSPECT, CLEAN AND CHECK FOR PROPER TERMINATIONS TO EXISTING EQUIPMENT WHICH IS TO REMAIN. ANY TERMINATIONS, LUGS, CLAMPS, ETC., WHICH REQUIRE REPLACEMENT OR ARE FOUND TO BE DEFICIENT OR NOT SERVICEABLE, SHALL BE PROVIDED AS PART OF THE WORK OF THIS CONTRACT. PROVIDE NEW LAMACOID NAMEPLATE ON THE FRONT OF THE COMPARTMENT DOOR TO READ "SPARE CIRCUIT BREAKER" OR "SPARE STARTER" AS APPLICABLE OR AS NOTED FOR THE MODIFICATION AND USE OF THIS EQUIPMENT. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
 - THE EXISTING FAN MOTOR SHALL BE REPLACED WITH A NEW TWO SPEED MOTOR. REFER TO THE MODIFICATION DRAWINGS FOR ADDITIONAL REQUIREMENTS.
 - RELOCATE THE EXISTING STARTER FROM COMPARTMENT 17 TO COMPARTMENT NOTED FOR A COMPLETE RELOCATION. PROVIDE A LAMACOID NAMEPLATE ATTACHED TO THE DOOR TO READ "SPARE STARTER". REFER TO THE MODIFICATION DRAWINGS FOR ADDITIONAL REQUIREMENTS.

- DEMOLITION NOTES:**
- ELECTRICAL EQUIPMENT INDICATED WITH SHADING SHALL BE DISCONNECTED AND REMOVED IN ITS ENTIRETY FOR A COMPLETE DEMOLITION. REFER TO NOTE 1 THIS DRAWING.
 - ELECTRICAL EQUIPMENT INDICATED SHALL REMAIN AND BE MODIFIED AS SHOWN AND NOTED ON THIS DRAWING AND THE MODIFICATION DRAWINGS. REFER TO NOTE 4 THIS DRAWING FOR ADDITIONAL REQUIREMENTS.
 - THE EXISTING PANELBOARD LP-1A SHALL REMAIN AND BE MODIFIED AS INDICATED IN THE PANELBOARD SCHEDULE THIS DRAWING AND ON THE MODIFICATION DRAWINGS. DISCONNECT AND REMOVE IN ITS ENTIRETY ALL CONDUIT AND WIRING ASSOCIATED WITH THE EQUIPMENT SHOWN AS BEING DEMOLISHED FOR A COMPLETE DEMOLITION. PROVIDE A NEW TYPED WRITTEN PANELBOARD DIRECTORY TO REFLECT ALL MODIFICATIONS ASSOCIATED WITH THE WORK OF THIS CONTRACT.
 - DISCONNECT AND REMOVE IN ITS ENTIRETY THE EXISTING SINGLE SPEED FAN MOTOR INCLUDING ALL ASSOCIATED CONDUIT AND WIRING FOR A COMPLETE DEMOLITION.
 - UPON REMOVAL OF THE EXISTING CONNECTED EQUIPMENT AND ASSOCIATED CONNECTIONS THE EXISTING STARTER COMPARTMENT #17 SHALL BE REMOVED AND SHALL BE RELOCATED TO ANOTHER COMPARTMENT AS NOTED. REFER TO THE MODIFICATION DRAWINGS FOR ADDITIONAL REQUIREMENTS. PROVIDE A NEW STARTER IN THE LOCATION OF COMPARTMENT #17 AS SHOWN ON THE MODIFICATION DRAWINGS.

MOTOR CONTROL CENTER MCC-1



SEE NOTE 5

SEE NOTES THIS DRAWING

BLUE HILLS PUMP STATION
MOTOR CONTROL CENTER MCC-1
 SINGLE LINE DIAGRAM - DEMOLITION
 NTS

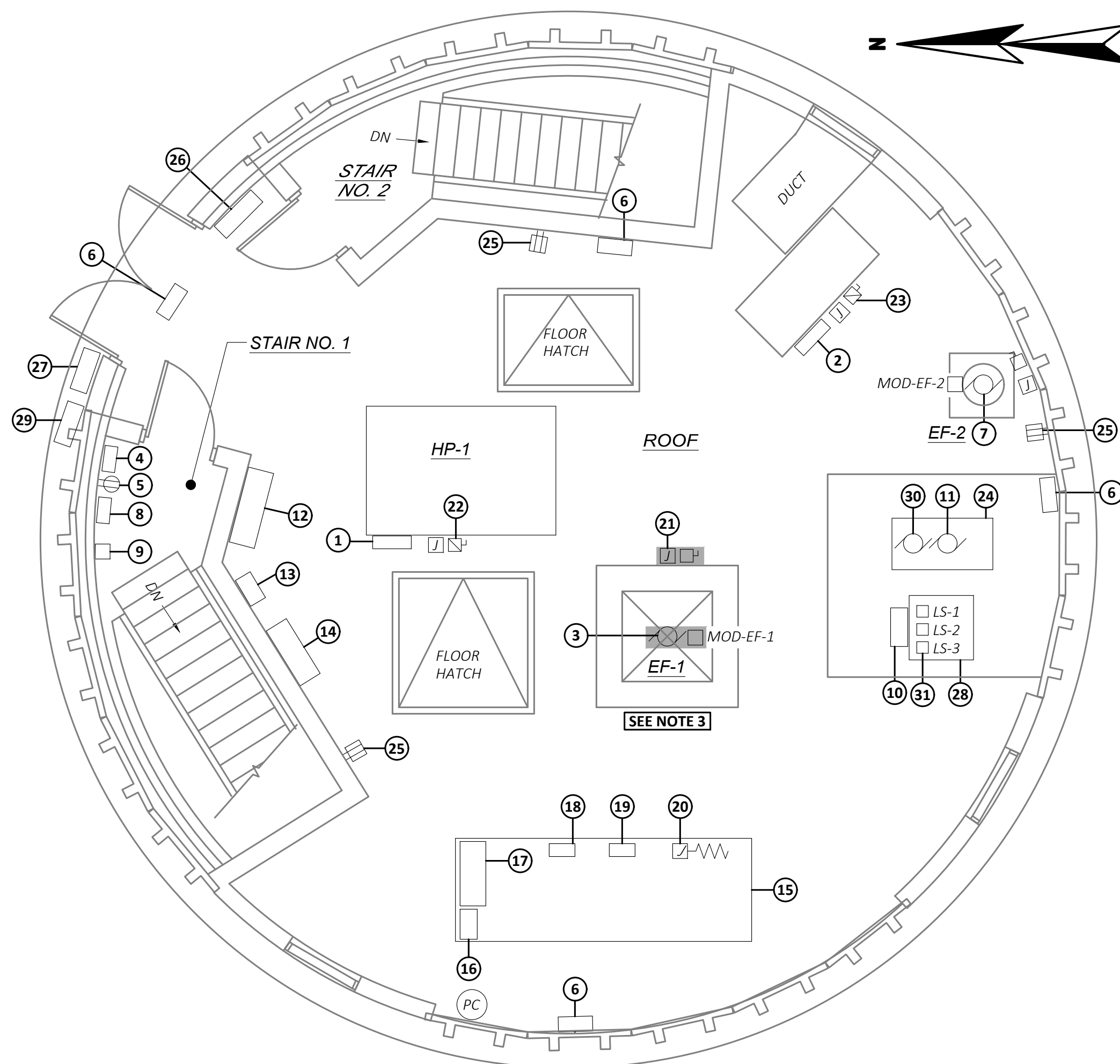
APP'D	DATE
DAD	12-20
DESIGNED BY: A.DAM	NO
CAD CORP.: BBB	NO
CREATED BY: A.DAM	NO
CHECKED BY: D.GUJ	NO
DATE: NOVEMBER 2020	NO
APPROVED BY: A.DAM	NO
DATE: DECEMBER 2020	NO
PROJECT NO.: 20488	NO

WATERFORD UTILITY COMMISSION
 EVERGREEN AVENUE &
 BLUE HILLS PUMP STATIONS
 HVAC IMPROVEMENTS

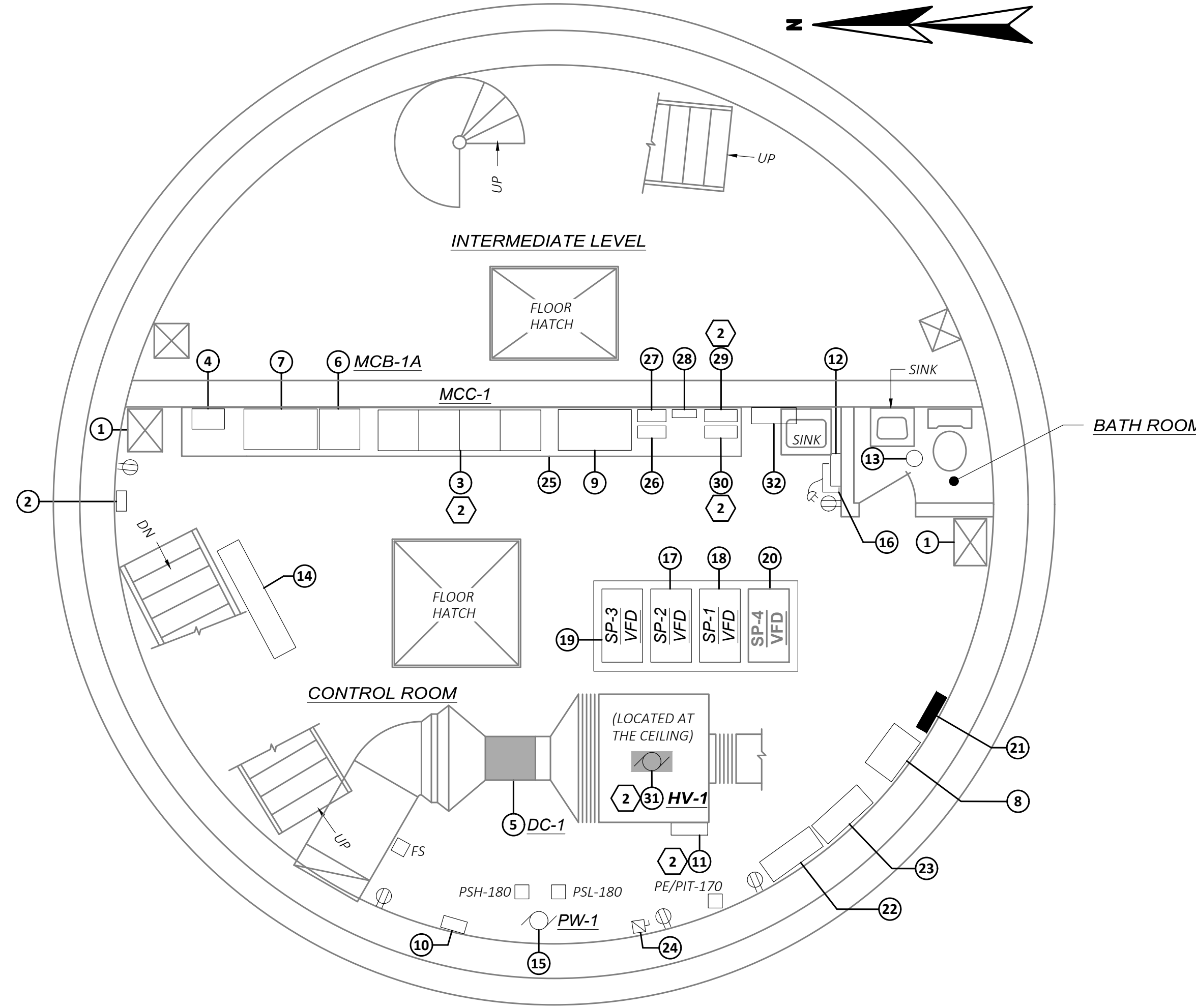
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BLUE HILLS PUMP STATION
 MOTOR CONTROL CENTER MCC-1 SINGLE LINE DIAGRAM - DEMOLITION

DRAWING
 E-10



**BLUE HILLS PUMP STATION
ROOF PLAN - DEMOLITION**
SCALE: 1/4" = 1'-0"



**BLUE HILLS PUMP STATION
CONTROL ROOM FLOOR PLAN - DEMOLITION**
SCALE: 1/4" = 1'-0"

ROOF PLAN EQUIPMENT LEGEND:

- ① DRY WELL HP-1 UNIT CONTROL PANEL
- ② WET WELL HP-2 UNIT CONTROL PANEL
- ③ EXHAUST FAN EF-1 - TO BE REMOVED (SEE NOTE 3)
- ④ GAS MONITORING SYSTEM CONTROL PANEL (WETWELL)
- ⑤ RECEPTACLE (TYP)
- ⑥ METAL HALIDE WALLPACK LIGHT FIXTURE
- ⑦ EXHAUST FAN EF-2
- ⑧ GAS MONITORING CONTROL PANEL (DRYWELL)
- ⑨ GAS SENSOR
- ⑩ DAY TANK CONTROL PANEL
- ⑪ DAY TANK TRANSFER PUMP NO. 2
- ⑫ PORTABLE GENERATOR CABLE CONNECTION PANEL
- ⑬ PORTABLE GENERATOR MAIN CIRCUIT BREAKER PGMCB-1
- ⑭ PORTABLE GENERATOR MANUAL TRANSFER SWITCH PGMTS-1
- ⑮ STAND-BY EMERGENCY GENERATOR GEN-1
- ⑯ STAND-BY EMERGENCY GENERATOR MAIN CIRCUIT BREAKER
- ⑰ STAND-BY EMERGENCY GENERATOR CONTROL PANEL
- ⑱ STAND-BY EMERGENCY GENERATOR BATTERY CHARGER
- ⑲ STAND-BY EMERGENCY GENERATOR BATTERIES
- ⑳ STAND-BY EMERGENCY GENERATOR BLOCK HEATER
- ㉑ EXHAUST FAN EF-1 JUNCTION BOX AND DISCONNECT SWITCH - TO BE REMOVED (SEE NOTE 3)
- ㉒ HP-1 UNIT CONTROL PANEL DISCONNECT SWITCH
- ㉓ HP-2 UNIT CONTROL PANEL DISCONNECT SWITCH
- ㉔ FUEL TRANSFER PUMP CONTROL PANEL
- ㉕ GFI TYPE RECEPTACLE
- ㉖ ROOF LIGHTING CONTROL PANEL (RLCP-1)
- ㉗ GENERATOR SERVICE DISCONNECT CIRCUIT BREAKER GDCB-1
- ㉘ 200 GALLON DAY TANK
- ㉙ EMERGENCY GENERATOR E-STOP
- ㉚ DAY TANK TRANSFER PUMP NO. 1
- ㉛ DAY TANK LEVEL SWITCHES

PANEL LOCATION: CONTROL ROOM				PANELBOARD LP-1A				FEEDER POINT: TRANSFORMER T-1A			
VOLTAGE: 120/208				MOUNTING: SURFACE				BUS RATING: 100 AMPS			
PHASE: 3				MAIN TYPE: X MCB				TRIP AMPS			
WIRE: 4											
AIC: 10000											
CKT NO.	AMPS	NO. POLES	DESCRIPTION	PHASE LOAD (VA)			DESCRIPTION	NO. POLES	AMPS	CKT NO.	
				A	B	C					
1	20	1	BLOCK HEATER					1	30	2	
3	20	1	BATTERY CHARGER				DAY TANK	1	20	4	
5	30	1					ALARM PANEL	1	20	6	
7	20	1	CONTROL ROOM OUTLETS				ATC PANELS (ATC-1) AND ATC-2 - SEE NOTE 8	1	20	8	
9	20	1	ROOF LIGHTS				PUMP CONTROL PANEL	1	20	10	
11	20	1	ROOF OUTLETS				CONTROL ROOM LIGHTS	1	20	12	
13	20	2	SUMP PUMP				PUMP CONTROL PANEL	1	20	14	
15							WET WELL LIGHTS	1	20	16	
17	20	1	POLE LIGHTS				PUMP CONTROL PANEL	1	20	18	
19	20	1	PUMP ROOM OUTLETS				SPARE	1	20	20	
21	20	1	PUMP ROOM LIGHTS				GAS DETECTION	1	20	22	
23	20	1	SPARE				UNKNOWN	1	20	24	
25	20	1	SPARE				SPARE	1	20	26	
27	20	1	SPARE				SPARE	1	20	28	
29	20	1	SPARE				SPARE	1	20	30	
31	20	1	SPARE				SPARE	1	20	32	
33	20	1	SPARE				SPARE	1	20	34	
35	20	1	SPARE				SPARE	1	20	36	
37	20	1	SPARE				SPARE	1	20	38	
39	20	1	SPARE				SPARE	1	20	40	
41	20	1	SPARE				SPARE	1	20	42	
SUB-TOTAL											

ESTIMATED DEMAND LOAD --- KVA
DEMAND LINE CURRENT --- AMP

SEE NOTE 9

- NOTES:**
- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
 - INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
 - THE EQUIPMENT LOCATED ON THE ROOF HAS BEEN INSTALLED IN A SPECIAL MANNER. THE UPPER ROOF AREA IS A SEALED MEMBRANE TYPE ROOF. ALL CONDUIT PENETRATIONS HAVE BEEN SEALED IN A SPECIFIC MANNER. THE CONTRACTOR SHALL RE-USE EXISTING CONDUITS WHEREVER POSSIBLE AT THIS LOCATION ONLY OR SHALL BE RESPONSIBLE TO SEAL ALL ROOF PENETRATIONS IN THE SPECIFIC MANNER REQUIRED FOR THE INSTALLATION FOR THE SPECIAL ROOF PENETRATION REQUIRED.
 - THE EXISTING HV-1 SINGLE SPEED FAN MOTOR SHALL BE DISCONNECTED AND REMOVED AND SHALL BE REPLACED WITH A NEW TWO SPEED MOTOR. THE HV-1 UNIT CONTROL PANEL SHALL BE MODIFIED BY DIVISION 15 FOR A NEW TWO SPEED STARTER AND ASSOCIATED CONTROLS. DIVISION 16 SHALL DISCONNECT AND RE-CONNECT THE NEW MOTOR FOR THIS INSTALLATION AS NOTED.
 - THERE ARE NO ELECTRICAL REQUIREMENTS FOR THIS DEHUMIDIFICATION COIL, HOWEVER, REFER TO THE MODIFICATION DRAWINGS FOR ADDITIONAL REQUIREMENTS FOR THIS EQUIPMENT. THIS IS A MECHANICAL MODIFICATION ONLY.
 - THE EXISTING ELECTRICAL EQUIPMENT INDICATED SHALL REMAIN AND SHALL BE MODIFIED AS SHOWN ON THE SCHEMATIC DIAGRAM DRAWING.
 - NOT USED
 - THE EXISTING PANELBOARD SCHEDULE DIRECTORY HAS BEEN UPDATED TO INCLUDE THE ATC PANELS FED FROM THIS CIRCUIT.
 - REFER TO THE ROOF AND CONTROL ROOM FLOOR PLANS - MODIFICATIONS DRAWINGS FOR REVISED PANELBOARD LP-1A SCHEDULE AND FINAL ESTIMATED DEMAND LOAD INFORMATION.

- DEMOLITION NOTES:**
- ELECTRICAL EQUIPMENT INDICATED WITH SHADING SHALL BE DISCONNECTED AND REMOVED IN ITS ENTIRETY FOR A COMPLETE DEMOLITION. REFER TO NOTE 1 THIS DRAWING.
 - ELECTRICAL EQUIPMENT INDICATED SHALL REMAIN AND BE MODIFIED AS SHOWN AND NOTED ON THE DEMOLITION AND MODIFICATION DRAWINGS.

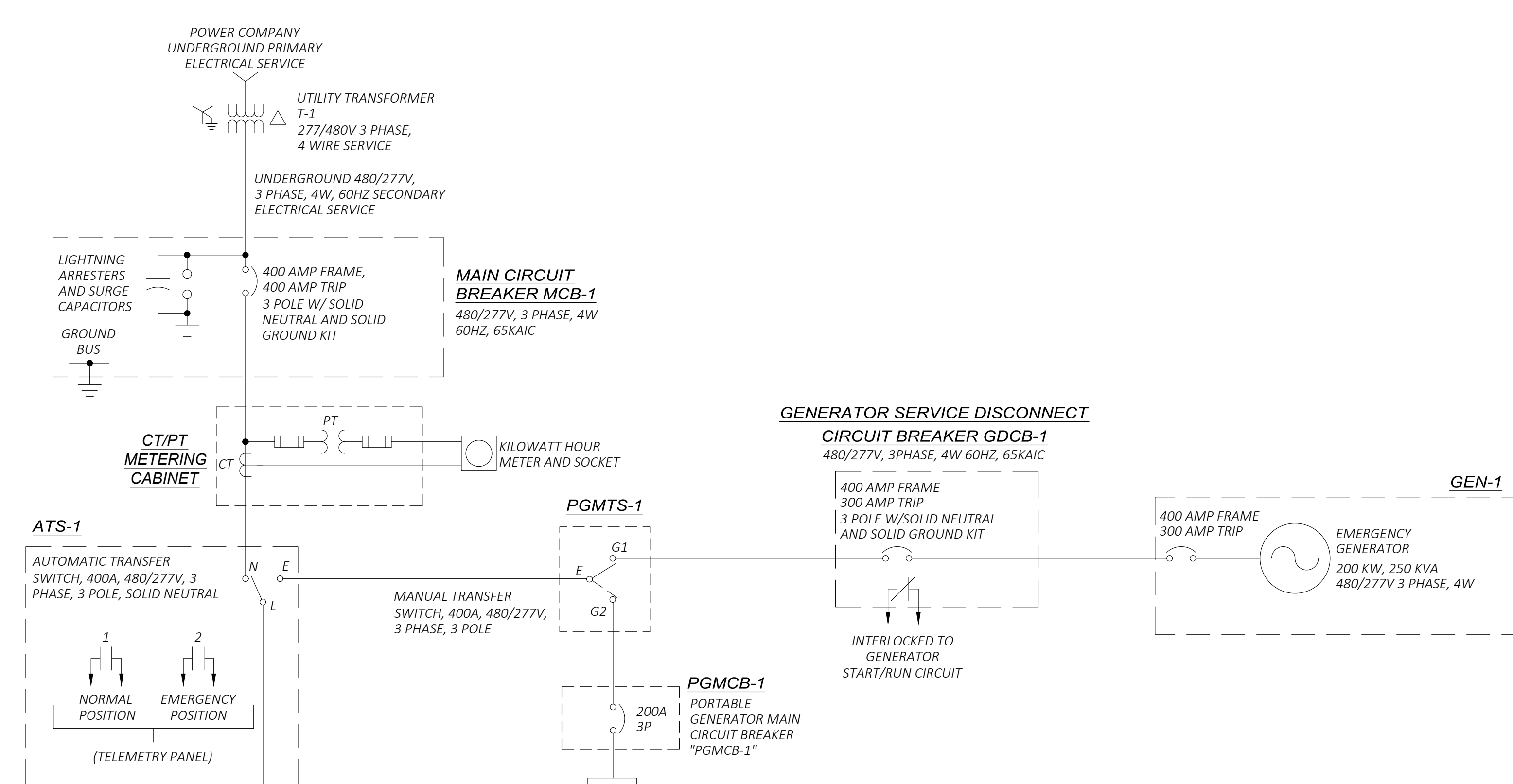
- CONTROL ROOM EQUIPMENT LEGEND:**
- HVAC DUCT
 - 24 HOUR TIME SWITCH (EXTERIOR LIGHTS)
 - MOTOR CONTROL CENTER MCC-1 SECTIONS
 - COMMUNOTOR NO. 1 CONTROL PANEL
 - DEHUMIDIFICATION COIL DC-1 - TO BE MODIFIED (SEE NOTE 5)
 - MAIN CIRCUIT BREAKER SECTION MCB-1A SECTION
 - AUTOMATIC TRANSFER SWITCH ATS-1 SECTION
 - 30 KVA DRY TYPE TRANSFORMER T-1A
 - PUMP CONTROL/TELEMETRY CONTROL PANEL
 - BATTERY CHARGER
 - DRY WELL HV-1 UNIT CONTROL PANEL - TO BE MODIFIED (SEE NOTE 4)
 - COMMUNOTOR NO. 2 CONTROL PANEL
 - BATH ROOM LIGHT FIXTURE
 - FILE CABINET
 - PLANT WATER PUMP PW-1
 - POINT OF USE WATER HEATER
 - SEWAGE PUMP NO. 1 SP-1 VFD CONTROL PANEL
 - SEWAGE PUMP NO. 2 SP-2 VFD CONTROL PANEL
 - SEWAGE PUMP NO. 3 SP-3 VFD CONTROL PANEL
 - FUTURE SEWAGE PUMP NO. 4 SP-4 VFD CONTROL PANEL
 - LIGHTING PANEL LP-1A - TO BE MODIFIED
 - TELEPHONE INTERFACE EQUIPMENT
 - AQUATROL TELEMETRY PANEL RTU-0010 (CONNELLY PANEL)
 - HV-1 UNIT CONTROL PANEL DISCONNECT SWITCH
 - CONCRETE PAD LOCATED BELOW EQUIPMENT
 - GAS DETECTION SYSTEM RELAY CONTROL PANEL RCP (BELOW)
 - ISB RELAY CONTROL PANEL (ABOVE)
 - FLOW INDICATING TRANSMITTER
 - AUTOMATIC TEMPERATURE CONTROL PANEL ATC-1 (ABOVE) - TO BE MODIFIED (SEE NOTE 6)
 - AUTOMATIC TEMPERATURE CONTROL PANEL ATC-2 (BELOW)
 - HV-1 FAN MOTOR - TO BE REMOVED (SEE NOTE 4)
 - BUBBLER SYSTEM CONTROL PANEL

APP'D	DATE
DAD	12-20
SUBMISSIONS/REVISIONS	
NO	CONTRACT DRAWINGS
DESIGNED BY: A.DAM	CAD CORP.: BBB
CREATED BY: A.DAM	DATE: NOVEMBER 2020
APPROVED BY: C.ABE	DATE: DECEMBER 2020
PROJECT NO.: 20483	

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WATERFORD UTILITY COMMISSION
EVERGREEN AVENUE &
BLUE HILLS PUMP STATIONS
HVAC IMPROVEMENTS
BLUE HILLS PUMP STATION
ROOF AND CONTROL ROOM FLOOR PLANS - DEMOLITION

DRAWING
E-11



SPACE	MLO	9	15	20
SPACE	4	10	16	21
1	5	11	17	22
2	6	12	18	23
3	7	13	19	25
	8	14	SPACE	24

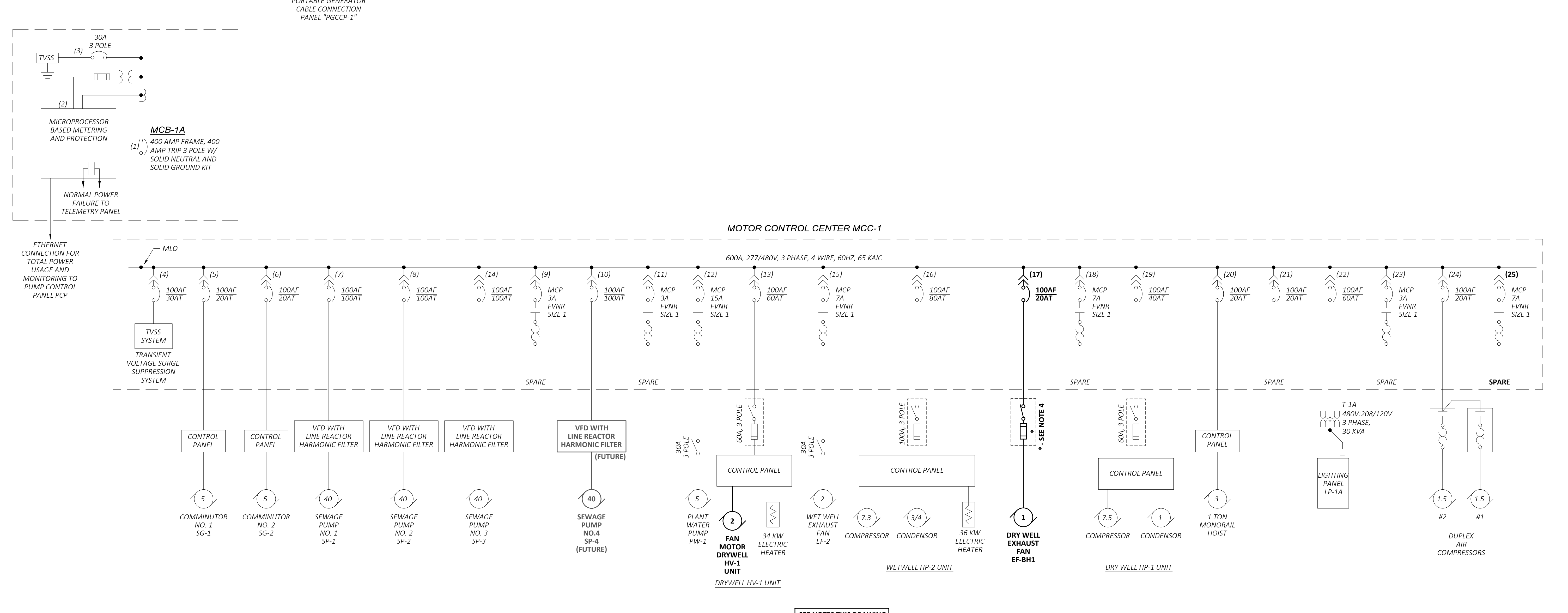
MOTOR CONTROL CENTER MCC-1 FRONT ELEVATION
NTS

- NOTES:**
- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
 - INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND SHOP DRAWINGS AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
 - THE EXISTING MOTOR CONTROL CENTER MCC IS AN EVOLUTION SERIES E9000 AS MANUFACTURED BY GENERAL ELECTRIC CORPORATION. THE EXISTING MOTOR CONTROL CENTER SHALL BE MODIFIED AS SHOWN ON THIS DRAWING AND THE DEMOLITION AND MODIFICATION DRAWINGS. REFER TO THE CONTRACT DRAWINGS FOR ADDITIONAL INFORMATION ON DEMOLITION AND MODIFICATION REQUIREMENTS TO THIS MOTOR CONTROL CENTER AND ASSOCIATED CONNECTED EXISTING EQUIPMENT.
 - THE CONTRACTOR SHALL FURNISH AND INSTALL A 3 POLE, FUSED, DISCONNECT SWITCH AS NOTED. COORDINATE, FURNISH AND INSTALL FUSES SIZED AS REQUIRED PER THE MANUFACTURER'S REQUIREMENTS FOR THIS EQUIPMENT.

NO.	DATE	DESCRIPTION
1	12-20	ISSUED FOR PERMIT
2	12-20	ISSUED FOR PERMIT
3	12-20	ISSUED FOR PERMIT
4	12-20	ISSUED FOR PERMIT

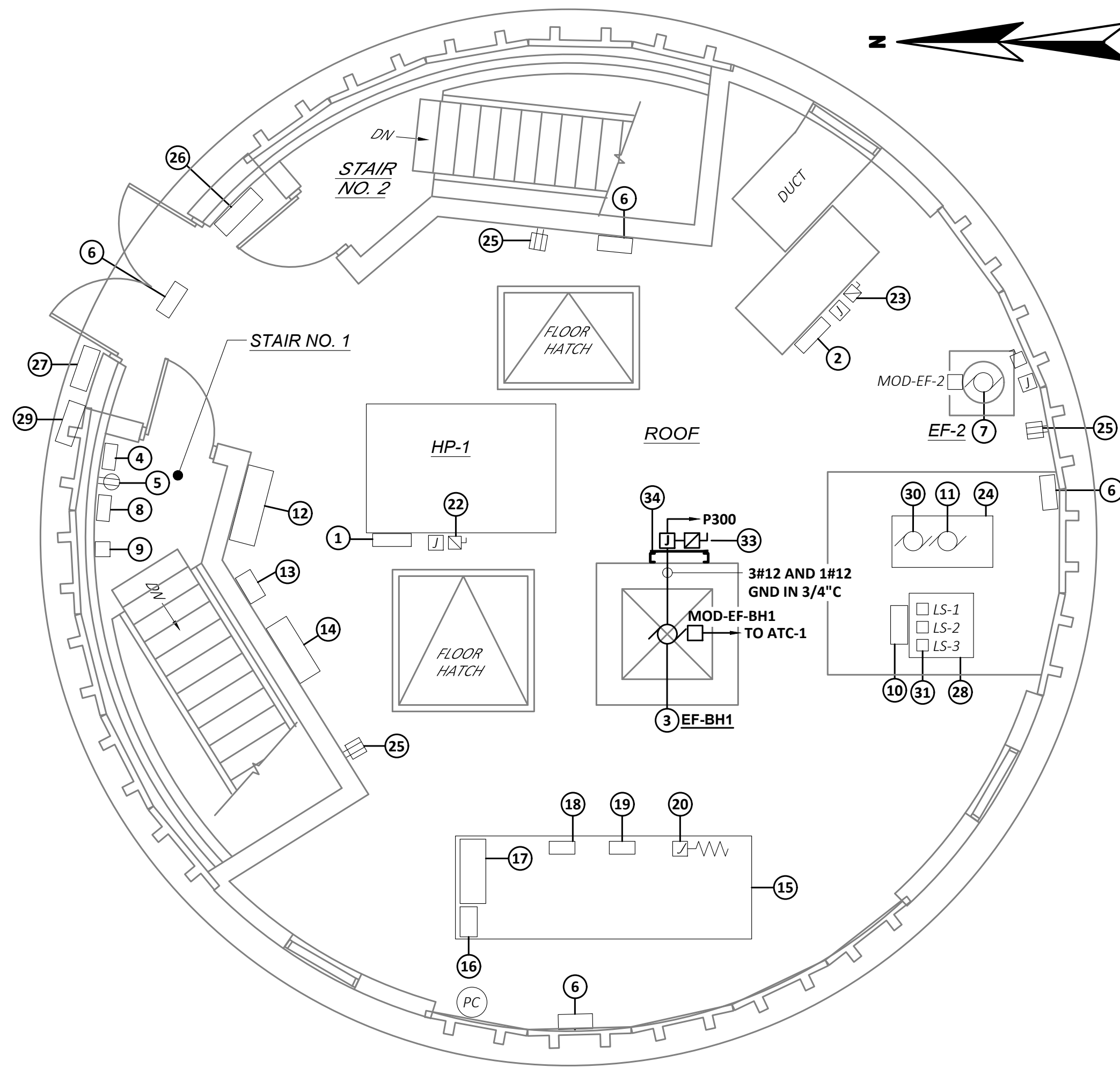
DESIGNED BY: A.DAM
 CAD CORP.: BB
 D.GU
 CHECKED BY: A.DAM
 DATE: NOVEMBER 2020
 APPROVED BY: C.A.BE
 DATE: DECEMBER 2020
 PROJECT NO.: 20483

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BLUE HILLS PUMP STATION MOTOR CONTROL CENTER MCC-1 SINGLE LINE DIAGRAM -MODIFICATIONS
NTS

WATERFORD UTILITY COMMISSION
 EVERGREEN AVENUE &
 BLUE HILLS PUMP STATIONS
 HVAC IMPROVEMENTS
 BLUE HILLS PUMP STATION
 MOTOR CONTROL CENTER MCC-1 SINGLE LINE DIAGRAM - MODIFICATIONS
DRAWING
 E-12

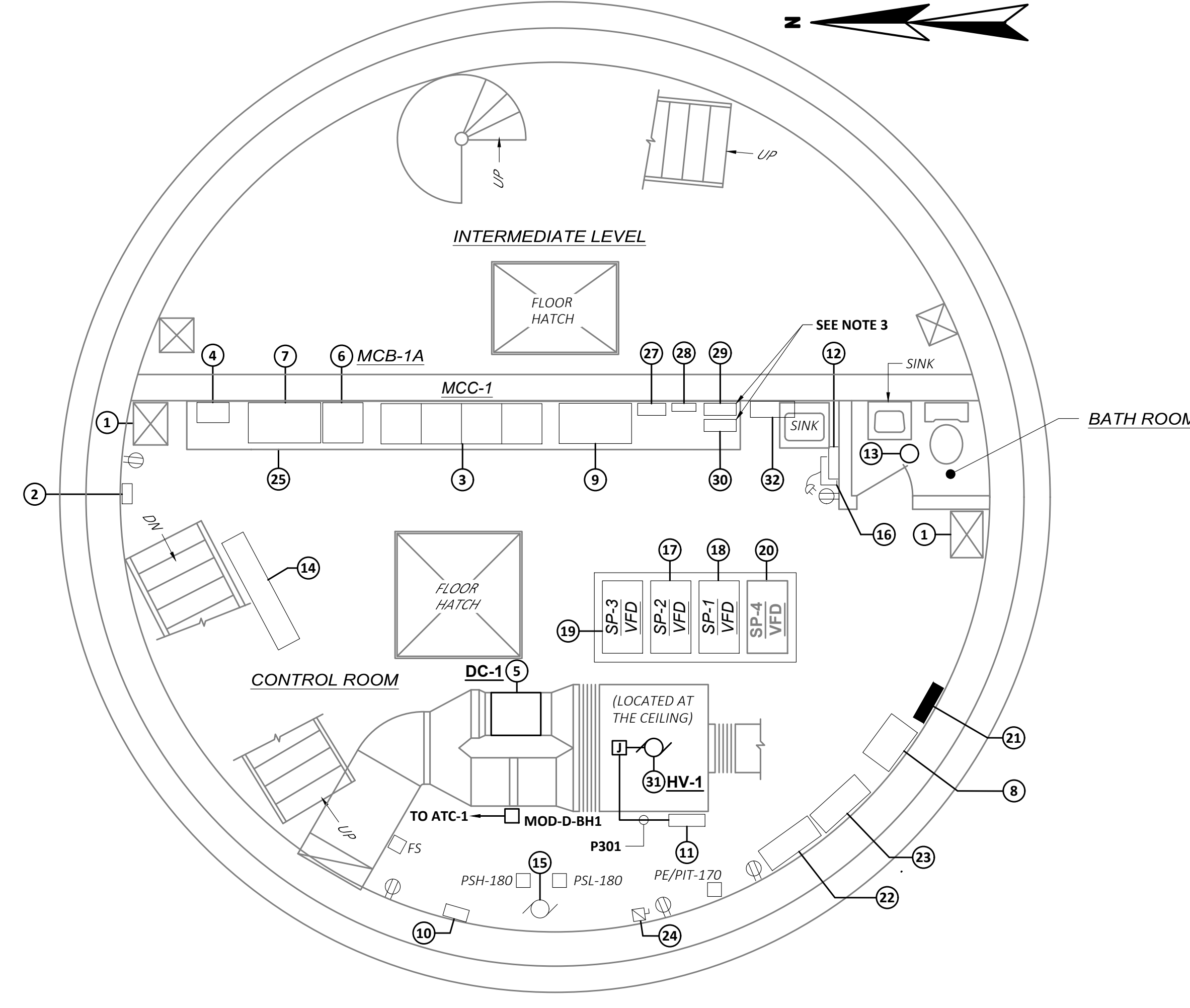


SEE NOTES THIS DRAWING

**BLUE HILLS PUMP STATION
ROOF PLAN - MODIFICATIONS**
SCALE: 1/4" = 1'-0"

ROOF PLAN EQUIPMENT LEGEND:

- 1 DRY WELL HP-1 UNIT CONTROL PANEL
- 2 WET WELL HP-2 UNIT CONTROL PANEL
- 3 EXHAUST FAN EF-BH1
- 4 GAS MONITORING CONTROL PANEL (WETWELL)
- 5 RECEPTACLE (TYP)
- 6 METAL HALIDE WALLPACK LIGHT FIXTURE
- 7 EXHAUST FAN EF-2
- 8 GAS MONITORING CONTROL PANEL (DRYWELL)
- 9 GAS SENSOR
- 10 DAY TANK CONTROL PANEL
- 11 DAY TANK TRANSFER PUMP NO. 2
- 12 PORTABLE GENERATOR CABLE CONNECTION PANEL
- 13 PORTABLE GENERATOR MAIN CIRCUIT BREAKER PGMCB-1
- 14 PORTABLE GENERATOR MANUAL TRANSFER SWITCH PGMTS-1
- 15 STAND-BY EMERGENCY GENERATOR GEN-1
- 16 STAND-BY EMERGENCY GENERATOR MAIN CIRCUIT BREAKER
- 17 STAND-BY EMERGENCY GENERATOR CONTROL PANEL
- 18 STAND-BY EMERGENCY GENERATOR BATTERY CHARGER
- 19 STAND-BY EMERGENCY GENERATOR BATTERIES
- 20 STAND-BY EMERGENCY GENERATOR BLOCK HEATER
- 21 NOT USED
- 22 HP-1 UNIT CONTROL PANEL DISCONNECT SWITCH
- 23 HP-2 UNIT CONTROL PANEL DISCONNECT SWITCH
- 24 FUEL TRANSFER PUMP CONTROL PANEL
- 25 GFI TYPE RECEPTACLE
- 26 ROOF LIGHTING CONTROL PANEL (RLCP-1)
- 27 GENERATOR SERVICE DISCONNECT CIRCUIT BREAKER GDCB-1
- 28 200 GALLON DAY TANK
- 29 EMERGENCY GENERATOR E-STOP
- 30 DAY TANK TRANSFER PUMP NO. 1
- 31 DAY TANK LEVEL SWITCHES
- 32 NOT USED
- 33 3 POLE FUSED DISCONNECT SWITCH (BY DIVISION 16)
- SEE NOTE 5
- 34 ELECTRICAL EQUIPMENT MOUNTING STRUCTURE
- SEE NOTE 4



SEE NOTES THIS DRAWING

**BLUE HILLS PUMP STATION
CONTROL ROOM FLOOR PLAN - MODIFICATIONS**
SCALE: 1/4" = 1'-0"

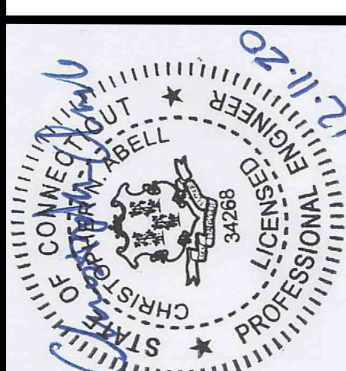
PANEL LOCATION: CONTROL ROOM			PANELBOARD LP-1A			FEEDER POINT: TRANSFORMER T-1A MOUNTING: SURFACE BUS RATING: 100 AMPS MAIN TYPE: { X } MCB { } MLO TRIP AMPS					
CKT NO.	AMPS	NO. POLES	DESCRIPTION	PHASE LOAD (VA)			DESCRIPTION	NO. POLES	AMPS	CKT NO.	
				A	B	C					
1	20	1	BLOCK HEATER	1400				1	30	2	
3	20	1	BATTERY CHARGER	400	600		DAY TANK	1	20	4	
5	30	1			400		ALARM PANEL	1	20	6	
7	20	1	CONTROL ROOM OUTLETS	800	1200		ATC PANELS (ATC-1) AND ATC-2	1	20	8	
9	20	1	ROOF LIGHTS	800	600		PUMP CONTROL PANEL	1	20	10	
11	20	1	ROOF OUTLETS	800	800	1100	CONTROL ROOM LIGHTS	1	20	12	
13	20	2	SUMP PUMP	1000	600		PUMP CONTROL PANEL	1	20	14	
15				1000	800		WET WELL LIGHTS	1	20	16	
17	20	1	POLE LIGHTS	500	900		PUMP CONTROL PANEL	1	20	18	
19	20	1	PUMP ROOM OUTLETS	600			SPARE	1	20	20	
21	20	1	PUMP ROOM LIGHTS	1000	600		GAS DETECTION	1	20	22	
23	20	1	SPARE		400		UNKNOWN	1	20	24	
25	20	1	SPARE				SPARE	1	20	26	
27	20	1	SPARE				SPARE	1	20	28	
29	20	1	SPARE				SPARE	1	20	30	
31	20	1	SPARE				SPARE	1	20	32	
33	20	1	SPARE				SPARE	1	20	34	
35	20	1	SPARE				SPARE	1	20	36	
37	20	1	SPARE				SPARE	1	20	38	
39	20	1	SPARE				SPARE	1	20	40	
41	20	1	SPARE				SPARE	1	20	42	
SUB-TOTAL				5600	5800	4600					
TOTAL				16000							

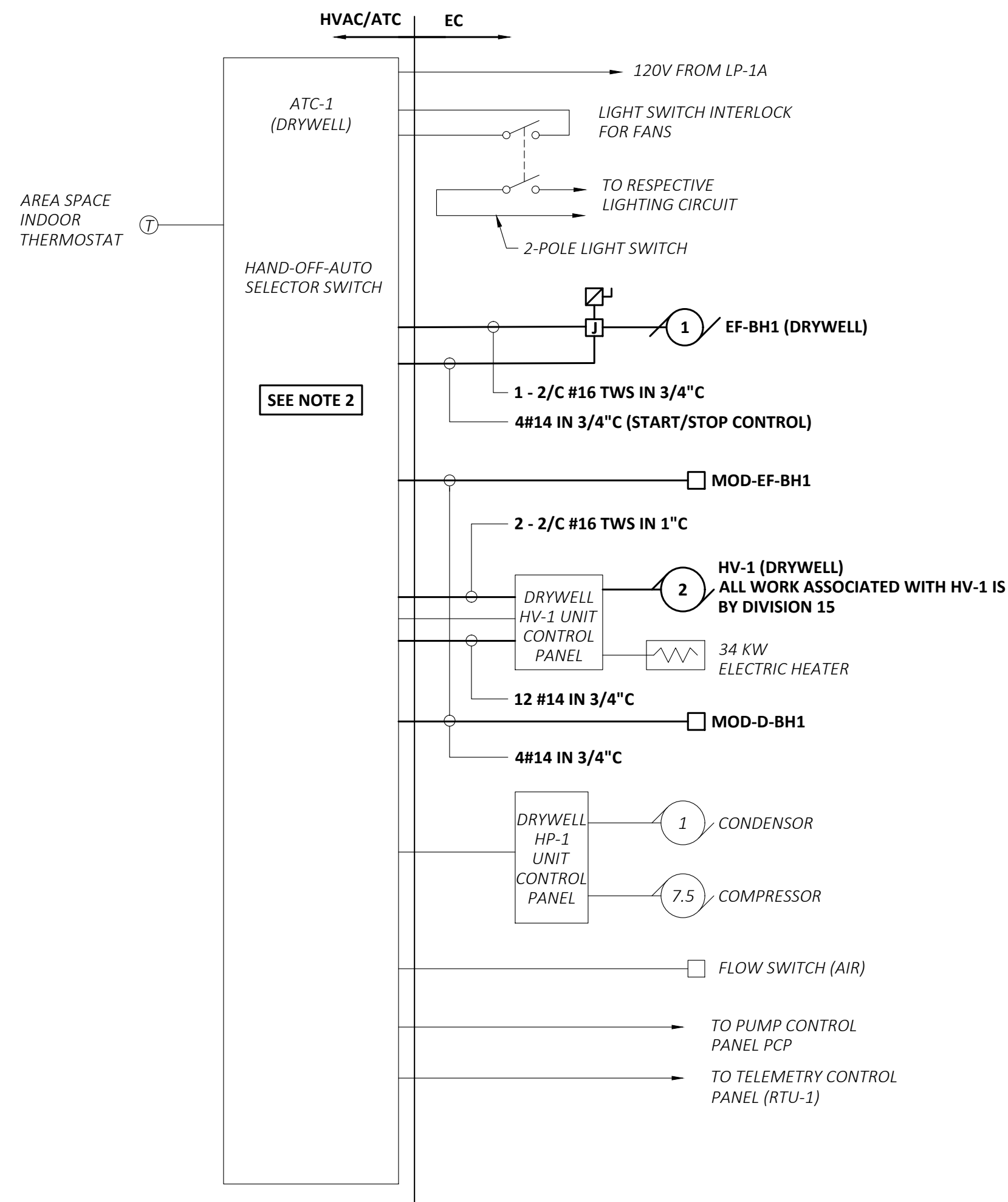
ESTIMATED DEMAND LOAD 16 KVA
DEMAND LINE CURRENT 55.5 AMP

- NOTES:**
- FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
 - INFORMATION CONTAINED ON THIS DRAWING HAS BEEN OBTAINED IN PART FROM EXISTING ELECTRICAL DRAWINGS, PHOTOGRAPHS, SITE CONDITIONS AND SHOP DRAWINGS. THE CONTRACTOR SHALL FIELD VERIFY ALL INFORMATION AND CIRCUITRY AFFECTING HIS OR HER WORK PRIOR TO COMMENCING THE WORK FOR THIS CONTRACT. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
 - THE EXISTING TEMPERATURE CONTROL PANELS ATC-1 SHALL BE MODIFIED AS SHOWN ON THE SCHEMATIC DIAGRAM DRAWING AND AS DESCRIBED IN SPECIFICATION 15604.
 - PROVIDE EQUIPMENT MOUNTING STRUCTURE AS SHOWN ON THE DETAIL. MODIFY MOUNTING REQUIREMENTS AS THIS IS A MEMBRANE EXISTING ROOF STRUCTURE. COORDINATE WITH ENGINEER PRIOR TO PERFORMING ANY WORK.
 - PROVIDE A FUSED DISCONNECT SWITCH AT THIS EQUIPMENT. SEE NOTE 4 ON DRAWING E-12 FOR ADDITIONAL REQUIREMENTS.

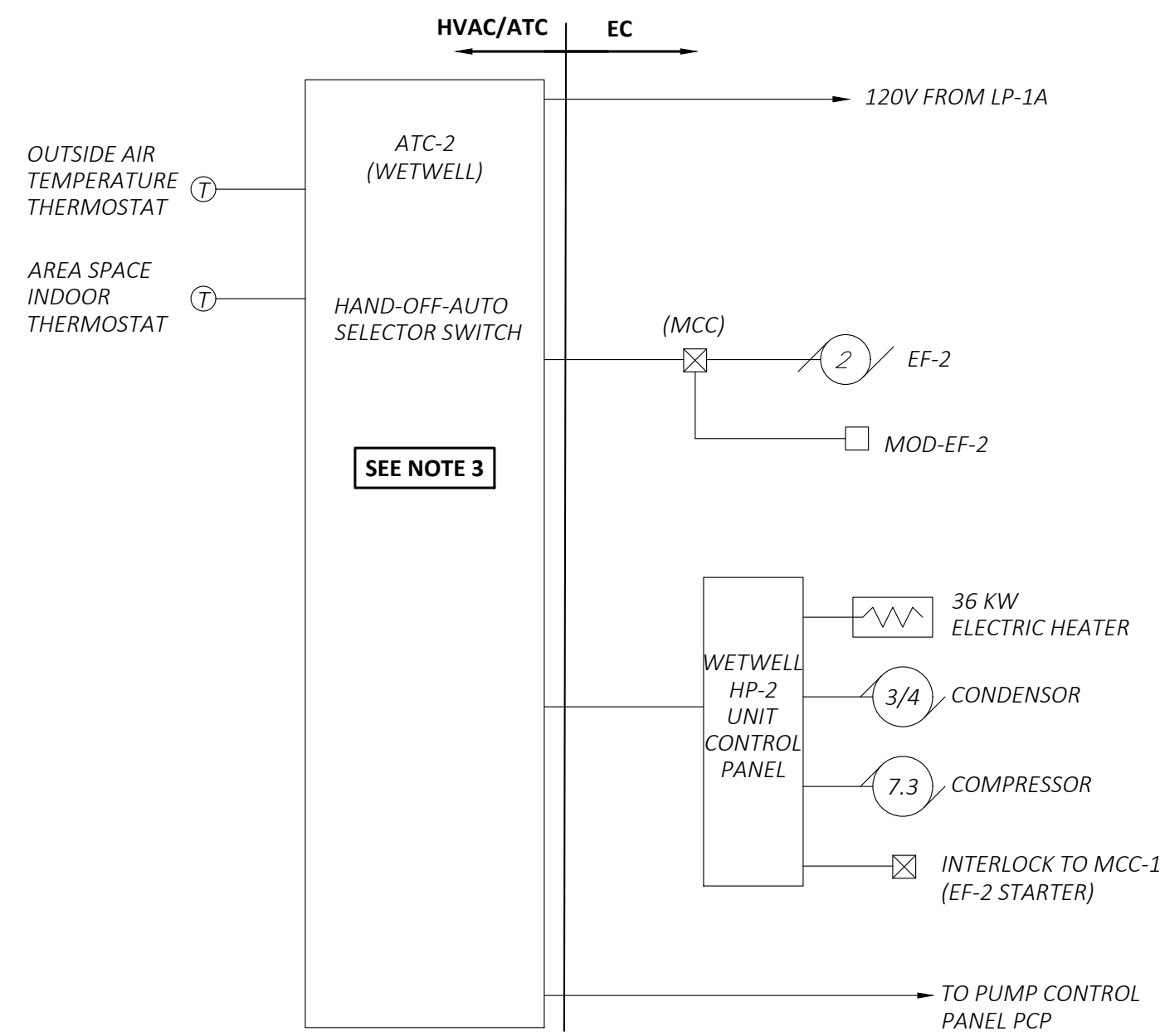
CONTROL ROOM EQUIPMENT LEGEND:

- 1 HVAC DUCT
- 2 24 HOUR TIME SWITCH (EXTERIOR LIGHTS)
- 3 MOTOR CONTROL CENTER MCC-1
- 4 COMMUNICATOR NO. 1 CONTROL PANEL
- 5 DEHUMIDIFICATION COIL DC-1
- 6 MAIN CIRCUIT BREAKER SECTION MCB-1A
- 7 AUTOMATIC TRANSFER SWITCH ATS-1
- 8 30 KVA DRY TYPE TRANSFORMER T-1A
- 9 PUMP CONTROL/TELEMETRY CONTROL PANEL
- 10 BATTERY CHARGER
- 11 DRY WELL HV-1 UNIT CONTROL PANEL
- 12 COMMUNICATOR NO. 2 CONTROL PANEL
- 13 BATH ROOM LIGHT FIXTURE
- 14 FILE CABINET
- 15 PLANT WATER PUMP PW-1
- 16 POINT OF USE WATER HEATER
- 17 SEWAGE PUMP NO. 1 SP-1 VFD CONTROL PANEL
- 18 SEWAGE PUMP NO. 2 SP-2 VFD CONTROL PANEL
- 19 SEWAGE PUMP NO. 3 SP-3 VFD CONTROL PANEL
- 20 FUTURE SEWAGE PUMP NO. 4 SP-4 VFD CONTROL PANEL
- 21 LIGHTING PANEL LP-1A
- 22 TELEPHONE INTERFACE EQUIPMENT
- 23 AQUATUM TELEMETRY PANEL RTU-0010 (CONNELLY PANEL)
- 24 HV-1 UNIT CONTROL PANEL DISCONNECT SWITCH
- 25 CONCRETE PAD LOCATED BELOW EQUIPMENT
- 26 NOT USED
- 27 ISB RELAY CONTROL PANEL (ABOVE)
- 28 FLOW INDICATING TRANSMITTER
- 29 MODIFIED AUTOMATIC TEMPERATURE CONTROL PANEL ATC-1 (ABOVE)
(SEE NOTE 3)
- 30 AUTOMATIC TEMPERATURE CONTROL PANEL ATC-2 (BELOW)
- 31 NEW TWO SPEED HV-1 MOTOR (BY DIVISION 15)
- 32 BUBBLER SYSTEM CONTROL PANEL

DESIGNED BY: ADAM CAD CORP.: BBB CD: D GJJ CHECKED BY: ADAM DATE: NOVEMBER 2020 APPROVED BY: CLARE DATE: DECEMBER 2020 PROJECT NO.: 20483	SUBMISSIONS/REVISIONS CONTRACT DRAWINGS NO. 1 NO. 2 NO. 3 NO. 4	APP'D DATE DAD 12-20 DAD 12-20 DAD 12-20 DAD 12-20	 <p>WRIGHT-PIERCE Engineering a Better Environment 888.621.8156 www.wright-pierce.com</p>
WATERFORD UTILITY COMMISSION EVERGREEN AVENUE & BLUE HILLS PUMP STATIONS HVAC IMPROVEMENTS		BLUE HILLS PUMP STATION ROOF AND CONTROL ROOM FLOOR PLANS - MODIFICATIONS	
DRAWING E-13			



**DRYWELL
EXISTING AUTOMATIC TEMPERATURE
CONTROL PANEL ATC-1**
NTS

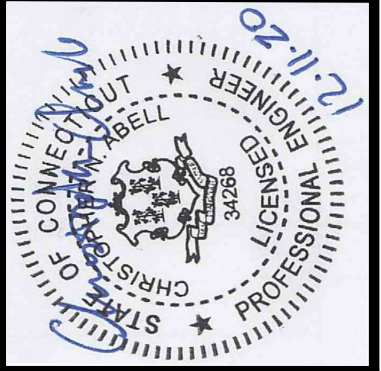


**WETWELL
AUTOMATIC TEMPERATURE
CONTROL PANEL ATC-2**
NTS

NOTES:

1. FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.
2. THERE IS A CONTROL WRITE-UP IN SPECIFICATION SECTION 15604 WHICH DEFINES THE NEW SEQUENCE OF OPERATION FOR EXISTING ATC-1 SPECIFIC EQUIPMENT BEING MODIFIED. REFER TO THIS SECTION FOR ADDITIONAL REQUIREMENTS.
3. THIS EQUIPMENT BLOCK DIAGRAM FOR EXISTING ATC-2 HAS BEEN SHOWN FOR CLARIFICATION PURPOSES ONLY. REFER TO SECTION 15604 FOR WORK TO BE PROVIDED BY DIVISION 15.

APP'D	DATE
DAD	12-20
SUBMISSIONS/REVISIONS	
NO	CONTRACT DRAWINGS
DESIGNED BY: A.DAM	
CAD CORP.: BBB	
CD: D.GU	
CREATED BY: A.DAM	
DATE: NOVEMBER 2020	
APPROVED BY: C.ABE	
DATE: DECEMBER 2020	
PROJECT NO.: 20483	

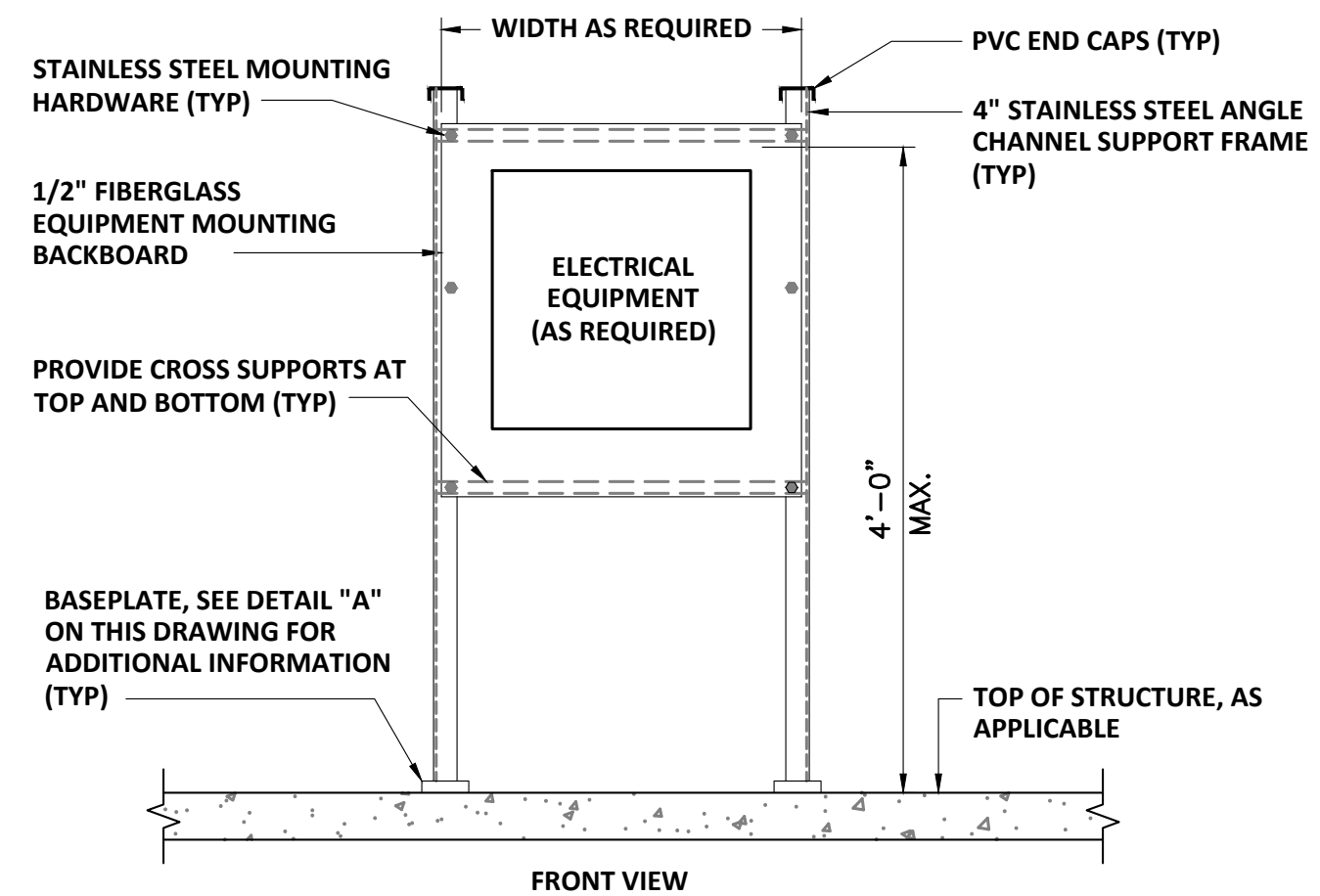
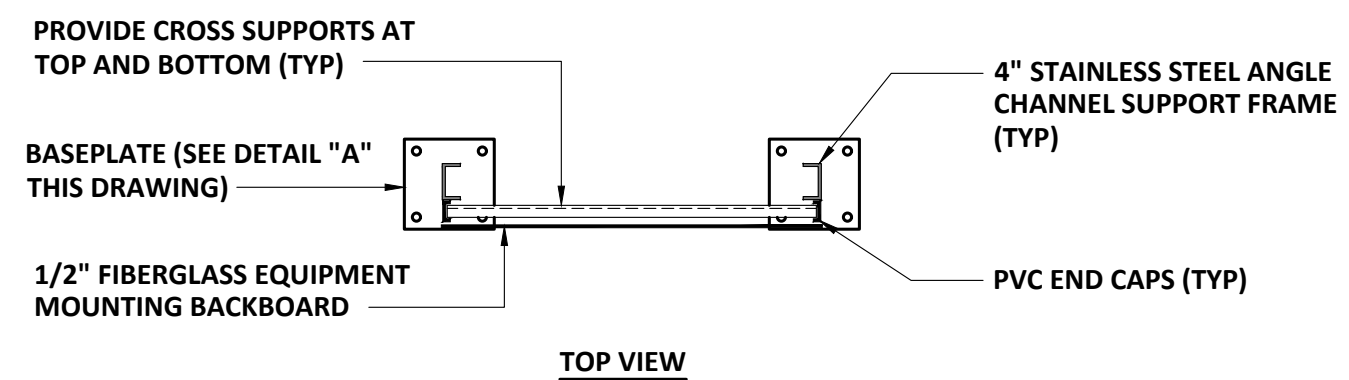


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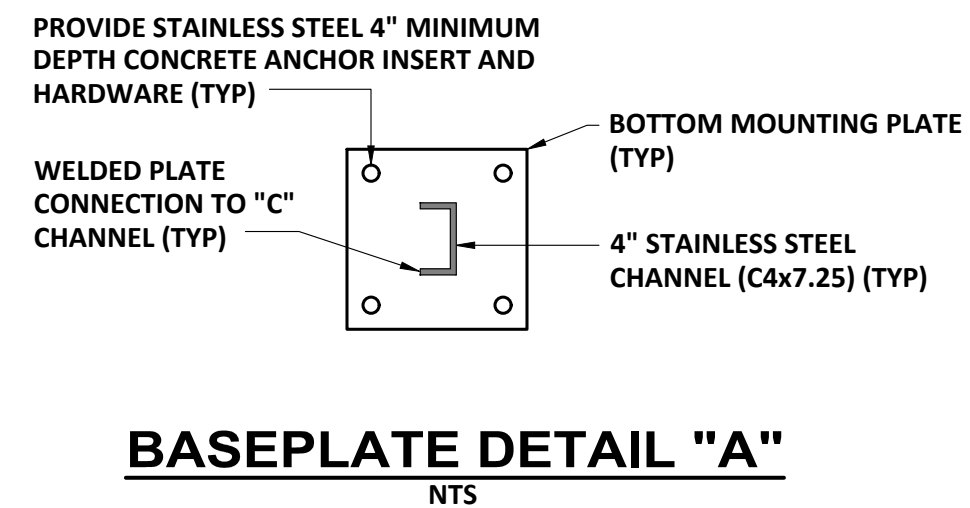
WATERFORD UTILITY COMMISSION
EVERGREEN AVENUE &
BLUE HILLS PUMP STATIONS
HVAC IMPROVEMENTS
BLUE HILLS PUMP STATION
SCHEMATIC DIAGRAMS

BLUE HILLS PUMP STATION CONDUIT AND WIRE SCHEDULE					
CONDUIT NO	CONDUIT SIZE	CONDUCTOR SIZE	DESTINATION		REMARKS
			FROM	TO	
P300	3/4"	3 #12 AND 1 #12 GND	EXHAUST FAN EF-BH1 AND CONTROL PANEL	MOTOR CONTROL CENTER MCC-1	
P301	1"	6 #12 AND 1 #12 GND	HV-1 MOTOR	DRY WELL HV-1 UNIT CONTROL PANEL	

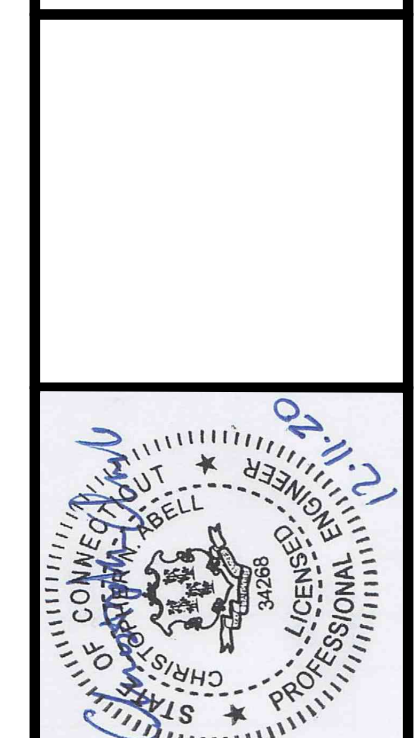
NOTE:
 1. FOR ELECTRICAL LEGEND, ABBREVIATIONS, AND ADDITIONAL GENERAL DEMOLITION NOTES AND GENERAL NOTES REFER TO DRAWINGS E-1 AND E-2.



EQUIPMENT MOUNTING STRUCTURE TYPICAL
 NTS



NO	DESIGNED BY	DATE
	A.DAM	12-20
	BBB	
	D.GU	
	CREATED BY	
	A.DAM	
	DATE	NOVEMBER 2020
	APPROVED BY	
	C.ABE	
	DATE	DECEMBER 2020
	PROJECT NO.	20483



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