



**BOARD OF CONTRACT AND SUPPLY  
CITY OF PROVIDENCE, RHODE ISLAND**

# REQUEST FOR PROPOSALS

**Item Description:** Dehumidification System Upgrade (Exp. 12/1/25)

**Procurement/MinuteTraq #: 44949**

**Date to be opened: 6/3/2024**

**Issuing Department:** Providence Water Supply Board

## **QUESTIONS**

- Please direct questions related to the bidding process, how to fill out forms, and how to submit a bid (Pages 1-8) to the Purchasing Department.
  - Email: [purchasing@providenceri.gov](mailto:purchasing@providenceri.gov)
    - Please use the subject line “**Solicitation Question**”
- Please direct questions relative to the Minority and Women’s Business Enterprise Program and the corresponding forms (Pages 9-13) to the MBE/WBE Outreach Director for the City of Providence, Grace Diaz
  - Email: [gdiaz@providenceri.gov](mailto:gdiaz@providenceri.gov)
    - Please use subject line “**MBE WBE Forms**”
- Please direct questions relative to the specifications outlined (beginning on page 14) to the issuing department’s subject matter expert:
  - Name: Victor Cabrera Valerio
  - Title: Project Engineer
  - Email Address: [victorc@provwater.com](mailto:victorc@provwater.com)

## **Pre-bid Conference**

There will be a Non-Mandatory Pre-Bid Conference

**A non-mandatory pre-Bid conference will be held at the Philip J. Holton Water Purification Plant Auditorium in Scituate, RI on May 1, 2024 at 10:00 a.m. Bidders are encouraged to attend.**

**Deadline for questions submissions:**

**May 17, 2024 at 5:00 pm.**



**BOARD OF CONTRACT AND SUPPLY  
CITY OF PROVIDENCE, RHODE ISLAND**

**INSTRUCTIONS FOR SUBMISSION**

**Meeting Date: 6/3/2024**

Bids may be submitted up to **2:15 P.M.** on the above meeting date at the **Department of the City Clerk, Room 311, City Hall, 25 Dorrance Street, Providence.** At 2:15 P.M. all bids will be publicly opened and read at the Board of Contract Meeting in Conference Room 305, on the 3<sup>rd</sup> floor of City Hall.

- Bidders must submit **2 copies** of their bid in sealed envelopes or packages labeled with the captioned **Item Description** and the **City Department to which the solicitation and bid are related and must include the company name and address on the envelope as well.** (On page 1).
- If required by the Department, please keep the original bid bond and check in only one of the envelopes.
- Communications to the Board of Contract and Supply that are not competitive sealed bids (i.e. product information/samples) should have **“NOT A BID”** written on the envelope or wrapper.
- Only use form versions and templates included in this solicitation. If you have an old version of a form **do not recycle it for use in this bid.**
- The bid envelope and information relative to the bid must be addressed to:

**Board of Contract and Supply  
Department of the City Clerk – City Hall, Room 311  
25 Dorrance Street  
Providence, RI 02903**

**\*\*PLEASE NOTE:** This bid may include details regarding information that you will need to provide (such as proof of licenses) to the issuing department before the formalization of an award.

*This information is **NOT** requested to be provided in your initial bid by design.*

**All bids submitted to the City Clerk become public record.** Failure to follow instructions could result in information considered private being posted to the city’s Open Meetings Portal and made available as a public record. The City has made a conscious effort to avoid the posting of sensitive information on the City’s Open Meetings Portal, by requesting that such sensitive information be submitted to the issuing department only at their request.



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**BID PACKAGE CHECKLIST**

Digital forms are available in the City of Providence Purchasing Department Office or online at <http://www.providenceri.gov/purchasing/how-to-submit-a-bid/>

The bid package **MUST** include the following, in this order:

- Bid Form 1: Bidder's Blank as the cover page/ 1<sup>st</sup> page (*see page 6 of this document*)
- Bid Form 2: Certification of Bidder as 2<sup>nd</sup> page (*see page 7 of this document*)
- Bid Form 3: Certificate Regarding Public Records (*see page 8 of this document*)
- Bid Form 4: Affidavit of City Vendor (*see pages 9 and 10 of this document*)
- Forms from the Minority and Women Business Enterprise Program: Based on Bidder Category. *See forms and instructions enclosed (pages 11-112) or on:*  
<https://www.providenceri.gov/purchasing/minority-women-owned-business-mbewbe-procurement-program/>

**\*Please note: MBE/WBE forms must be completed for EVERY bid submitted and must be inclusive of ALL required signatures. Forms without all required signatures will be considered incomplete.**

- Bidder's Proposal/Packet: Formal response to the specifications outlined in this RFP, including pricing information and details related to the good(s) or service(s) being provided. Please be mindful of formatting responses as requested to ensure clarity.
- Financial Assurance, *if requested* (as indicated on page 5 of this document under "Bid Terms")

**All of the above listed documents are REQUIRED.** (With the exception of financial assurances, which are only required if specified on page 5.)

**\*\*\*Failure to meet specified deadlines, follow specific submission instructions, or enclose all required documents with all applicable signatures will result in disqualification, or in an inability to appropriately evaluate bids.**



**BOARD OF CONTRACT AND SUPPLY  
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**NOTICE TO VENDORS**

1. The Board of Contract and Supply will make the award to the lowest qualified and responsible bidder.
2. In determining the lowest responsible bidder, cash discounts based on preferable payment terms will not be considered.
3. Where prices are the same, the Board of Contract and Supply reserves the right to award to one bidder, or to split the award.
4. No proposal will be accepted if the bid is made in collusion with any other bidder.
5. Bids may be submitted on an “equal in quality” basis. The City reserves the right to decide equality. Bidders must indicate brand or the make being offered and submit detailed specifications if other than brand requested.
6. A bidder who is an out-of-state corporation shall qualify or register to transact business in this State, in accordance with the Rhode Island Business Corporation Act, RIGL Sec. 7-1.2-1401, et seq.
7. The Board of Contract and Supply reserves the right to reject any and all bids.
8. Competing bids may be viewed in person at the Department of the City Clerk, City Hall, Providence, immediately upon the conclusion of the formal Board of Contract and Supply meeting during which the bids were unsealed/opened. Bids may also be accessed electronically on the internet via the City’s [Open Meetings Portal](#).
9. As the City of Providence is exempt from the payment of Federal Excise Taxes and Rhode Island Sales Tax, prices quoted are not to include these taxes.
10. In case of error in the extension of prices quoted, the unit price will govern.
11. The contractor will **NOT** be permitted to: a) assign or underlet the contract, or b) assign either legally or equitably any monies or any claim thereto without the previous written consent of the City Purchasing Director.
12. Delivery dates must be shown in the bid. If no delivery date is specified, it will be assumed that an immediate delivery from stock will be made.
13. A certificate of insurance will normally be required of a successful vendor.
14. For many contracts involving construction, alteration and/or repair work, State law provisions concerning payment of prevailing wage rates apply ([RIGL Sec. 37-13-1 et seq.](#))
15. No goods should be delivered, or work started without a Purchase Order.
16. **Submit 2 copies of the bid to the City Clerk, unless the specification section of this document indicates otherwise.**
17. Bidder must certify that it does not unlawfully discriminate on the basis of race, color, national origin, gender, gender identity or expression, sexual orientation and/or religion in its business and hiring practices and that all of its employees are lawfully employed under all applicable federal, state and local laws, rules and regulations. (See Bid Form 2.)



**BOARD OF CONTRACT AND SUPPLY  
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**BID TERMS**

1. Financial assurances may be required in order to be a successful bidder for Commodity or Construction and Service contracts. If either of the first two checkboxes below is checked, the specified assurance must accompany a bid, or the bid will not be considered by the Board of Contract and Supply. The third checkbox indicates the lowest responsible bidder will be contacted and required to post a bond to be awarded the contract.
  - a)  A certified check for \$10,000.00 must be deposited with the City Clerk as a guarantee that the Contract will be signed and delivered by the bidder.

OR

  - b)  A bid bond in the amount of 5 per centum (%) of the proposed total price, must be deposited with the City Clerk as a guarantee that the contract will be signed and delivered by the bidder; and the amount of such bid bond shall be retained for the use of the City as liquidated damages in case of default. Any person signing a bid bond as an attorney-in-fact shall include with the bid bond an original, or a photocopy or facsimile of an original, power of attorney.
  - c)  A performance and payment bond with a satisfactory surety company will be posted by the bidder in a sum equal to one hundred per centum (100%) of the awarded contract.
  - d)  No financial assurance is necessary for this item.
2. Awards will be made within **nighty (90) days of bid opening**. All bid prices will be considered firm, unless qualified otherwise. Requests for price increases will not be honored.
3. Failure to deliver within the time quoted or failure to meet specifications may result in default in accordance with the general specifications. It is agreed that deliveries and/or completion are subject to strikes, lockouts, accidents, and Acts of God.

**The following entry applies only for COMMODITY BID TERMS:**

4. Payment for partial delivery will not be allowed except when provided for in blanket or term contracts.

**The following entries apply only for CONSTRUCTION AND SERVICE BID TERMS:**

5. Only one shipping charge will be applied in the event of partial deliveries for blanket or term contracts.
6. Prior to commencing performance under the contract, the successful bidder shall attest to compliance with the provisions of the Rhode Island Worker's Compensation Act, [RIGL 28-29-1, et seq.](#) If exempt from compliance, the successful bidder shall submit a sworn Affidavit by a corporate officer to that effect, which shall accompany the signed contract.
7. Prior to commencing performance under the contract, the successful bidder shall, submit a certificate of insurance, in a form and in an amount satisfactory to the City.



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**BID FORM 1: Bidders Blank**

1. Bids must meet the attached specifications. Any exceptions or modifications must be noted and fully explained.
2. Bidder's responses must be in ink or typewritten, and all blanks on the bid form should be completed.
3. The price or prices proposed should be stated both in **WRITING** and in **FIGURES**, and any proposal not so stated may be rejected. **Contracts exceeding twelve months must specify annual costs for each year.**
4. Bids **SHOULD BE TOTALED** so that the final cost is clearly stated (unless submitting a unit price bid), however **each item should be priced individually**. Do not group items. Awards may be made on the basis of *total* bid or by *individual items*.
5. All bids **MUST BE SIGNED IN INK.**

**Name of Bidder (Firm or Individual):** \_\_\_\_\_

Contact Name: \_\_\_\_\_

Business Address: \_\_\_\_\_

Business Phone #: \_\_\_\_\_

Contact Email Address: \_\_\_\_\_

Agrees to bid on (Write the "Item Description" here): \_\_\_\_\_

If the bidder's company is based in a state *other than Rhode Island*, list name and contact information for a local agent for service of process that *is located within Rhode Island* \_\_\_\_\_

Delivery Date (if applicable): \_\_\_\_\_

Name of Surety Company (if applicable): \_\_\_\_\_

Total Amount in Writing\*: \_\_\_\_\_

Total Amount in Figures\*: \_\_\_\_\_

***\*If you are submitting a unit price bid, please insert "Unit Price Bid"***

***Use additional pages if necessary for additional bidding details.***

\_\_\_\_\_  
Signature of Representation

\_\_\_\_\_  
Title



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**BID FORM 2: Certification of Bidder**  
(Non-Discrimination/Hiring)

Upon behalf of \_\_\_\_\_ (Firm or Individual Bidding),

I, \_\_\_\_\_ (Name of Person Making Certification),

being its \_\_\_\_\_ (Title or "Self"), hereby certify that:

1. Bidder does not unlawfully discriminate on the basis of race, color, national origin, gender, sexual orientation and/or religion in its business and hiring practices.
2. All of Bidder's employees have been hired in compliance with all applicable federal, state and local laws, rules and regulations.

I affirm by signing below that I am duly authorized on behalf of Bidder, on  
this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_.

\_\_\_\_\_  
Signature of Representation

\_\_\_\_\_  
Printed Name



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**BID FORM 3: Certificate Regarding Public Records**

Upon behalf of \_\_\_\_\_ (Firm or Individual Bidding),

I, \_\_\_\_\_ (Name of Person Making Certification),

being its \_\_\_\_\_ (Title or "Self"), hereby certify an

understanding that:

1. All bids submitted in response to Requests for Proposals (RFP's) and Requests for Qualification (RFQ's), documents contained within, and the details outlined on those documents become public record upon receipt by the City Clerk's office and opening at the corresponding Board of Contract and Supply (BOCS) meeting.
2. The Purchasing Department and the issuing department for this RFP/RFQ have made a conscious effort to request that sensitive/personal information be submitted directly to the issuing department and only at request if verification of specific details is critical the evaluation of a vendor's bid.
3. The requested supplemental information may be crucial to evaluating bids. Failure to provide such details may result in disqualification, or an inability to appropriately evaluate bids.
4. If sensitive information that has not been requested is enclosed or if a bidder opts to enclose the defined supplemental information prior to the issuing department's request in the bidding packet submitted to the City Clerk, the City of Providence has no obligation to redact those details and bears no liability associated with the information becoming public record.
5. The City of Providence observes a public and transparent bidding process. Information required in the bidding packet may not be submitted directly to the issuing department at the discretion of the bidder in order to protect other information, such as pricing terms, from becoming public. Bidders who make such an attempt will be disqualified.

I affirm by signing below that I am duly authorized on behalf of Bidder, on

this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_.

\_\_\_\_\_  
Signature of Representation

\_\_\_\_\_  
Printed Name





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**BID FORM 4: Affidavit of City Vendor**

Per our Code of Ordinances [Sec. 21.-28.1 \(e\)](#), this form applies to a) the business, b) any political action committee whose name includes the name of the business, c) all persons holding ten (10) percent or greater equity interest or five thousand dollars (\$5,000.00) or greater cash value interest in the business at any time during the reporting period, d) all executive officers of the business entity, e) any spouse or dependent child of any individual identified in a) though d) above.

Executive officers who are not residents of the state of Rhode Island are exempted from this requirement.

Per [R.I.G.L. § 36-14-2](#), “Business” means a sole proprietorship, partnership, firm, corporation, holding company, joint stock company, receivership, trust, or any other entity recognized in law through which business for profit or not for profit is conducted.

Name of the person making this affidavit: \_\_\_\_\_

Position in the “Business” \_\_\_\_\_

Name of Entity \_\_\_\_\_

Address: \_\_\_\_\_

Phone number: \_\_\_\_\_

The number of persons or entities in your entity that are required to report under [Sec. 21.-28.1 \(e\)](#): \_\_\_\_\_

**Read the following paragraph and answer one of the options:**

Within the 12 month period preceding the date of this bid submission with the City of Providence, or with respect to the contracts that are not in writing within the 12 month period preceding the date of notification that the contract has reached the \$100,000 threshold, have you made campaign contributions within a calendar year to (please list all persons or entities required under [Sec. 21.-28.1 \(e\)](#)).

a. Members of the Providence City Council?  Yes  No

- If Yes, please complete the following:

Recipient(s) of the Contribution:

Contribution Date(s):

Contribution Amount(s):

b. Candidates for election or reelection to the Providence City Council?  Yes  No

- If Yes, please complete the following:

Recipient(s) of the Contribution:

Contribution Date(s):

Contribution Amount(s):



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c. The Mayor of Providence?  Yes  No

- If Yes, please complete the following:

Recipient(s) of the Contribution:

Contribution Date(s):

Contribution Amount(s):

d. Candidates for election or reelection to the office of Mayor of Providence?  Yes  No

- If Yes, please complete the following:

Recipient(s) of the Contribution:

Contribution Date(s):

Contribution Amount(s):

\_\_\_\_\_  
Signed under the pains and penalties of perjury.

\_\_\_\_\_  
Position



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**MBE/WBE Participation Plan**

**Please complete separate forms for each MBE/WBE subcontractor/supplier to be utilized on the solicitation.**

Bidder's Name:				
Bidder's Address:				
Point of Contact:				
Telephone:				
Email:				
Procurement #:				
Project Name:				
Which one of the following describes your business' status in terms of Minority and/or Woman Owned Business Enterprise certification with the State of Rhode Island? (Check all that apply).	<input type="checkbox"/> MBE	<input type="checkbox"/> WBE	<input type="checkbox"/> Neither MBE nor WBE	
<p>This form is intended to capture commitments between the prime contractor/vendor and MBE/WBE subcontractors and suppliers, including a description of the work to be performed and the percentage of the work as submitted to the prime contractor/vendor. Please note that all MBE/WBE subcontractors/suppliers must be certified by the Office of Diversity, Equity and Opportunity at the time of bid. The MBE/WBE Directory can be found <a href="#">here</a>. Please visit, the <a href="#">City's MBE/WBE page</a> for details of the program (e.g. instructions and requirements).</p> <ul style="list-style-type: none"> <li><b>Nonprofit organizations are not required to complete the rest of this form.</b></li> <li><b>Construction projects unable to identify subcontractors prior to bid submission (e.g. Design Build) are required to provide updates to the MBE/WBE Outreach Office</b></li> </ul>				
Name of Subcontractor/Supplier:				
Type of RI Certification:	<input type="checkbox"/> MBE	<input type="checkbox"/> WBE	<input type="checkbox"/> Neither	
Address:				
Point of Contact:				
Telephone:				
Email:				
Detailed Description of Work to Be Performed by Subcontractor or Materials to be Supplied by Supplier Per the Scope of Work provided in the RFP				
Total Contract Value (\$):		Subcontract Value (\$):		Participation Rate (%):
Anticipated Date of Performance:				
I certify under penalty of perjury that the forgoing statements are true and correct.				
<b>Prime Contractor/Vendor Signature</b>		<b>Title</b>		<b>Date</b>
<b>Subcontractor/Supplier Signature</b>		<b>Title</b>		<b>Date</b>

**\*If you did not meet the 20% MBE/WBE combined participation goal, submit a Waiver Request Form.**



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**MBE/WBE Waiver Request Form**

**Fill out this form only if you did not meet the 20% MBE/WBE participation goal.  
State-certified MBE or WBE Prime Bidders are NOT REQUIRED to fill out this form.**

Submit this form to the City of Providence MBE/WBE Outreach Director, Grace Diaz, at [gdiaz@providenceri.gov](mailto:gdiaz@providenceri.gov), for review **prior to bid submission**. This waiver applies only to the current bid which you are submitting to the City of Providence and does not apply to other bids your company may submit in the future. **In case a waiver is needed, City Department Directors should not** recommend a bidder for an award if this form is not included, absent or is not signed by the city of Providence MBE/WBE director.

Prime Bidder: \_\_\_\_\_ Contact Email and Phone \_\_\_\_\_  
Company Name, Address: \_\_\_\_\_ Trade \_\_\_\_\_  
Project /Item Description (as seen on RFP): \_\_\_\_\_

To receive a waiver, you must list the certified MBE and/or WBE companies you contacted, the name of the primary individual with whom you interacted, and the reason the MBE/WBE company could not participate on this project.

MBE/WBE Company Name	Individual's Name	Company Name	Why did you choose not to work with this company?

I acknowledge the City of Providence's goal of a combined MBE/WBE participation is 20% of the total bid value. I am requesting a waiver of \_\_\_\_\_ % MBE/WBE (20% minus the value of **Box F** on the Subcontractor Disclosure Form). If an opportunity is identified to subcontract any task associated with the fulfillment of this contract, a good faith effort will be made to select MBE/WBE certified businesses as partners.

\_\_\_\_\_  
Signature of Prime Contractor /  
or Duly Authorized Representative

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Date Signed

\_\_\_\_\_  
Signature of City of Providence  
MBE/WBE Outreach Director /  
or Duly Authorized Representative

\_\_\_\_\_  
Printed Name of City of Providence  
MBE/WBE Outreach Director

\_\_\_\_\_  
Date Signed



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## **SUPPLEMENTAL INFORMATION**

If the issuing department for this RFP determines that your firm's bid is best suited to accommodate their need, you will be asked to provide proof of the following prior to formalizing an award.

An inability to provide the outlined items at the request of the department may lead to the disqualification of your bid.

*This information is **NOT** requested to be provided in your initial bid that you will submit to the City Clerk's office by the "date to be opened" noted on page 1. This list only serves as a list of items that your firm should be ready to provide on request.*

**All bids submitted to the City Clerk become public record. Failure to follow instructions could result in information considered private being posted to the city's Open Meetings Portal and made available as a public record.**

**You must be able to provide:**

- Business Tax ID will be requested after an award is approved by the Board of Contract and Supply.
- Proof of Insurance.
- Certificate of Good Standing with the Rhode Island Secretary of State.



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**CITY OF PROVIDENCE STANDARD TERMS & CONDITIONS**

1. The terms “you” and “your” contained herein refer to the person or entity that is a party to the agreement with the City of Providence (“the City”) and to such person’s or entity’s employees, officers, and agents.
2. The Request For Proposals (“RFP”) and these Standard Terms and Conditions together constitute the entire agreement of the parties (“the Agreement”) with regard to any and all matters. By your submission of a bid proposal or response to the City’s RFP, you accept these Standard Terms & Conditions and agree that they supersede any conflicting provisions provided by bid or in any terms and conditions contained or linked within a bid and/or response. Changes in the terms and conditions of the Agreement, or the scope of work thereunder, may only be made by a writing signed by the parties.
3. You are an independent contractor and in no way does this Agreement render you an employee or agent of the City or entitle you to fringe benefits, workers’ compensation, pension obligations, retirement or any other employment benefits. The City shall not deduct federal or state income taxes, social security or Medicare withholdings, or any other taxes required to be deducted by an employer, and this is your responsibility to yourself and your employees and agents.
4. You shall not assign your rights and obligations under this Agreement without the prior written consent of the City. Any assignment without prior written consent of the City shall be voidable at the election of the City. The City retains the right to refuse any and all assignments in the City’s sole and absolute discretion.
5. Invoices submitted to the City shall be payable sixty (60) days from the time of receipt by the City. Invoices shall include support documentation necessary to evidence completion of the work being invoiced. The City may request any other reasonable documentation in support of an invoice. The time for payment shall not commence, and invoices shall not be processed for payment, until you provide reasonably sufficient support documentation. In no circumstances shall the City be obligated to pay or shall you be entitled to receive interest on any overdue invoice or payment. In no circumstances shall the City be obligated to pay any costs associated with your collection of an outstanding invoice.
6. For contracts involving construction, alteration, and/or repair work, the provisions of applicable state labor law concerning payment of prevailing wage rates (R.I. Gen. Laws §§ 37-13-1 et seq., as amended) and the City’s First Source Ordinance (Providence Code of Ordinances §§ 21-91 et seq., as amended) apply.
7. With regard to any issues, claims, or controversies that may arise under this Agreement, the City shall not be required to submit to dispute resolution or mandatory/binding arbitration. Nothing prevents the parties from mutually agreeing to settle any disputes using mediation or non-binding arbitration.
8. To the fullest extent permitted by law, you shall indemnify, defend, and hold harmless the City, its employees, officers, agents, and assigns from and against any and all claims, damages, losses, allegations, demands, actions, causes of action, suits, obligations, fines, penalties, judgments, liabilities, costs and expenses, including but not limited to attorneys’ fees, of any nature whatsoever arising out of, in connection with, or resulting from the performance of the work provided in the Agreement.
9. You shall maintain throughout the term of this Agreement the insurance coverage that is required by the RFP or, if none is required in the RFP, insurance coverage that is considered in your industry to be commercially reasonable, and you agree to name the City as an additional insured on your general liability policy and on any umbrella policy you carry.
10. The City shall not subject itself to any contractual limitations on liability. The City shall have the time permitted within the applicable statute of limitations, and no less, to bring or assert any and all causes of action, suits, claims or demands the City may have arising out of, in connection with, or resulting from the performance of the work provided in the Agreement, and in no event does the City agree to limit your liability to the price of the Agreement or any other monetary limit.
11. The City may terminate this Agreement upon five (5) days’ written notice to you if you fail to observe any of the terms and conditions of this Agreement, or if the City believes your ability to perform the terms and conditions of this Agreement has been materially impaired in any way, including but in no



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- way limited to loss of insurance coverage, lapsing of a surety bond, if required, declaration of bankruptcy, or appointment of a receiver. In the event of termination by the City, you shall be entitled to just and equitable compensation for any satisfactory work completed and expenses incurred up to the date of termination.
12. Written notice hereunder shall be deemed to have been duly served if delivered in person to the individual or member of the firm or entity or to an officer of the entity for whom it was intended, or if delivered at or sent by registered or certified mail to the last business address known by the party providing notice.
  13. In no event shall the Agreement automatically renew or be extended without a writing signed by the parties.
  14. You agree that products produced or resulting from the performance of the Agreement are the sole property of the City and may not be used by you without the express written permission of the City.
  15. For any Agreement involving the sharing or exchange of data involving potentially confidential and/or personal information, you shall comply with any and all state and/or federal laws or regulations applicable to confidential and/or personal information you receive from the City, including but not limited to the Rhode Island Identity Theft Protection Act, R.I. Gen. Laws § 11-49.3-1, during the term of the Agreement. You shall implement and maintain appropriate physical, technical, and administrative security measures for the protection of, and to prevent access to, use, or disclosure of, confidential and/or personal information. In the event of a breach of such information, you shall notify the City of such breach immediately, but in no event later than twenty-four (24) hours after discovery of such breach.
  16. The Agreement is governed by the laws of the State of Rhode Island. You expressly submit yourself to and agree that any and all actions arising out of, in connection with, or resulting from the performance of the Agreement or relationship between the parties shall occur solely in the venue and jurisdiction of the State of Rhode Island or the federal court located in Rhode Island.
  17. The failure of the City to require performance of any provision shall not affect the City's right to require performance at any time thereafter, nor shall a waiver of any breach or default of this Agreement constitute a waiver of any subsequent breach or default or a waiver of the provision itself.
  18. If any term or provision of this Agreement, or the application thereof to any person or circumstance shall, in any extent, be invalid or unenforceable, the remainder of this Agreement shall not be affected thereby, and each term and provision shall be valid and enforceable to the fullest extent permitted by law.

# Dehumidification System Design Philip J. Holton Water Works Purification Plant

## Providence Water

Providence, Rhode Island

April 2, 2024

## Construction Documents



**Tighe & Bond**

1 Cedar Street, Suite #300  
Providence, RI 02903



PROVIDENCE WATER SUPPLY BOARD  
PHILP HOLTON PURIFICATION PLANT DEHUMIDIFICATION SYSTEM  
SCITUATE, RI  
ADVERTISEMENT FOR BIDS

The work consists of heating, ventilating, and air conditioning (HVAC) system upgrades with associated electrical and structural system improvements. The primary HVAC system upgrades include new dehumidification systems. Bids shall be on a lump sum with additive allowances as indicated in the Bid Form. A total lump sum bid shall be provided for all work, including the four subdivisions of work and the allowances. Separate lump sum bids shall also be included for each of the four subdivisions of work.

Bidding Documents may be obtained in the City of Providence Purchasing Department Office or online at <http://www.providenceri.gov/purchasing/how-to-submit-a-bid/>

A Bid must be accompanied by a Bid Security made payable to the City of Providence and Providence Water in the form of a certified check for \$10,000.00, as a guarantee that the Contract will be signed and delivered by the bidder; OR a Bid Bond in the amount of five percent (5%) of the total amount bid as a guarantee that the contract will be signed and delivered by the bidder; and in default thereof, the bid bond shall be retained for the use of the City of Providence and the Providence Water as liquidated damages on account of such default.

Bidders are required to include with their Bid, information pertaining to proposed subcontractors and suppliers as indicated in the Bid Form or required by the Bidding Documents.

Compliance with State of Rhode Island General Laws, Chapters 37-12 and 37-13, and prevailing Wage Rate provisions is a requirement for Bidders and any subcontractors. Reference is hereby made to the Appendices of Section 00800 - Supplementary Conditions of the Contract Specifications for "Special Notes" pertaining to Bonds; Labor and Payment; Minority Businesses; and Prevailing Wage Rates. Bidders shall review Article 14, "Basis of Bid; Evaluation of Bids", as provided in Section 00200, "Instructions to Bidders" of the Contract Specifications.

This project is partially funded by a loan from the Efficient Building Fund. Section 00800 contains the funding program construction contract requirements, all of which shall be applicable to this Contract.

Bidders must complete and submit with their bids all forms required by the City of Providence bid forms and Bidder Information - MBE/WBE Participation Requirements. Failure to submit all required forms and documentation will result in the bid being considered non-responsive and rejection of the bid.

Bidders must be familiar with and comply with all permitting and licensing requirements of federal, state, and local laws, ordinances, and regulations applicable to the Work. Compliance with all such requirements, including but not limited to applicable chapters of Titles 5 and 28 of the State of Rhode Island General Laws, is a requirement for Bidders and any subcontractors.

The City of Providence and Providence Water reserve the right to waive any irregularities and to reject any or all bids.

A non-mandatory pre-Bid conference will be held at the Philip J. Holton Water Purification Plant Auditorium in Scituate, RI on May 1, 2024 at 10:00 a.m. Bidders are encouraged to attend.

Consulting Engineer:

Tighe & Bond, Inc.  
One Cedar St.  
Suite 300  
Providence, RI 02903  
401-455-4300

END OF SECTION

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**ARTICLE 1 DEFINED TERMS**

1.1 Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions.

2.2 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor

Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.3 Owner and Engineer in making copies of Bidding Documents available on the above terms

do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

**ARTICLE 3 QUALIFICATIONS OF BIDDERS**

3.1 Bidders shall be experienced in the kind of Work to be performed, shall have the necessary equipment, and shall possess sufficient capital to properly execute the Work within the time allowed. Bids received from Bidders who have previously failed to complete Work within the time required, or who have previously performed similar Work in an unsatisfactory manner, may be rejected. A Bid may be rejected if Bidder cannot show that he has the necessary ability, plant and equipment to commence the Work at the time prescribed and thereafter to prosecute and complete the Work at the rate or within the time specified. A Bid may be rejected if Bidder is already obligated for the performance of other Work which would delay the commencement, prosecution or completion of the Work.

3.2 Bidders shall have a minimum of 15 years of experience and shall have successfully completed HVAC projects of similar scope within the past 10 years. Submit with the bid a summary of experience and representative projects to show compliance with these qualifications.

3.3 Bidders may be investigated by Owner to determine if they are qualified to perform the Work. All Bidders shall be prepared to submit within five days of Owner's or Engineer's request, written evidence of such information and data necessary to make this determination. The investigation of a Bidder will seek to determine whether the organization is adequate in size, is authorized to do business in the jurisdiction where the project is located, has had previous experience and whether available equipment and financial resources are adequate to assure Owner that the Work will be completed in accordance with the terms of the Agreement. Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of such Bidder fails to satisfy Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein.

A. Bidders may be required to provide a letter stating that the Bidder is in good financial standing. The letter must:

1. Be provided by a financial institution or certified public accountant having a relationship with the Bidder;
2. Be on the bank or accountant's letterhead;

3. Include name and contact information for the bank or accountant including address, email and telephone number;
4. Identify the account holder(s), whose names must match the name of the Bidder, the type and length of business relationship, and the historical status of the accounts (i.e. good standing, timely payments, no overdrafts, etc.); and
5. NOT include account numbers, account amounts, or lines of credit.

**ARTICLE 4 SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE**

4.1 The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment are to be obtained and paid for by Contractor.

4.2 Existing Site Conditions

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:
  - a. No data exists.

4.3 Site Visit and Testing by Bidders

A. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

B. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.

C. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

D. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.4 Owner's Safety Program

A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.5 Other Work at the Site

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work for which a Bid is to be submitted. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

#### ARTICLE 5 BIDDER'S REPRESENTATIONS

5.1 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, including any Addenda, data, and referenced items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, or performance of the Work;
- D. carefully study all reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or adjacent to the Site which have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and carefully study all reports and drawings relating to a Hazardous Environmental Condition, if any, at or adjacent to the Site which have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on 1) the cost, progress, and performance of the Work; 2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, , and 3) Bidder's safety precautions and programs;
- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the Work to be performed by others at the site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;

- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and finishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

#### ARTICLE 6 PRE-BID CONFERENCE

- 6.1 A pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

#### ARTICLE 7 INTERPRETATIONS AND ADDENDA

- 7.1 All questions about the meaning or intent of the Bidding Documents shall be submitted in writing to the Owner. Contact the Owner to review how questions shall be submitted (i.e. electronically)
- 7.2 In order to receive consideration, questions must be received by the Owner and Engineer by May 17, 2024 at 5:00 pm. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda to all parties recorded by Engineer as having received the Bidding Documents not later than three days prior to the date fixed for the opening of Bids. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.3 Addenda may be issued to clarify, correct, supplement or change the Bidding Documents. Such Addenda, if any, will be issued in the manner and within the time period stated in paragraph 7.2.
- 7.4 The Bidder must acknowledge receipt of each Addendum, if any, in the space provided on the Bid Form.

#### ARTICLE 8 BID DEPOSIT

- 8.1 In the Bidding Documents, the terms “Bid security” and “Bid deposit” shall have the same meaning.
- 8.2 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5% of Bidder’s maximum Bid price (including any additive alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.
- 8.3 All Bid deposits of General Bidders, except those under consideration by Owner, will be returned within 5 days, excluding Saturdays, Sundays and legal holidays, after the opening of General Bids. Other Bid deposits will be returned upon the execution and delivery of the Agreement. The Bid deposit of the Successful Bidder will be retained until such bidder has furnished the required contract security and executed the Agreement, whereupon the bid

deposit shall be returned. If the Successful Bidder fails to furnish the required contract security within 15 days after the Notice of Award and execute the Agreement within 5 days after receipt from Owner, Owner may annul the Notice of Award and the Bid deposit of that Bidder will be forfeited to Owner as liquidated damages for such failure.

#### ARTICLE 9 CONTRACT TIMES

9.1 The number of days within which, or the dates by which, the Work is to be:

- A. substantially completed, and/or
- B. completed and ready for final payment

are set forth in the Agreement.

#### ARTICLE 10 LIQUIDATED DAMAGES

10.1 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

#### ARTICLE 11 SUBSTITUTE AND "OR EQUAL" ITEMS

11.1 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the effective date of the Contract.

#### ARTICLE 12 NOT USED

#### ARTICLE 13 PREPARATION OF BID

13.1 A Bid must be made on the Bid form included with the Project Manual. The Bid form shall not be altered in any way.

13.2 The Bid form must be completed in ink. Blank spaces in the Bid form must be filled in correctly where indicated, and the Bidder must state, both in words and numerals, the prices for which he proposes to complete each and every item of Work. Ditto marks shall not be used.

13.3 A Bidder shall execute his Bid as stated below.

- A. A Bid by an individual shall show the Bidder's name and official address.
- B. A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature) accompanied by evidence of authority to sign. The official address of the partnership shall be shown.
- C. A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature) and must be accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the corporate secretary. The state of incorporation and the official corporate address shall be shown.

- D. A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
  - E. A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
  - F. All names must be printed in ink below the signature.
- 13.4 The Bid shall contain an acknowledgment of the receipt of all Addenda in the space provided on the Bid form.
- 13.5 Postal and email addresses and telephone number to which communications regarding the Bid are to be directed shall be shown.
- 13.6 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.
- 13.7 In order to be considered for selection, the Bidder must submit a complete bid package in accordance with these Bidding Documents. Partial Bids will not be accepted. Refer to the Bid Form for a list of documents that shall be submitted in addition to the Bid Form.
- 13.8 Any deviations in completion of the Bid Form and accompanying documents from the instructions provided in this Article may be cause for rejection of the Bid.

#### ARTICLE 14 BASIS OF BID

##### 14.1 Lump Sum

- A. Bidders shall submit a Bid on a lump sum basis as set forth in the Bid form and include a separate price for each alternate described in the Bidding Documents as provided for in the Bid form.

##### 14.2 Unit Price

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity" (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with paragraph 13.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.
- D. Unit prices for identical item numbers that are in more than one bid schedule shall be equal. Discrepancies will be resolved in favor of the lowest unit price.



14.3 Allowances

- A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents in accordance with paragraph 13.02 of the General Conditions.

- 17.4 No responsibility will attach to Owner, its employees or the Engineer for premature opening of a Bid not properly addressed and identified in accordance with the Bidding Documents.

#### ARTICLE 18 DISQUALIFICATION OF BIDDERS

- 18.1 More than one Bid for the same Work from an individual, or a firm, partnership, corporation or an association under the same or different names will not be considered. Reasonable grounds for believing that any Bidder is interested in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder is interested.

#### ARTICLE 20 EVALUATION OF BIDS AND AWARD OF CONTRACT

- 20.1 Owner reserves the right to reject any and all Bids, to waive any and all informalities, and the right to disregard all nonconforming, nonresponsive or conditional Bids.
- 20.2 Owner reserves the right to reject any Bid not accompanied by specified documentation and Bid deposit.
- 20.3 Owner reserves the right to reject any Bid if it shows any omissions, alterations of form, additions not called for, conditions or qualifications, or irregularities of any kind.
- 20.4 Owner reserves the right to reject any Bid that, in his sole discretion, is considered to be unbalanced or unreasonable as to the amount bid for any lump sum or unit price item.
- 20.5 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 20.6 In evaluating whether a Bidder is responsible, Owner will consider the qualifications the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 20.7 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.
- 20.8 If the Owner awards the Contract for the Work, such award shall be to the responsible Bidder (who has neither been disqualified nor rejected pursuant to Article 18 or this Article 20) submitting the lowest responsive Bid.
- 20.9 Contents of the Bid of the Successful Bidder will become part of any contract awarded.

#### ARTICLE 21 CONTRACT SECURITIES

- 21.1 Performance and payment bonds shall be furnished by the successful Bidder. The amounts of and other requirements for performance and payment bonds are stated in Article 6 of the General Conditions. Performance and payment bonds submitted shall be posted by a recognized surety company having a place of business in the State of Rhode Island. All

21.3 The required contract securities will become part of the Contract Documents.

**ARTICLE 22 CONTRACT INSURANCE**

22.1 The requirements for insurance to be provided by the Successful Bidder are stated in Article 6 of the General Conditions and in the Supplementary Conditions.

22.2 Within 15 days from the date of the Notice of Award, the Successful Bidder shall deliver evidence of required insurance to Owner and Engineer.

22.3 The required insurance certificates will become part of the Contract Documents.

**ARTICLE 23 SIGNING OF AGREEMENT**

23.1 The Owner will transmit the required number of unsigned Agreements to the Successful Bidder with the Notice of Award. Within 15 days of the date of the Notice of Award, the Successful Bidder shall sign the Agreements and return them to the Owner. The Owner will return one executed Contract to the Successful Bidder.

**ARTICLE 24 SALES TAXES**

24.1 Owner is exempt from Rhode Island State sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Bid. The successful bidder shall contact the Owner for the tax exemption number.

**END OF SECTION**

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SECTION 00410

FORM FOR GENERAL BID

PROJECT IDENTIFICATION:

Philip Holton Water Purification Plant

Dehumidification System Project

- 1.2 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 - BIDDER'S ACKNOWLEDGEMENTS

- 2.1 Bidder accepts all of the terms and conditions of the Advertisement for Bids and Instructions to Bidders, including without limitation, those dealing with the disposition of Bid deposit. The Bid will remain subject to acceptance for 30 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 - BIDDER'S REPRESENTATIONS

- 3.1 In submitting this Bid, Bidder represents, as set forth in the Agreement, that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents and hereby acknowledges the receipt of all Addenda.
- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all federal, state and local Laws and Regulations that may affect cost, progress and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

#### ARTICLE 4 - BIDDER'S CERTIFICATION

- 4.1 Bidder hereby certifies under the penalties of perjury, to the best of Bidder's knowledge and belief, that Bidder has filed all State tax returns and paid all State taxes required by law.

- 4.2 Bidder certifies that this Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
- 4.3 Bidder certifies that Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
- 4.4 Bidder certifies that Bidder has not solicited or induced any individual or entity to refrain from bidding.
- 4.5 Bidder certifies that Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph:
  - A. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
  - B. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of the Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
  - C. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
  - D. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

#### ARTICLE 5 - BASIS OF BID

- 5.1 Bidder proposes to furnish all labor and materials required for construction of the Project in accordance with the accompanying Bidding Documents prepared by Tighe & Bond, Inc., for the Contract Price specified below, subject to additions and deductions according to the terms of the Bidding Documents.

Item Number	Item Name and Unit Bid Prices Written in Words and Figures	Estimated Quantity	Total Amount of Item (in figures)
1	Unknown Conditions Allowance:  Two hundred thousand dollars (\$ 200,000.00)	Allowance =	\$ 200,000.00
2	Miscellaneous Architectural Upgrades Allowance  Two hundred thousand dollars (\$ 200,000.00)	Allowance =	\$ 200,000.00

5.2 This Bid includes Addenda numbered \_\_\_\_\_.

5.3 The proposed Contract Price (base bid including all subdivisions of work and allowances is: \_\_\_\_\_ dollars

(words)

(\$ \_\_\_\_\_)

(figures)

5.4 The subdivision of the proposed Contract Price (base bid)f for each work area, excluding allowances is as follows:

**Area 1 – Basement Pipe Gallery, Effluent Gallery Lower Pump Room, and Pump Room:** All work associated with supporting the upgrades to the basement Pipe Gallery, Effluent Gallery Lower Pump Room and Pump Room.

\_\_\_\_\_ dollars

(Bid in words)

(\$ \_\_\_\_\_)

(figures)

**Area 2 – Central Filter Gallery and Filter Beds:** All work associated with supporting the upgrades to the Central Filter Gallery and Filter Beds.

\_\_\_\_\_ dollars

(Bid in words)

(\$ \_\_\_\_\_)

(figures)

**Area 3 – Influent Building and Chlorine Room:** All work associated with supporting the upgrades to the Influent Building and Chlorine Room.

\_\_\_\_\_ dollars  
(Bid in words)

(\$ \_\_\_\_\_ )  
(figures)

**Area 4 – Washwater Utility Structure (Clearwell):** All work associated with supporting the upgrades to the Washwater Utility Structure.

\_\_\_\_\_ dollars  
(Bid in words)

(\$ \_\_\_\_\_ )  
(figures)

Refer to the Drawings, including G-002 that indicates the scope of work for each work area.

**ARTICLE 6 - TIME OF COMPLETION**

- 6.1 Bidder agrees that the Work will be substantially completed and ready for final payment in accordance with paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.2 Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times as stated in the Agreement.

**ARTICLE 7 - ATTACHMENTS TO THIS BID**

- 7.1 The following documents are attached to and made a condition of this Bid:
  - A. Bid deposit in the amount of \_\_\_\_\_ dollars (\$ \_\_\_\_\_), consisting of a bid bond in the amount of five percent of the total amount of Bid
  - B. Evidence of authority to sign
  - C. List of Project References
  - D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids
  - E. A list of adversarial proceedings in which the bidder is or was a party within the past 5 years that relate to the procurement or performance of any public or private construction contract together with a brief statement as to outcome if concluded or status if pending.
  - F. A list of any projects on which the firm was terminated or failed to complete the work within the past 5 years, including a brief explanation for each instance listed.



- G. Contractor's License or Registration No.: \_\_\_\_\_ or Evidence of Bidder's ability to obtain a license or registration and a covenant by Bidder to obtain said license or registration within the time for acceptance of Bids;
- H. Evidence of Bidder's qualifications in accordance with Article 3 of Section 00200
- I. List of Subcontractors

ARTICLE 8 - BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By:

*[Signature]* \_\_\_\_\_

*[Printed name]* \_\_\_\_\_

*(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)*

Attest:

*[Signature]* \_\_\_\_\_

*[Printed name]* \_\_\_\_\_

Title: \_\_\_\_\_

Submittal Date: \_\_\_\_\_

Address for giving notices:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Telephone Number: \_\_\_\_\_

Fax Number: \_\_\_\_\_

Contact Name and e-mail address: \_\_\_\_\_

\_\_\_\_\_

Bidder's License No.: \_\_\_\_\_

*(where applicable)*

END OF SECTION

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## BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

---

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

### BID

Bid Due Date:

Description (*Project Name— Include Location*):

### BOND

Bond Number:

Date:

Penal sum \_\_\_\_\_

\$ \_\_\_\_\_

(Words)

(Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

**BIDDER**

**SURETY**

\_\_\_\_\_  
(Seal)

\_\_\_\_\_  
(Seal)

Bidder's Name and Corporate Seal

Surety's Name and Corporate Seal

By: \_\_\_\_\_

Signature

By: \_\_\_\_\_

Signature (Attach Power of Attorney)

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

Attest: \_\_\_\_\_

Signature

Attest: \_\_\_\_\_

Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

*Note: Addresses are to be used for giving any required notice.*

*Provide execution by any additional parties, such as joint venturers, if necessary.*

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
  - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
  - 3.2 All Bids are rejected by Owner, or
  - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

## SECTION 00520

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION  
CONTRACT

This Agreement is by and between the Providence Water Supply Board hereinafter called Owner and \_\_\_\_\_ hereinafter called Contractor.

Owner and Contractor hereby agree as follows:

## ARTICLE 1 WORK

- 1.1 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described with the following title: "Philip Holton Purification Plant Dehumidification System Project".

## ARTICLE 2 ENGINEER

- 2.1 The part of the Project that pertains to the Work has been designed by Tighe & Bond, Inc
- 2.2 The Owner has retained Tighe & Bond ("Engineer") to act as Owner's representative, assuming all duties and responsibilities, rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

## ARTICLE 3 CONTRACT TIMES

## 3.1 Time of the Essence

- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

## 3.2 Substantial Completion and Final Payment

- A. The Work will be substantially completed within 240 days from the date of the Notice to Proceed and completed and ready for final payment in accordance with paragraph 15.06 of the General Conditions within 45 days from the date of the Notice to Proceed.

## 3.3 Liquidated Damages

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 3.1 above and that Owner will suffer financial and other losses if the Work is not completed within the times specified in Paragraph 3.2 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner \$1,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 3.1 above for Substantial Completion until the Work is substantially complete.

2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract), for completion and readiness for final payment, Contractor shall pay Owner \$1,500 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

#### ARTICLE 4 CONTRACT PRICE

- 4.1 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount equal to the prices stated in Contractor's Bid, attached hereto as an exhibit, subject to adjustment under the Contract.

#### ARTICLE 5 PAYMENT PROCEDURES

- 5.1 Applications for Payment shall be processed in accordance with Article 15 of the General Conditions and in accordance with Rhode Island General Law.
- 5.2 Owner shall make progress payments on account of the Contract Price on the basis of processed Applications for Payment monthly during construction, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All progress payments will be measured by the Schedule of Values established as provided in the General Conditions, or in the event there is no schedule of values, as provided elsewhere in the Contract.
- 5.3 Owner shall retain from progress payments 5 percent of the value of Work completed.
- 5.4 Substantial Completion
  - A. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to ninety-nine percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.
- 5.5 Final Payment
  - A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

#### ARTICLE 6 CONTRACTOR'S REPRESENTATIONS

- 6.1 Contractor makes the following representations:
  - A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
  - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

- C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

## ARTICLE 7 CONTRACT DOCUMENTS

### 7.1 Contents

- A. The Contract Documents consist of the following:
  - 1. This Agreement (pages 00520-1 to 00520-6, inclusive);
  - 2. Performance Bond (pages 1 to 3, inclusive);
  - 3. Payment Bond (pages 1 to 3, inclusive);
  - 4. General Conditions (title pages, table of contents, and pages 1 to 65, inclusive);

5. Supplementary Conditions (pages 00800-1 to 00800-11, inclusive);
  6. Specifications (Divisions 1 through 16);
  7. Drawings consisting of a cover sheet and sheets numbered 1 through 52, inclusive, with each sheet bearing the following general title: Philp J. Holton Water Purification Plan Dehumidification System Project;
  8. Addenda (numbers \_\_\_\_\_ to \_\_\_\_\_, inclusive);
  9. Exhibits to this Agreement (enumerated as follows):
    - a. Contractor's Bid (pages 00410-1 to 00410-5, inclusive);
  10. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
    - a. Notice to Proceed;
    - b. Work Change Directives;
    - c. Change Order(s);
    - d. Field Orders
- B. The documents listed in Paragraph 7.1.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 7.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

## ARTICLE 8 MISCELLANEOUS

### 8.1 Terms

- A. Terms used in this Agreement will have the meanings indicated in the General Conditions and the Supplementary Conditions.

### 8.2 Assignment of Contract

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

### 8.3 Successors and Assigns

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal



representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

#### 8.4 Severability

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

#### 8.5 Contractor Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.5:
  - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
  - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
  - 3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
  - 4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

#### 8.6 Other Provisions

- A. Owner stipulates that the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and Owner has plainly shown all modifications to the standard wording of such published document to the Contractor in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. This Agreement will be effective on \_\_\_\_\_, \_\_\_\_\_ (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

\_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

[CORPORATE SEAL]

[CORPORATE SEAL]

Attest \_\_\_\_\_

Attest \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

Address for giving notices:

Address for giving notices:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution of other documents authorizing execution of Owner-Contractor Agreement.)

License No. \_\_\_\_\_  
(Where applicable)

(If Contractor is a corporation or a partnership, attach evidence of authority to sign.)

Certified as to the availability of funds:

\_\_\_\_\_

Date

\_\_\_\_\_

Signed

\_\_\_\_\_

Title

END OF SECTION

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## PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

### CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

### BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form:  None  See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

### CONTRACTOR AS PRINCIPAL

### SURETY

\_\_\_\_\_  
Contractor's Name and Corporate Seal *(seal)*

\_\_\_\_\_  
Surety's Name and Corporate Seal *(seal)*

By: \_\_\_\_\_  
Signature

By: \_\_\_\_\_  
Signature *(attach power of attorney)*

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

Attest: \_\_\_\_\_  
Signature

Attest: \_\_\_\_\_  
Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

**Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.**

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a

qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

#### 14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper

payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

## PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

### CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location)*:

### BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:

Amount:

Modifications to this Bond Form:  None  See Paragraph 18

---

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

### CONTRACTOR AS PRINCIPAL

### SURETY

\_\_\_\_\_ *(seal)*  
Contractor's Name and Corporate Seal

\_\_\_\_\_ *(seal)*  
Surety's Name and Corporate Seal

By: \_\_\_\_\_  
Signature

By: \_\_\_\_\_  
Signature *(attach power of attorney)*

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Print Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

Attest: \_\_\_\_\_  
Signature

Attest: \_\_\_\_\_  
Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

**Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.**

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
  - 5.1 Claimants who do not have a direct contract with the Contractor,
    - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
    - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
  - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
  - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
  - 7.2 Pay or arrange for payment of any undisputed amounts.
  - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the



Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

## 16. Definitions

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by



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## ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

### 1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
  2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
  3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
  4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
  5. *Bidder*—An individual or entity that submits a Bid to Owner.
  6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
  7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
  8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
  9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
  10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or “RPR” includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

## 1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
  1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
  1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
  1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
    - a. does not conform to the Contract Documents; or
    - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
    - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
  1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
  2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
  4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

## **ARTICLE 2 – PRELIMINARY MATTERS**

### **2.01 *Delivery of Bonds and Evidence of Insurance***

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

### **2.02 *Copies of Documents***

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

### **2.03 *Before Starting Construction***

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
  1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
  2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

#### 2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

#### 2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
  1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
  2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
  3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

#### 2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

### **ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE**

#### **3.01 *Intent***

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

#### **3.02 *Reference Standards***

- A. Standards Specifications, Codes, Laws and Regulations
  - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
  - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

#### **3.03 *Reporting and Resolving Discrepancies***

- A. *Reporting Discrepancies:*
  - 1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,



error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
  - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
  - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

### 3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
  - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
  - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

## **ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK**

### 4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

### 4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

### 4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

### 4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
  - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

#### 4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
  2. abnormal weather conditions;
  3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
  4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

## **ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS**

### *5.01 Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

### *5.02 Use of Site and Other Areas*

#### *A. Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

### 5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
  - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
  - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
  - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
  - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
  - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
  - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

#### 5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
  2. is of such a nature as to require a change in the Drawings or Specifications; or
  3. differs materially from that shown or indicated in the Contract Documents; or
  4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
    - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
    - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
  - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
  - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
  - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

#### 5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
  1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
  2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
    - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
    - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
    - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
    - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
  - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
    - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
    - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
    - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
    - d. Contractor gave the notice required in Paragraph 5.05.B.
  - 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
  - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.



5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
  2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
  2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
  3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

## ARTICLE 6 – BONDS AND INSURANCE

### 6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

### 6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

### 6.03 *Contractor's Insurance*

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
  - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
  - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
  - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
  2. claims for damages insured by reasonably available personal injury liability coverage.
  3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
    - a. Such insurance shall be maintained for three years after final payment.
    - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
  2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
  3. Broad form property damage coverage.
  4. Severability of interest.
  5. Underground, explosion, and collapse coverage.
  6. Personal injury coverage.
  7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
  8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
  - 1. include at least the specific coverages provided in this Article.
  - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
  - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
  - 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
  - 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

#### 6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

#### 6.05 *Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
  - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
  - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
  - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
  - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
  6. extend to cover damage or loss to insured property while in transit.
  7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
  8. allow for the waiver of the insurer's subrogation rights, as set forth below.
  9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
  10. not include a co-insurance clause.
  11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
  12. include performance/hot testing and start-up.
  13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.



## 6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
  - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
  - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

## 6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

## **ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES**

### *7.01 Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

### *7.02 Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

### *7.03 Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

#### 7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
  - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment Engineer determines that:
      - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
      - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
      - 3) it has a proven record of performance and availability of responsive service; and
      - 4) it is not objectionable to Owner.
    - b. Contractor certifies that, if approved and incorporated into the Work:
      - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
      - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

#### 7.05 *Substitutes*

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
  - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
  - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
  - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
    - a. shall certify that the proposed substitute item will:
      - 1) perform adequately the functions and achieve the results called for by the general design,
      - 2) be similar in substance to that specified, and
      - 3) be suited to the same use as that specified.
    - b. will state:
      - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
      - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
      - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
    - c. will identify:
      - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
- d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

#### 7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

- O. Nothing in the Contract Documents:
1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
  2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

#### 7.09 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

#### 7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

#### 7.11 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

#### 7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
  - 1. all persons on the Site or who may be affected by the Work;



2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
  3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
  - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
  - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
  - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
  - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
  - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

#### 7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

#### 7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

#### 7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

#### 7.16 *Shop Drawings, Samples, and Other Submittals*

##### A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
  - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
  - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
  - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
  - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

##### 1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*
    - a. Contractor shall submit the number of Samples required in the Specifications.
    - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.
  3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- D. *Engineer's Review:*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
  2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
  3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
  4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
  5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
  6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
  7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
  2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
  1. observations by Engineer;
  2. recommendation by Engineer or payment by Owner of any progress or final payment;
  3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
  4. use or occupancy of the Work or any part thereof by Owner;
  5. any review and approval of a Shop Drawing or Sample submittal;
  6. the issuance of a notice of acceptability by Engineer;
  7. any inspection, test, or approval by others; or
  8. any correction of defective Work by Owner.

- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

#### 7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
  - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
  - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

#### 7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

## **ARTICLE 8 – OTHER WORK AT THE SITE**

### **8.01 *Other Work***

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

## 8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
  - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
  - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
  - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

## 8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

## **ARTICLE 9 – OWNER'S RESPONSIBILITIES**

### *9.01 Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

### *9.02 Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

### *9.03 Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

### *9.04 Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

### *9.05 Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

### *9.06 Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

### *9.07 Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.



9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

**ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION**

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

#### 10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

#### 10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

#### 10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

#### 10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

#### 10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

#### 10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

#### 10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

### **ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK**

#### 11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
  1. *Change Orders:*
    - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
    - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
  2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

#### 11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

#### 11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

#### 11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
  1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
  2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
  3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
  2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
    - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
    - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
    - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
    - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
    - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
    - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

#### 11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

#### 11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
  2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
  3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

#### 11.07 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
  2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
  3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
  4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

#### 11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

### **ARTICLE 12 – CLAIMS**

#### 12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
  - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
  - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
  - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
  - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
  - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

## **ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK**

### 13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
  1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
  2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
  1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable



thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
  - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
  - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
  - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
  - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
  - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
  - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

## 13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

- B. *Cash Allowances*: Contractor agrees that:
  - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
  - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

### 13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
  - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
  - 2. there is no corresponding adjustment with respect to any other item of Work; and
  - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

## ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

### 14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

### 14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
  - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
  - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
  - 3. by manufacturers of equipment furnished under the Contract Documents;
  - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
  - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

#### 14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

#### 14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

#### 14.05 *Uncovering Work*

- A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
  - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
  - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

#### 14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

#### 14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

## **ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD**

### **15.01 Progress Payments**

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
  2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
  3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
  2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
  - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
  - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
    - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
    - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
  4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
    - a. to supervise, direct, or control the Work, or
    - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
    - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
    - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
    - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
  5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
  6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
    - a. the Work is defective, requiring correction or replacement;
    - b. the Contract Price has been reduced by Change Orders;
    - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
    - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or



- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

- 1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
  - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
  - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
  - c. Contractor has failed to provide and maintain required bonds or insurance;
  - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
  - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
  - f. the Work is defective, requiring correction or replacement;
  - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
  - h. the Contract Price has been reduced by Change Orders;
  - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
  - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
  - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
  - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

#### 15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

#### 15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

#### 15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
  - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
  - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
  - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
  - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

#### 15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

#### 15.06 *Final Payment*

- A. *Application for Payment:*
  - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
  - a. all documentation called for in the Contract Documents;
  - b. consent of the surety, if any, to final payment;
  - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
  - d. a list of all disputes that Contractor believes are unsettled; and
  - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

**B. *Engineer's Review of Application and Acceptance:***

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

**C. *Completion of Work:*** The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

**D. *Payment Becomes Due:*** Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

#### 15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

#### 15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
  - 1. correct the defective repairs to the Site or such other adjacent areas;
  - 2. correct such defective Work;
  - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
  - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

## **ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION**

### **16.01 *Owner May Suspend Work***

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

### **16.02 *Owner May Terminate for Cause***

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
  - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
  - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
  - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
  - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
  - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
  - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

#### 16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
  - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
  - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
  - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

#### 16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

## **ARTICLE 17 – FINAL RESOLUTION OF DISPUTES**

### **17.01 *Methods and Procedures***

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
  - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
  - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
  - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
  - 2. agree with the other party to submit the dispute to another dispute resolution process; or
  - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

## **ARTICLE 18 – MISCELLANEOUS**

### **18.01 *Giving Notice***

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
  - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
  - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

### **18.02 *Computation of Times***

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

### **18.03 *Cumulative Remedies***

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.



18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00800

SUPPLEMENTARY CONDITIONS

PART 1 AMENDMENTS TO GENERAL CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC C-700, 2013 Edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated below, which are applicable to both the singular and plural thereof.

The address system used in the Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 Delete paragraph 1.01A.38 in its entirety and insert the following in its place:

1.01A.38. Specifications – Sections included under Division 1 through Division 16 of the Project Manual.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.02 Delete paragraph 2.02A in its entirety.

ARTICLE 3 –DOCUMENTS: INTENT, REQUIREMENTS, REUSE

SC-3.01 Replace paragraph 3.01E with the following paragraph:

3.01E In the event of conflicts, inconsistencies or discrepancies among the Contract Documents, to the extent applicable, the better quality or greater quantity of work shall be provided without change to the Contract Price. In the event of such conflicts, inconsistencies or discrepancies which do not relate to the quality or quantity of work, the Contractor shall request clarifications or interpretations from the Engineer as provided herein.

SC-3.01 Add the following new paragraph immediately after paragraph 3.01E:

3.01F Each and every provision of law and clause required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the

Contract Documents shall forthwith be physically amended to make such insertion.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01 Delete paragraph 4.01A in its entirety and insert the following in its place:

4.01A The Contract Times will commence to run on the date specified in the Notice to Proceed.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 Add the following new paragraphs immediately after paragraph 5.03B.3:

SC-5.06 Delete Paragraphs 5.06A and 5.06B in their entirety and insert the following:

5.06A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to the Owner.

5.06B. Not used.

ARTICLE 6 - BONDS AND INSURANCE

SC-6.03 Add the following new paragraph immediately after paragraph 6.03B.3:

6.03B.4 Insurance certificate(s) shall also contain the following:

1. Confirmation that the General Liability policy covers only the Work under this Contract, with project specific limits.
2. Confirmation that automobile insurance covers all Scheduled, Hired and Non-Owned vehicles.
3. Names of all additional insureds as specified herein.

SC-6.03 Add the words “and Paragraph 6.04” after the words “Paragraph 6.03” in Paragraph 6.03I.

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

6.03.K The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers’ Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

Employer’s Liability:

Bodily injury, each accident	<u>\$500,000 (statutory)</u>
Bodily injury by disease, each employee	<u>\$500,000 (statutory)</u>

Bodily injury/disease aggregate	
2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:	
General Aggregate	\$2,000,000
	Included in listed
Products - Completed Operations Aggregate	amounts
	Included in listed
Personal and Advertising Injury	amounts
Each Occurrence	
(Bodily Injury and Property Damage)	\$1,000,000
3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:	
Bodily Injury:	
Each person	\$1,000,000
Each accident	\$1,000,000
Property Damage:	
Combined Single Limit of	\$1,000,000
4. Excess or Umbrella Liability:	
Per Occurrence	\$
General Aggregate	\$
5. Contractor's Pollution Liability:	
Each Occurrence	N/A
General Aggregate	N/A
<input checked="" type="checkbox"/> If box is checked, Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract	
6. Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following: None	
7. Contractor's Professional Liability:	
Each Claim	\$2,000,000
Annual Aggregate	\$2,000,000

SC-6.04 Delete paragraph 6.04 in its entirety and insert the following in its place:

6.04 Contractor shall purchase and maintain a separate Owner's Protective Liability policy, issued to Owner at the expense of Contractor, including Owner as named insured. This insurance shall provide coverage for not less than the following amounts:

Bodily Injury      \$1,000,000 Each Occurrence  
                             \$1,000,000 Aggregate

Property Damage \$1,000,000 Each Occurrence  
                             \$2,000,000 Aggregate

A. Insurance coverage for the Contractor's Comprehensive General and Excess Liability policies and for the Owner's Protective Liability policy shall be written by one and the same insurance company to avoid the expense of duplicate and/or overlapping coverage and to facilitate and expedite the settlement of claims.

B. The Owner's Protective Liability policy shall protect from claims which may arise from operations under the Contract, including operations performed for a named insured by independent contractors and general inspection or monitoring by a named insured. The policy also shall protect against Automobile Non-Ownership Liability in connection with the Contractor's operations under the Contract, whether such operations be by itself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable.

SC-6.05 Add the following new subparagraph after subparagraph 6.05.A.1:

6.05.A.1.a In addition to Owner, Contractor, and all Subcontractors, include as insureds the following:

1) Tighe & Bond (53 Southampton Rd, Westfield, MA 01085)

SC-6.08 Add the following new paragraph after paragraph 6.07:

6.08 Additional Owner Insurance Requirements

A. Refer to Attachment "Certificate of Insurance" preceding this specification for additional Owner insurance requirements.

## ARTICLE 7 - CONTRACTOR'S RESPONSIBILITIES

SC-7.02 Add the following new paragraph immediately after paragraph 7.02B.

7.02C Whenever Owner shall notify Contractor in writing that any person on the Work appears to be incompetent, disorderly, or otherwise unsatisfactory, such person shall be removed from the Project and shall not again be employed on it except with the consent of Owner.

SC-7.07 Delete paragraph 7.07B in its entirety and replace it with the following:

7.07B Not used.

SC-7.09 Add the following sentence at the end of paragraph 7.09.A.

All materials provided under this Contract are exempt from the Sales and Use Taxes for the State of RI. Contact the Owner for the tax exemption number will be provided to the Contractor.

SC-7.18 Add the following new paragraph immediately after paragraph 7.18.C.

7.18D If, through acts of neglect on the part of Contractor, any other Contractor or any Subcontractor shall suffer loss or damage on the Work, Contractor shall settle with such other Contractor or Subcontractor by agreement or arbitration if such other Contractor or Subcontractor will so settle. If such other Contractor or Subcontractor shall assert any claim against Owner on account of any such damage alleged to have been sustained, Owner shall notify Contractor, who shall indemnify, defend, and save harmless Owner against any such claim.

#### ARTICLE 8 - OTHER WORK AT THE SITE

SC-8.01 Add the following new paragraph immediately after paragraph 8.01.D:

8.01E Contact the Owner to discuss other work occurring on site.

SC-8.02 Delete paragraph 8.02A in its entirety and replace with the following:

8.02A The Owner intends to contract with others for the performance of other work on the Project at the Site.

1. Owner shall have the authority and responsibility for coordination of the various contractors at the Site;

#### ARTICLE 10 – ENGINEER’S STATUS DURING CONSTRUCTION

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.

1. Provide part time observation.
2. RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors

shall only be through or with the full knowledge and approval of Contractor.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including “or-equal” items).
2. Exceed limitations of Engineer’s authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor’s work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

SC-11.06 Insert the following sentence at the end of Paragraph 11.06.A.2:

If Engineer does not take action on the Change Proposal and neither Owner nor Contractor submit a letter to the other party indicating that the Change Proposal is deemed denied, then the Change Proposal shall be deemed denied after 60 days of Engineer’s receipt of the Contractor’s supporting data, thereby commencing the time for appeal of the denial under Article 12.

ARTICLE 14 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

SC-14.02 Insert after the word “notice” the words “(minimum 24 hours)” in paragraph 14.02A.

SC-14.03 Delete paragraph 14.03B in its entirety and replace with the following:

14.03B *Engineer’s Authority:* At any time during the progress of the Work, Engineer shall have the authority to determine whether Work is

defective, and reject defective Work, even though such work has been previously inspected and paid for.

SC-14.06 Add the following new paragraph immediately after paragraph 14.06A.

14.06B If Owner stops work under Paragraph 14.06, Contractor shall not be entitled to an extension of Contract Time nor to an increase in Contract Price.

#### ARTICLE 15 - PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01 Insert the following sentence at the end of paragraph 15.01B.1:

The Certificate of Insurance for stored materials must list Tighe & Bond and the Providence Water Supply Board as additional insureds.

SC-15.01 Delete paragraph 15.01D.1 in its entirety and insert the following in its place:

15.01D.1 Thirty days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

SC-15.03 Delete the second sentence in Paragraph 15.03A in its entirety.

SC-15.03 Delete paragraph 15.03C in its entirety and insert the following in its place:

15.03C If, after consultation with Owner, Engineer considers and the Owner agrees that the Work is substantially complete, Engineer will prepare and deliver to Contractor, in a form approved by Owner, a Certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be included with the certificate a list of items to be completed or corrected before final payment.

SC-15.03 Delete the word "preliminary" from paragraph 15.03D.

SC-15.04 Add the following new paragraph immediately after paragraph 15.04A.3:

15.04A.4 Owner may at any time request Contractor in writing to permit Owner to take over operation of any part of the Work although it is not substantially complete. A copy of such request will be sent to Engineer, and within a reasonable time thereafter Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If Contractor does not object in writing to Owner and Engineer that such part of the Work is not ready for separate operation by Owner, Engineer will finalize the list of items to be completed or corrected and will deliver such lists to Owner and



Contractor together with a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, utilities, insurance, warranties, and guarantees for that part of the Work which will become binding upon Owner and Contractor at the time when Owner takes over such operation (unless they shall have otherwise agreed in writing and so informed Engineer). During such operation and prior to Substantial Completion of such part of the Work, Owner shall allow Contractor reasonable access to complete or correct items on said list and to complete other related Work.

Paragraph 15.04.A.4 shall be renumbered to 15.04.A.5

SC-15.06 Delete paragraph 15.06.D in its entirety and insert the following in its place:

- D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, or other time period in accordance with applicable laws and regulations, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

#### ARTICLE 16 - SUSPENSION OF WORK AND TERMINATION

SC- 16.02 Add the following new paragraph immediately after paragraph 16.02.A.4:

- 16.02.A.5 If Contractor abandons the Work, or sublets this Contract or any part thereof, without the previous written consent of Owner, or if the Contract or any claim thereunder shall be assigned by Contractor otherwise than as herein specified.

#### ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.02 Add the following paragraph after paragraph 17.01:

- 17.02 Venue  
A. Any suit by either party arising under this Contract shall be brought only in the Superior Court in the county where the Project is located. The parties hereto waive any argument that this venue is improper or that the forum is inconvenient.

#### ARTICLE 18 - MISCELLANEOUS

SC-18.08 Add the following new paragraphs immediately after paragraph 18.08.

- 18.09 Wage Rates

- A. The requirements and provisions of all applicable laws and any amendments thereof or additions thereto as to the employment of labor, and to the schedule of minimum wage rates established in compliance with laws shall be a part of these Contract Documents. Copies of the wage schedules are included in Part II of these Supplementary Conditions. If it becomes necessary to employ any person in a trade or occupation not classified in the wage determinations, such person shall be paid at not less than such rates as shall be determined by the officials administering the laws mentioned above. Such approved minimum rate shall be retroactive to the time of the initial employment of such person in such trade or occupation.
- B. The schedules of wages referred to above are minimum rates only, and Owner will not consider any claims for additional compensation made by Contractor because of payment by Contractor of any wage rate in excess of the applicable rate contained in these Contract Documents. All disputes in regard to the payment of wages in excess of those specified in the schedules shall be resolved by Contractor.
- C. The said schedules of wages shall continue to be the minimum rates to be paid during the life of this Agreement and a legible copy of said schedules shall be kept posted in a conspicuous place at the site of the work.

## PART II – FEDERAL AND STATE GOVERNMENT PROVISIONS

Federal and State Government Provisions referenced or included herein, have been selected from those to which specific references have been made elsewhere in the Contract Documents. Each and every other provision of law or clause required by law to be inserted in this Contract shall be deemed to be also inserted herein in accordance with paragraph 3.01.F of the Supplementary Conditions.

### 1.0 FEDERAL GOVERNMENT PROVISIONS

- 1.1 Labor Standards Provisions for Federal and Federally Assisted Contracts
- 1.2 Federal Wage Rates
- 1.3 FmHA Compliance Statement
- 1.4 FmHA Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions
- 1.5 FmHA Certification for Contracts, Grants and Loans
- 1.6 FmHA Supplemental General Conditions EOCD

END OF SECTION

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**ATTACHMENTS TO SUPPLEMENTARY CONDITIONS**

**ATTACHMENT A**  
**FEDERAL (DAVIS-BACON) WAGE RATES AND RHODE ISLAND STATE WAGE**  
**RATES**

**ATTACHMENT A  
FEDERAL (DAVIS-BACON) WAGE RATES AND RHODE ISLAND STATE WAGE  
RATES**

**PREVAILING WAGE RATES**

**(APPROPRIATE WAGE RATE TO BE INSERTED BY BIDDER IN SPECIFICATIONS)**

**FOR A COPY OF THE APPROPRIATE WAGE RATE, CONTACT:**

**RI DEPARTMENT OF LABOR AND TRAINING  
PREVAILING WAGES  
CENTER GENERAL COMPLEX  
1511 PONTIAC AVENUE  
CRANSTON, RI 02920**

**ATTACHMENT B  
CERTIFICATE OF INSURANCE**

## Certificate of Insurance

1. The Original Certificate of Insurance must be mailed to:

**Providence Water**

125 Dupont Drive  
 Providence, RI 02907  
 Attention: Elizabeth Paquin

2. Certificate must be completely filled out listing all Insurance Companies, Coverage's. and Limits. Providence Water (PW) require the following Certificate must be completely filled out listing all Insurance Companies, Coverage's. and Limits. Providence Water (PW) require the following insurances requirements.

Required	Coverage
x	<b>Worker's Compensation and Occupational Insurance:</b> In statutory amounts, Covering all employees of the contractor. Employer's liability coverage with limits of not less than \$500,000.00/ each accident or illness shall be included.
x	<b>Commercial General Liability Insurance:</b> Commercial Liability Insurance with limits of not less than \$1,000,000.000 per occurrence, for bodily injury and/or property damage liability \$2,000,000.000 in the aggregate. Products/completed operation, independent contractors, and contractual liability coverages are to be included. No exclusions for rigging, hoisting, explosions, collapse and/or underground. Completed operations coverage must remain in effect for a period of not less than 2 years after the completion of all work. "The City of Providence, Providence Water, its officers and agents are to name as an additional insured."
x	<b>Automobile Liability Insurance:</b> When any motor vehicles are used in connection with the work to be performed the Contractor shall maintain Automobile Liability Insurance with limits of not less \$1,000,000.00 per occurrence, combined single limit, for bodily injury and property damage. "The City of Providence, Providence Water are to be named as additionally insured."
	<b>Builder's Risk Policy:</b> When a free standing unit is to be constructed or any addition to our facilities made in connection with the work specified, the Contractor must provide Builder's Risk Insurance or an Installation Floater covering all risks with limits equal to the award of the contract.
	<b>Professional Liability Insurance:</b> When any architects, engineers, or consulting firms perform work in connection with any contract, the contractor shall maintain Professional Liability Insurance with limits not less than \$2,000,000.00 per occurrence and aggregate.

3. The insured name must be the same name as the name on the bid submitted.
4. Insurance Certificates should state the Title of Project to be performed.

5. Certificate must read “The City of Providence, Providence Water, its Officers and Agents are named as additional insured.”
6. Certificate Holder provision of the certificate must list “The City of Providence and Providence Water.”
7. Cancellation and/or reduction in coverage must provide 30 days' notice.
8. The successful bidder must produce a satisfactory Certificate of Insurance within 10 days after award. No work will begin or contract signed unless all these requirements are met. Failure to do so may result in the cancellation of the award and award to another bidder.
9. The insurances specified shall be carried until all work required to be performed under the terms of the CONTRACTOR's services are satisfactorily completed and for a period of at least two years after the date when final payment becomes due. Failure to carry or keep such insurance in force shall constitute a violation of the contract, and the Providence Water \ maintains the right to stop work and/or withhold payment until proper evidence is provided.
10. The insurance shall provide for 30 days' prior written notice to be given to the Providence Water in the event coverage is substantially changed, canceled, or not renewed.
11. In no case shall the coverage limits stated for Commercial General Liability, Automobile Liability, or Professional Liability insurance stated above be less than the total contract amount. If the total contract amount exceeds any stated limit, the limit shall be adjusted to the satisfaction of the OWNER to the next highest \$1,000,000.00 exceeding the total contract amount.
12. Providence Water maintains the right to modify, delete, alter or change these requirements.
13. The successful bidder understands and agrees that any insurance protection furnished by the CONTRACTOR hereunder shall in no way limit its responsibility to indemnify and save harmless Providence Water.
14. For additional Information contact Elizabeth Paquin at (401)521-6300 ext. 7227

(SAMPLE ATTACHED)





# CERTIFICATE OF LIABILITY INSURANCE

DATE(MM/DD/YYYY)  
03/11/2016

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

**IMPORTANT:** If the certificate holder is an **ADDITIONAL INSURED**, the policy(ies) must have **ADDITIONAL INSURED** provisions or be endorsed. If **SUBROGATION IS WAIVED**, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER A	CONTACT NAME:	
	PHONE (A/C. No. Ext): ( )	FAX (A/C. No.):
E-MAIL ADDRESS:		
INSURER(S) AFFORDING COVERAGE		NAIC #
INSURED	INSURER A:	
	INSURER B: N	
	INSURER C:	
	INSURER D:	
	INSURER E:	
	INSURER F:	

Holder Identifier :

**COVERAGES**      **CERTIFICATE NUMBER:** 570061419077      **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.      **Limits shown are as requested**

INSR LTR	TYPE OF INSURANCE	ADDD INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	<input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR  GENL AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input checked="" type="checkbox"/> PRO-JECT <input checked="" type="checkbox"/> LOC OTHER:			GL			EACH OCCURRENCE	\$1,000,000
							DAMAGE TO RENTED PREMISES (Ea occurrence)	\$
							MED EXP (Any one person)	\$10,000
							PERSONAL & ADV INJURY	\$1,000,000
							GENERAL AGGREGATE	\$2,000,000
							PRODUCTS - COMP/OP AGG	\$2,000,000
A	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> OWNED AUTOS ONLY <input type="checkbox"/> SCHEDULED AUTOS <input type="checkbox"/> HIRED AUTOS ONLY <input type="checkbox"/> NON-OWNED AUTOS ONLY			B			COMBINED SINGLE LIMIT (Ea accident)	\$1,000,000
							BODILY INJURY ( Per person)	
							BODILY INJURY (Per accident)	
							PROPERTY DAMAGE (Per accident)	
B	<input type="checkbox"/> UMBRELLA LIAB <input checked="" type="checkbox"/> OCCUR <input checked="" type="checkbox"/> EXCESS LIAB <input type="checkbox"/> CLAIMS-MADE <input type="checkbox"/> DED <input type="checkbox"/> RETENTION						EACH OCCURRENCE	\$25,000,000
							AGGREGATE	\$25,000,000
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR / PARTNER / EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below <input checked="" type="checkbox"/> Y <input checked="" type="checkbox"/> N    N / A						<input checked="" type="checkbox"/> PER STATUTE <input type="checkbox"/> OTHER	
							E.L. EACH ACCIDENT	\$1,000,000
							E.L. DISEASE-EA EMPLOYEE	\$1,000,000
							E.L. DISEASE-POLICY LIMIT	\$1,000,000

Certificate No : 570061419077

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)  
 RE:

<b>CERTIFICATE HOLDER</b>	<b>CANCELLATION</b>
Providence Water 125 Dupont Drive Providence, RI 02907	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION ATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.  AUTHORIZED REPRESENTATIVE

**DIVISION 1 - GENERAL REQUIREMENTS**

## SECTION 01110

## SUMMARY OF WORK

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Work of the Contract is shown and described in Drawings and Project Manual entitled:

Dehumidification System Design  
Philip J. Holton Water Purification Plant  
Providence Water Supply Board  
October 2023

Tighe & Bond, Inc.  
Consulting Engineers  
Westfield, Massachusetts

2. The Work includes the following major items:
  - a. HVAC and electrical system improvements
  - b. Structural supports

## B. Construction Correspondence Management

1. All construction related correspondences, such as submittals, requests for information, invoicing, application for payments, etc. shall be submitted through the Owner's eBuilder construction management software. Access to eBuilder will be provided by the Owner.

## C. Related Requirements

1. Section 00800 - Supplementary Conditions

## 1.2 SUBMITTALS

## A. Informational Submittals

1. Submit copies of permits or approvals required for the Work, prior to initiating the Work.

## 1.3 PROJECT/SITE CONDITIONS

## A. Permits

1. Obtain the permits and approvals listed below:
  - a. Permits and licenses of a temporary nature necessary to perform the Work.
  - b. Permits for disposal of construction wastes including disposal of cleared and grubbed materials.

- c. Other permits or licenses required for the Contractor's operations or required elsewhere in the Contract Documents and not included herein.
  2. Obtain required time extensions to permits obtained by the Contractor, if construction authorized by permits has not been completed by the expiration date noted on these permits.
  3. Obtain permits and approvals from appropriate jurisdictional agencies and property owners for use of premises not furnished by the Owner, and for all off-site areas.
  4. Submit copies of permits prior to performance of Work authorized by permits.
- B. Existing Conditions
1. Use of Premises and Off-site Work
    - a. The Work shall occur on the Owner's within the limits of Work.
    - b. Land owned by the Owner is available for staging. Confirm staging areas with Owner.
    - c. Obtain permits and approvals for use of any land and access thereto that is deemed necessary for the Work, where such land is not available for use by the Owner, including land for temporary construction facilities, access and egress, or for storage of materials. Confine apparatus and storage to such additional areas.
    - d. Obtain permits and written approvals from appropriate jurisdictional agencies for the use of premises not available for use by the Owner, including all offsite staging areas, borrow pits and waste areas. Submit copies of all permits and approvals to the Owner prior to using areas.
    - e. Provide for the disposal of waste materials off-site in accordance with all applicable laws.
    - f. Adhere to the limits of Work as indicated, to minimize obstruction to traffic and inconvenience to the Owner. Keep fire hydrants on or adjacent to the Work accessible to fire fighting equipment at all times.
    - g. Maintain access to businesses and residences including driveways and parking lots at all times during the Work.

## PART 2 PRODUCTS

### 2.1 MATERIALS FURNISHED BY OWNER

- A. The Owner will not furnish any materials, labor or equipment under this Contract.

## PART 3 EXECUTION – NOT USED

### END OF SECTION

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## SECTION 01140

## WORK RESTRICTIONS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Work Schedule
  - 2. Construction Constraints
- B. Related Requirements
  - 1. Section 01310 - Coordination
  - 2. Section 01325 - Scheduling of Construction

## 1.2 SUBMITTALS

- A. Incorporate the requirements of this Section in the project schedule submitted under Section 01325.

## 1.3 WORK SCHEDULE

- A. Conduct the Work on Monday through Friday, and within the time between 7:00 a.m. and 5:00 p.m. Work may be allowed on Owner's holidays, Saturdays, Sundays or outside of the work hours described above only with written permission from the Owner.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION

## 3.1 CONSTRUCTION CONSTRAINTS

- A. The following are constraints for the Work. Incorporate these constraints into the schedule required to be submitted under Section 01325.
  - 1. All components of the existing facility must remain in operation throughout construction of the new facility unless otherwise specified herein or in Section 01310.

END OF SECTION

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## SECTION 01150

## SECURITY DOCUMENTATION

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Security documentation and approval of Contractor's and subcontractors' employees required for access to the Site

## 1.2 SUBMITTALS

## A. Informational Submittals

1. Security documentation for each employee of the Contractor and all subcontractors requiring access to the Site including:
  - a. Name, social security number, date of birth, and current address
  - b. Operator's license number
  - c. Employment history (most recent 5 years)
  - d. Citizenship status
  - e. Criminal history, if applicable
  - f. Any other security related documentation maintained by the employer
  - g. A release (see attached form) signed by the employee authorizing the release of information to the Owner
2. Submit documentation to the Owner at least 10 days before commencing on-Site work.

## 1.3 CREDENTIALS REQUIRED FOR SITE ACCESS

- A. All persons must present acceptable photo identification prior to entering the facility. Acceptable forms of identification include:
  1. Current driver's license issued in the United States
- B. Only pre-approved employees will be allowed access to the Site. Any employee substitutions during the execution of the Work must be pre-approved by the Owner. The Owner reserves the right to conduct additional background checks on any employee of the Contractor or subcontractors and to deny Site access to any person who, in the opinion of the Owner, represents a security risk.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION – NOT USED

END OF SECTION

*Include release form if required in 1.2 A*

**RELEASE FORM**

Case Number: \_\_\_\_\_

I, the undersigned, \_\_\_\_\_ authorize all law enforcement agencies, courts, and former employers to release information they may have about me to Providence Water Supply Board or its agents, and release them from liability or responsibility from doing so.

A photocopy of this release shall be as valid as an original thereof, even though said photocopy does not contain an original writing of my signature.

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

Name (Please print): \_\_\_\_\_

Maiden Name (or also known as): \_\_\_\_\_

Address: \_\_\_\_\_

Previous Addresses: \_\_\_\_\_

Date of Birth: \_\_\_\_\_

Social Security Number: \_\_\_\_\_

Driver License No. \_\_\_\_\_ State: \_\_\_\_\_

Other Form of ID: \_\_\_\_\_ Number: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Are You Authorized To Work in the United States? Yes \_\_\_\_\_ No \_\_\_\_\_

Indicate How You Are Authorized: U.S. Citizen \_\_\_\_\_ Permanent Resident \_\_\_\_\_

Other, Please Specify \_\_\_\_\_ Permanent Resident (Alien#)A \_\_\_\_\_

Attach COPY of Photo Identification/Permanent Resident Card to this form.

## SECTION 01290

## APPLICATION AND CERTIFICATE FOR PAYMENT

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Definition and description of measurement and payment to be used for the Work
  - 2. Payment procedures
  - 3. Payment requests for stored materials
- B. Related Requirements
  - 1. Section 01295 - Schedule of Values

## 1.2 GENERAL

- A. The following paragraphs describe payment procedures for the work to be done under the respective items in the Bid Form.
- B. Each lump sum will be deemed to include an amount considered by the Contractor to be adequate to cover the Contractor's overhead and profit for each separately identified item.
- C. Except as provided for in Section 01295, no separate measurement or payment will be made for Work called for in Division 0 or Division 1 of the Contract Specifications, unless specifically covered under the Bid items listed below. All costs associated with this Work will be considered incidental to the Contract Bid price.
- D. Division 2 through Division 16 Work will be measured and paid for at the Contractor's Bid price or lump sum Bid price as indicated on the Bid form. Those payable Work items, and related prices as Bid, will be the basis for all compensation to the Contractor for Work performed under this Contract. Work not specifically included as a Bid item, but which is required to properly and satisfactorily complete the Work is considered ancillary and incidental to the Bid item Work, and payment for such Work is considered to be included in the values as Bid for payable items.

## 1.3 LUMP SUM ITEMS

- A. Each lump sum price stated in the Bid form shall constitute full compensation for all labor, equipment and materials necessary and required to complete the work specified under that particular item, and also all costs for doing related work as set forth in the Contract Documents or implied in carrying out their intent.
  - 1. Measurement
    - a. There will be no measurement of quantities for lump sum items. Periodic partial payments for this Work, included under the Agreement, shall be based on the percent completion of each work item listed in the Schedule



of Values provided under Section 01295 estimated by the Contractor and approved by the Engineer.

2. Payment

- a. The lump sum payment shall be full compensation for furnishing all labor, materials, tools, equipment, and services necessary for the construction of the Project, in its entirety as detailed in the Contract Documents.

1.4 PAYMENT PROCEDURES

A. Informal submittal: Unless otherwise directed by the Engineer:

1. Make an informal submittal of request for payment by filling in, with erasable pencil, pertinent portions of EJCDC C-620, Contractor's Application for Payment, plus continuation sheet or sheets.
2. Make this preliminary submittal to the Engineer at the last regular job meeting of each month.
3. Revise the preliminary submittal as approved by the Engineer and incorporate the approved payments into the formal submittal.

B. Formal submittal: Unless otherwise directed by the Engineer:

1. Make formal submittal of request for payment by filling in the agreed data, by typewriter or electronically on EJCDC C-620, Contractor's Application for Payment, plus continuation sheet or sheets.
2. Sign and notarize the Application for Payment.
3. Submit the original of the Application for Payment, plus six identical copies of the continuation sheet or sheets, to the Engineer.
4. The Engineer will compare the formal submittal with the approved informal submittal and, if acceptable, will sign the Contractor's Application for Payment, and present the Application to the Owner.
5. Provide a signed and notarized Certificate for Stored Materials and proof of storage in a dry, watertight, heated and insured warehouse facility.

1.5 PAYMENT REQUESTS FOR STORED MATERIALS

- A. Requests for payment for stored materials shall be made in accordance with Section 00700 and shall be accompanied by the attached "Certificate for Stored Materials" form. Payment for stored materials shall not exceed the value actually paid by the Contractor for the stored materials as evidenced by the accompanying bill of sale, invoice, or other documentation.
- B. Partial payment requests for materials stored or so-called "engineering costs" by equipment manufacturers will not be allowed. All such costs shall be distributed proportionately among the various items of equipment/hardware to be furnished.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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CERTIFICATE FOR STORED MATERIALS

\_\_\_\_\_ Tighe & Bond Project No.

We, \_\_\_\_\_, request payment for materials and/or equipment not incorporated in the work included under our firm's contract with \_\_\_\_\_ as listed below.

We hereby certify under penalty of perjury, that the materials not incorporated in the work have been delivered and are securely stored at the site or at \_\_\_\_\_ and that we have title to said materials free and clear of all Liens, as evidenced by the attached bill of sale, invoice, or other documentation.

We also certify that an inventory of said materials and/or equipment has been compiled for the purposes of this monthly partial payment request. This list of materials and/or equipment, including unit prices for said material not incorporated in the work for which payment is hereby requested, consisting of \_\_\_\_\_ pages and dated \_\_\_\_\_, is signed and attached hereto.

We acknowledge that payments made based on this request for materials and/or equipment not incorporated in the work does not relieve the contractor of its responsibility for furnishing all materials and equipment required for the satisfactory completion of the project pursuant to the contractual requirements.

We further certify that we can and will adequately protect said materials and/or equipment until they are incorporated in the work; that they meet the requirements of the specifications, and that they will be needed for incorporation in the work in the near future.

IN WITNESS WHEREOF, we, the said \_\_\_\_\_ h-  
ereunto set our hand and seal this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Contractor's Firm Name

SIGNED, SEALED AND DELIVERED IN THE PRESENCE OF

By \_\_\_\_\_

Title \_\_\_\_\_

\_\_\_\_\_  
Notary Public

**SCHEDULE OF STORED MATERIALS**

Job No. \_\_\_\_\_  
 Contract No. \_\_\_\_\_  
 Contractor: \_\_\_\_\_  
 Location: \_\_\_\_\_

Date \_\_\_\_\_  
 Pay Estimate \_\_\_\_\_

Item	Description	Supplier/Manufacturer	Quantity Stored and not Incorporated	Unit \$	Certified Value

Signature: \_\_\_\_\_  
 Contractor's Principal

Total Amount Due for Stored Materials \_\_\_\_\_

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				
Number	Additions	Deductions		
TOTALS				
NET CHANGE BY				
CHANGE ORDERS				

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

<b>Contractor's Certification</b>	
<p>The undersigned Contractor certifies that to the best of its knowledge: (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 Work covered by prior Applications for Payment; (2) title of 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 Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.</p>	
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 Agency (if applicable) (Date)



## SECTION 01295

## SCHEDULE OF VALUES

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Schedule of Values

## 1.2 SUBMITTALS

- A. Action Submittals
  - 1. Submit 3 copies of the Schedule of Values for approval within 10 days after the Effective Date of the Agreement.

## 1.3 SCHEDULE OF VALUES

- A. Schedule of Values shall be a detailed breakdown of the lump sum Work items showing values allocated to the various elements of the Work.
- B. The format of the Schedule of Values shall be a breakdown by Specification Section and content and shall be submitted on EJCDC C-620, Contractor's Application for Payment. The Engineer may require additional detailed documentation to support the values in the form of executed purchase orders, subcontracts, or other agreements.
- C. The Engineer will determine the level of breakdown and detail required. The breakdown shall include materials, installation, and start-up for equipment and controls where applicable. The final document will be the basis of payment requests for the duration of the Contract. No progress payment will be made until the Schedule of Values is approved by the Engineer.
- D. An unbalanced Schedule of Values providing overpayment on items of work performed first will not be accepted.
- E. At the Contractor's option, items for mobilization and demobilization may be included in the Schedule of Values. The combined value shall not exceed 5 percent of the Contract Price, and the values for mobilization and demobilization shall be equal. Payment for mobilization will be included in the first payment request after the Contractor has initiated full-time construction activity. Payment for demobilization will be included in the first payment request after Substantial Completion has been reached and all equipment has been removed from the Site.
- F. At the Contractor's option, an item for bonds and insurance may be included in the Schedule of Values. If included, requests for payment including values for bonds and insurance shall be accompanied by matching invoices.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION – NOT USED

END OF SECTION

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## SECTION 01310

## COORDINATION

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Project Management
  - 2. Coordination
  - 3. Project Meetings
- B. Related Requirements
  - 1. Section 01140 - Work Restrictions
  - 2. Section 01325 - Scheduling of Construction
- C. Related Work Not Included
  - 1. Operation of existing facilities will be performed by the Owner unless otherwise specified. The Owner will assist in arranging operation of any existing facilities or equipment required by the Contractor to connect to existing facilities, and the Contractor shall not operate existing valves or equipment. Only the Owner will operate Owner valves.

## 1.2 SUBMITTALS

- A. Incorporate the requirements of this Section, as well as Work which may impact the existing system operation, or the operations of any adjacent utility, in the project schedule submitted under Section 01325.
- B. Informational Submittals
  - 1. Submit to the affected utility company, the Owner, and the Engineer, in writing, all requests for temporary shutdowns of facilities or interruption of operations. No shutdowns or interruptions to existing operations will be permitted except as outlined in this Section. Submit requests at least 2 weeks prior to the beginning of the Work requiring shutdown or interruption. No shutdown shall occur without the approval of the utility company or the Owner.
  - 2. At the pre-construction conference, supply to the Owner the cell phone number of a responsible person who may be contacted during off-hours for emergencies 24 hours a day, seven days a week.
  - 3. Prepare a contact list of phone numbers, including cell phone numbers, and emails for all Project personnel and submit to the Engineer at the pre-construction conference. Include Contractor, Owner, Engineer, and Scituate, RI personnel including police, fire, and ambulance.

## 1.3 COORDINATION

- A. Do not interfere with the operation of the existing facilities.

- B. Coordinate with appropriate utility companies, as well as with the Owner, where the Work crosses or is adjacent to existing utilities.

#### 1.4 PROJECT MEETINGS

##### A. Pre-Construction Conference

1. The Contractor shall be prepared to discuss the following subjects at the Pre-Construction Conference. Documentation for these items is required to be submitted within the time frames included in individual specification sections.
  - a. Project scheduling
  - b. Sequencing of critical path Work items
  - c. Shop Drawing procedures
  - d. Project changes and clarification procedures
  - e. Use of sites, access to Work areas, office and storage areas, security and temporary facilities
  - f. Contractor safety plan and representative
  - g. Progress payments and procedures
  - h. Required documentation
  - i. Project personnel contact list

##### B. Progress Meetings

1. Progress meetings will be held every 2 weeks and at other times as requested by the Owner or as required by the Progress of the Work.
2. The Contractor's Superintendent shall attend all progress meetings.
3. At a minimum, progress meetings will review Work progress, schedule, Shop Drawing submission schedule, Applications for Payment, and other matters needing discussion and resolution.
4. Review the schedule with all parties to be affected by upcoming work.
5. Review the monthly construction report required under Section 01325.

#### PART 2 PRODUCTS - NOT USED

#### PART 3 EXECUTION

##### 3.1 GENERAL

##### 3.2 COORDINATION WITH THE OWNER'S OPERATIONS

- A. Notify the Owner and Engineer, in writing, a minimum of 1 week in advance of commencing Work on site. Work on site shall not occur until permits are obtained.
- B. Notify the Owner and Engineer, in writing, a minimum of 1 week before commencing any work which may affect the Owner's operations.

- C. Perform all construction activities so as to avoid interference with operations of the facility and the work of others.
- D. Coordinate the following operations with the Owner and the Engineer:
  - 1. Operation of existing valves. The opening and closing of existing valves will be performed by the Owner.
  - 2. Operation of the existing water treatment facilities. The Owner will operate all existing facilities. Do not operate any existing equipment without the Owner's approval. The Owner will operate existing facilities or equipment that may be required in order for the Contractor to make connections to existing facilities.
- E. The Owner has the authority to order the Work stopped which could unreasonably result in stopping the necessary functions of the water treatment facility. Any costs and/or delays associated with these work stoppages due to the Contractor's operation shall be borne by the Contractor.

### 3.3 SEQUENCE OF CONSTRUCTION

- A. Constructing the proposed improvements while maintaining existing operations will require a specific sequence of construction. The Contractor will be allowed reasonable flexibility in scheduling the construction activities. Provide a detailed construction schedule as required in Section 01325.

END OF SECTION

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SECTION 01320

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Photographs taken at specified intervals before and after construction.

1.2 SUBMITTALS

A. Informational Submittals

1. Submit electronic files of each photograph on a CD or USB flash drive.

PART 2 PRODUCTS

2.1 CONSTRUCTION PHOTOGRAPHS

- A. Electronic files shall be in .jpg format.

PART 3 EXECUTION

3.1 PRE-CONSTRUCTION PHOTOGRAPHY

- A. Provide a minimum of 12 preconstruction photographs in each area of construction, or more as required to document the preconstruction condition of the Site and adjacent properties. Request Owner to accompany photographer, who may provide input on photos to capture.

3.2 PROGRESS PHOTOGRAPHY

- A. Take construction photographs of active work areas at least every 3 weeks throughout the life of the Contract. The photographs shall be indicative of the work that is currently in progress. A minimum of 3 photographs shall be taken at each scheduled interval at each location where Work is in progress.

3.3 POST-CONSTRUCTION PHOTOGRAPHY

- A. Provide post construction photography after all Work has been completed at each location. The locations to be photographed and the number of photographs required shall be as specified in Paragraph 3.1 for the preconstruction photography.

END OF SECTION

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## SECTION 01330

## SUBMITTAL PROCEDURES

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Action Submittals
  - 2. Informational Submittals

## 1.2 DEFINITIONS

- A. Action Submittals – includes written and graphic information submitted by Contractor that requires Engineer’s approval.
- B. Informational Submittals – includes information submitted by Contractor that does not require Engineer’s approval. The Engineer will acknowledge receipt of such documents and provide comments when the submittals lack the detail required by the Contract Documents.

## 1.3 ACTION SUBMITTALS

- A. Shop Drawings
  - 1. Shop Drawings as defined in the General Conditions, and as specified in individual work sections include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation drawings, schedule information, piece part drawings, actual shop work manufacturing instructions, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certification, as applicable to the Work.
  - 2. Shop Drawings shall be of standardized sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard size drawings shall be
    - a. 24 inches by 36 inches
    - b. 22 inches by 34 inches
    - c. 11 inches by 17 inches
    - d. 8.5 inches by 11 inches
  - 3. Submit Shop Drawings at the proper time to prevent delays in delivery of materials. Coordinate submittals for related or interdependent equipment.
  - 4. Advise the Engineer in writing of any deviations from the requirements of the Contract Documents.
  - 5. Check all Shop Drawings regarding measurements, size of members, materials, and details to determine if they conform to the Contract Documents. Shop Drawings found to be inaccurate, not in compliance, or otherwise in error shall

be returned to the Subcontractors or Suppliers for correction before submission to the Engineer. Drawings that are current shall be marked with the date, name, and approval stamp of the Contractor.

6. All details on Shop Drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the Shop Drawings before being submitted for approval.
  7. Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be drawn to scale and fully dimensioned.
  8. No material or equipment shall be purchased or fabricated until the required Shop Drawings have been submitted and approved. Materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by the Shop Drawings.
  9. Until the necessary approval has been given, do not proceed with any portion of the work, the design or details of which are dependent upon the design or details of work, materials, equipment or other features for which approval is required.
  10. If submitted equipment requires modifications to the structures, piping, layout, or other details shown on the Drawings, details of the proposed modifications must also be submitted for approval. If such equipment and modifications are approved, perform all Work necessary to make such modifications at no additional cost to the Owner.
- B. Product Data: Product data as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing, and printed product warranties, as applicable to the Work.
- C. Samples and color selection charts: Provide sample, when requested by individual Specification to establish conformance with the Specifications, and as necessary to define color, texture and pattern selections available.
- D. Product Substitutions: In accordance with Section 01630.
- E. Operation and Maintenance Manuals: In accordance with Section 01770.
- F. Schedule of Values: In accordance with Section 01295.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Schedule of Submittals

1. Submit a preliminary Schedule of Submittals within 10 days of the Effective Date of the Agreement in accordance with Article 2.05 of Section 00700.
- B. Schedule of Manufacturers and Suppliers
1. Submit a schedule of manufacturers and Suppliers within 7 days after Notice to Proceed including the names and addresses of the manufacturers and Suppliers of materials and equipment to be incorporated into the Work.
- C. Schedule of Major Products
1. Submit a schedule of major products within 30 days after Notice to Proceed including a complete list of major products proposed for use, with specification section number, name of manufacturer, trade name, and model number of each product.
- D. Product Listing and Manufacturers Qualifications
1. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation and reference standards. Specifically identify the products, the anticipated schedule for delivery and storage, and the estimated value thereof for materials which the Contractor intends to request approval for off-site storage.
- E. Certificates of Compliance
1. General:
    - a. Submit sworn certificates from the manufacturer or material supplier that the materials and fabrications provided under the Specification section conform with the Contract Documents.
    - b. Certificates shall be signed by an officer of the manufacturer's corporation and witnessed by a Notary Public.
  2. Welding: Submit in accordance with individual Specification sections.
  3. Installer: Prepare written statements on manufacturer's letterhead certifying that installer complies with requirements as specified in individual Specification sections.
  4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
  5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency, or when specified in individual Specification sections.
  6. Manufacturer's Certificate of Compliance: In accordance with individual Specification sections.
- F. Application for Payment
1. Submit applications for payment in accordance with Section 01270, Measurement and Payment or Section 01290, Application and Certificate for Payment.

2. Submit schedule of stored materials when requesting payment for materials not yet installed.
- G. Construction Photography: Provide preconstruction, progress, and post-construction photography and videography in accordance with Sections 01320 and 01321.
- H. Contract Closeout Submittals: In accordance with Section 01770.
- I. Contractor Design Data
1. Written and graphic information
  2. List of assumptions
  3. List of performance and design criteria
  4. Summary of loads or load diagram
  5. Calculations
  6. List of applicable codes and regulations
  7. Name and version of software
  8. Information requested in individual Specification section
- J. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification sections.
- K. Schedules - Submit construction progress schedules and schedule updates in accordance with Section 01325.
- L. Statement of Qualifications: Submit evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty subcontractor, trade, specialist, consultant, installer, and other professionals.
- M. Submittals Required by Laws, Regulations, and Governing Agencies
1. Submit promptly notifications, reports, certifications, payrolls, and other required information as may be required, directly to the applicable federal, state, or local governing agency or their representative.
  2. Transmit to Engineer for Owner's records, one copy of correspondence and transmittals (including enclosures and attachments) between Contractor and governing agency.
- N. Test and Inspection Reports
1. Submit test and inspection reports as required by individual Specification sections.
  2. Test and inspection reports shall contain signature of person responsible for test or report.
  3. Reports shall include identification of product and Specification, project name, date and time of test, type of test, location, test results, corrective action



required if report indicates test is not in compliance with Contract Documents, interpretation of test results, and other information as required in individual Specification sections.

- O. Equipment Data: Submit information on equipment to be used in the performance of the Work as required by individual Specification sections.
- P. Testing and Start-up Data: Prepare and submit testing procedures proposed to perform testing required by individual Specification sections.
- Q. Vendor Training Plan: At least two weeks prior to scheduling training of Owner's personnel, submit lesson plans for vendor training in accordance with individual Specification section and manufacturer's Operations and Maintenance Manuals.
- R. Health & Safety Plans: When specified in individual Specification sections, prepare and submit a Health and Safety Plan modified or supplemented to include job-specific considerations.
- S. Submittals stamped by another Professional Engineer: When specified in individual Specification sections, prepare and submit calculations and/or drawings stamped by a Professional Engineer licensed in the State where the work is being performed.
- T. Coordination Drawings: When specified in individual Specification sections, prepare and submit drawings to show how multiple system and interdisciplinary work will be coordinated. Examples are conduit routing diagrams, duct layouts, utility coordination drawings, sprinkler plans etc.
- U. Work Plans: When specified in individual Specification sections, prepare and submit copies of all work plans needed to demonstrate to the Owner that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.
- V. Shutdown Requests: Submit notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities. Unless otherwise specified, provide outage requests a minimum of 7 days' notice shall be provided.
- W. Equipment Data: When specified in other Specification sections, information on equipment used by the Contractor to complete the Work, such as compaction equipment and closed-circuit television inspection equipment.

## 1.5 PROCEDURES

### A. Coordination

1. Prepare and submit documentation in advance of fabrication and product manufacturer, so that the installation will not be delayed, other related work can be properly coordinated, and there is adequate time for review and resubmission, if required.
2. Provide no less than 30 days for review of submittals from the time received by the Engineer. For submittals of major equipment, that require more than 30 days to review, due to complexity and detail or those requiring review by multiple engineering disciplines, Engineer will notify Contractor of the

- circumstances and identify the anticipated date when the submittal will be returned.
3. Re-submittals will be subject to same review time.
  4. No extension of time will be authorized due to failure to provide approvable submittals sufficiently in advance of the Work.
- B. Review Shop Drawings, product data, and samples prior to submission and verify and determine:
1. Field measurements
  2. Conformance with the Contract Documents. Advise the Engineer in writing of any deviations from the requirements of the Contract Documents.
  3. Delete or strike out information that is not applicable to the Work.
- C. Upload the electronic submittal files via Owner's eBuilder program. Access to eBuilder will be provided by the Owner. Files must be in .pdf format. The submittals will be returned in electronic .pdf format via eBuilder.
- D. Numbering: Submissions shall be accompanied by a transmittal form referencing the project name and applicable Specification section. Submittals shall be numbered sequentially, with the applicable Specification section and a hyphen preceding the number. (*e.g.* Submittal number 11330-01). Resubmittals shall bear the same transmittal number with a revision number commencing with "1" (*e.g.* Submittal number 11330-01-1).
- E. Provide a copy of the Submittal Certification Form (copy attached at the end of this section) which shall be attached to every copy of each submittal as required under Article 7.16 A.2 of Section 00700. Apply the Contractor's stamp and initials or signature certifying that the submission has been thoroughly reviewed for completeness, compliance with the Contract Documents, coordination with adjacent construction and dimensional compatibility. Items submitted without the stamp or that are incomplete will be returned by the Engineer for rework and resubmission.
- F. Provide a copy of the PE Certification Form (copy attached at the end of this section) which shall be attached to every copy of each submittal stamped by another Professional Engineer. Items submitted without the completed certification form will be returned by the Engineer for resubmission.
- G. Distribute copies of reviewed submittals along with the Engineer's transmittal to concerned parties with instructions to promptly report any inability to comply with the provisions or integrate the requirements with interfacing work.
- H. Partial and Incomplete Submittals
1. 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.

2. Engineer will return entire submittals if preliminary review deems it incomplete including:
    - a. Missing or incomplete Submittal Certification Form
    - b. Insufficient number of copies
    - c. Missing content
  3. Partial submittals may be considered, at Engineer's option, only when necessary to expedite the Project.
  4. Partial submittals shall be clearly identified as such on the transmittal to identify missing components.
- I. Submittals not required by the Specification will be returned without review or action code.
- J. Resubmission
1. Make corrections and modifications required by the Engineer and resubmit until approved.
  2. Clearly identify changes made to submittals and indicate other changes that have been made other than those requested by the Engineer.
  3. A maximum of two re-submissions of each shop drawing will be reviewed, checked and commented upon without charge to the Contractor (total of 3 submittals). Any additional submissions which are required by the Engineer to fulfill the stipulations of the Contract Documents will be charged to the Contractor as described in paragraph 7.16.E.2 of Section 00700.
- K. Distribution
1. Distribute approved Shop Drawings and approved product data to the Project Site and elsewhere as required to communicate the information to Suppliers, Subcontractors, and field personnel.

#### 1.6 ENGINEER'S REVIEW

- A. The Engineer will review submittals for design, general methods of construction and detailing. The Engineer's review and approval of submittals shall not be construed as a complete check nor does it relieve the Contractor from responsibility for any departures or deviations from the requirements of the Contract Documents unless he has, in writing, called the Engineer's attention to such deviations at the time of submission. It will not extend to means, methods, technique, sequences, or procedures of construction (except where specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto.
- B. The Engineer's review of the submittals shall not relieve the Contractor from the responsibility for proper fitting of the Work, or the responsibility of furnishing any work required by the Contract Documents which may not be indicated on the submittals. The Contractor shall be solely responsible for any quantities shown on the submittals.

- C. If the Contractor considers any correction indicated on the submittals to constitute a change to the Contract Documents, the Contractor shall provide written notice to the Engineer at least 7 working days prior to release for manufacture.
- D. When the submittals have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.
- E. Action submittals as defined in paragraph 1.2 will be reviewed and returned under one of the following codes:
  - 1. Approved (Action Code 1) is assigned when there are no notations or comments on the submittal. Equipment or materials may be released for manufacture, provided that it complies with requirements of the Contract Documents.
  - 2. Approved as Noted (Action Code 2) is assigned when there are notations or comments on the submittal, but the equipment or materials may still be released for manufacture. All notations and comments must be incorporated in the final product. Resubmission is not necessary.
  - 3. Revise and Resubmit (Action Code 3) is assigned when there are notations and comments requiring a resubmittal of the package. Work cannot proceed until the submittal is revised and resubmitted for review.
  - 4. Not Approved (Action Code 4) is assigned when the submittal contains non-specified items or does not meet the requirements of the Contract Documents. It may also be assigned when there is a significant amount of missing material required for the Engineer to perform a complete review. The entire package must be resubmitted, revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
- F. Informational submittals as defined in paragraph 1.2 do not require approval by the Engineer. Such submittals will be returned under one of the following codes:
  - 1. Receipt Acknowledged (Action Code 5) is assigned when the submittal is provided for documentation purposes and is acknowledged as received. Comments may be noted using this action code.
  - 2. Revise and Resubmit (Action Code 6) is assigned when there are notations and comments requiring a resubmittal of the package.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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**SUBMITTAL CERTIFICATION FORM**

PROJECT: \_\_\_\_\_  
ENGINEER: \_\_\_\_\_ ENGINEER'S PROJECT NO.: \_\_\_\_\_  
CONTRACTOR: \_\_\_\_\_ CONTRACTOR'S PROJECT  
NO.: \_\_\_\_\_

TRANSMITTAL NO.: \_\_\_\_\_ SUBMITTAL NO.: \_\_\_\_\_  
SPECIFICATION NO.: \_\_\_\_\_ DRAWING NO: \_\_\_\_\_  
DESCRIPTION: \_\_\_\_\_  
MANUFACTURER: \_\_\_\_\_

The above referenced submittal has been reviewed by the undersigned and I/we certify that the materials and/or equipment meets or exceeds the project specification requirements; that field measurements, dimensions, quantities, specified performance criteria, installation requirements, materials, catalog numbers and related materials have been verified; that all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the work has been determined and verified; that review includes all information related to the contractor's sole responsibility for means, methods, techniques, sequences, and procedures of construction and safety; and item has been coordinated with the overall project with:

- NO DEVIATIONS
  
- A COMPLETE LIST OF DEVIATIONS AS FOLLOWS:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SUBMITTED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

GENERAL CONTRACTOR'S STAMP
----------------------------

**PE CERTIFICATION FORM**

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of Rhode Island and that he/she has been employed by

\_\_\_\_\_ to design  
(Name of Contractor)

\_\_\_\_\_  
(Insert PE Responsibilities)

In accordance with Specification section \_\_\_\_\_ for the

\_\_\_\_\_  
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and PE stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

\_\_\_\_\_  
(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

\_\_\_\_\_  
PE Name

\_\_\_\_\_  
Contractor's Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Title

\_\_\_\_\_  
Address

\_\_\_\_\_  
Address

## SECTION 01350

## HEALTH &amp; SAFETY PLAN

## PART 1 GENERAL

## 1.1 SUMMARY

## A. The Contractor shall:

1. develop a site-specific Health and Safety Plan (HASP) specifically addressing the potential hazards that may be encountered at the work site. The HASP shall include the information described in this specification (as applicable) and meet all applicable OSHA requirements.
2. furnish all labor, equipment, materials, and employee training for effective implementation of the HASP and worker health and safety protection of all Contractor personnel.
3. furnish all labor, equipment, materials, and employee training to effectively complete any required air monitoring and/or decontamination.
4. review the requirements and data provided for the project and supplement the HASP with any additional measures deemed necessary to fully comply with applicable regulatory requirements and to adequately protect personnel on the site.
5. maintain a copy of the HASP at the worksite, accessible to employees working at the site.
6. post the emergency response plan section of the HASP, inclusive of emergency alerting and response procedures and directions to the nearest hospital, in a visible location for all workers to see.

## B. Related Sections

1. 02225 – Selective Demolition

## 1.2 SITE-SPECIFIC PROJECT CONDITIONS

- A. The Contractor shall review and understand all existing information as it relates to potential exposure to subsurface site contaminants, environmental data and reports. Reference Section 00800 for copies of applicable environmental data.
- B. The nature of the materials present at the site may require use of special protective clothing and the possible use of respiratory protective equipment, which is intended to help minimize worker exposure to known or suspected site hazards.
  1. Levels of personal protection are established in reference standards and generally described for Levels C and D herein. It is anticipated that a majority of the Work to be performed on this project may be performed at Personnel Protection Level D.
  2. The Contractor shall be responsible for determining if a higher level of personnel protection is required based on the criteria outlined in the

Contractor's HASP. In the event that the Contractor determines that a level of protection higher than Level D is required, the Contractor's personnel shall take the necessary steps outlined in the Contractor's HASP.

3. The Contractor shall notify the Engineer and Owner in writing prior to implementing any upgrades in personal protection. The Engineer will review the Contractor's notification and determine the need to notify other applicable agencies.

### 1.3 REFERENCES

- A. OSHA 29 CFR Part 1910 (General Industry standards)
- B. OSHA 29 CFR Part 1926 (Construction Standards)
- C. OSHA Regulation 29 CFR §1926.62 (Lead)

### 1.4 DEFINITIONS

- A. CHMM: Certified Hazardous Materials Manager, as certified by the Institute of Hazardous Materials Management.
- B. CIH: Certified Industrial Hygienist, as certified by the American Board of Industrial Hygiene®.
- C. CSP: Certified Safety Professional, as certified by the Board of Certified Safety Professionals.
- D. Site Safety and Health Official (SSHO): The individual located at a job site who is responsible to the Contractor and has the authority and knowledge necessary to implement the HASP and verify compliance with applicable safety and health requirements.

### 1.5 SUBMITTALS

- A. On-site Work shall not begin until the HASP has been submitted by the Contractor and accepted by the Owner/Engineer.
- B. Informational Submittals
  1. Submit the following within thirty (30) days after the Effective Date of the Agreement.
    - a. A site-specific HASP, including the information described in this Specification as applicable.
      - 1) The HASP must be reviewed, approved, and signed by Contractor representative, with specific responsibility for safety for the Contracting company.
      - 2) The Engineer's review is only to determine if the HASP is consistent with the minimum requirements of this specification. Engineer has no control over contractor's health & safety and the means and methods of health & safety implementation. Engineer also does not perform health & safety monitoring of Contractor's Work.



- 3) The review will not determine the adequacy of the HASP to address all potential hazards, as that remains the sole responsibility of the Contractor.
- b. Documentation of qualifications and experience of the SSHO.
- c. Applicable health and safety training records.

## 1.6 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor is solely responsible for the health and safety of workers employed by the Contractor, any subcontractor, vendors/manufacturers, site visitors and anyone directly or indirectly employed by any of them.
- B. Provide a designated SSHO for the project.
- C. Pre-arrange emergency medical care services at a nearby hospital or medical clinic, including establishment of an emergency notification process and emergency routes of travel.
- D. Conduct pre-entry and weekly safety meetings with all site personnel, documenting attendance and topics covered.
- E. Develop and implement the site-specific HASP, inclusive of the elements in contained in this specification.
- F. For projects where contaminated media are known, likely, or suspected to be encountered:
  1. monitor air quality in and around the work area using appropriate air monitoring equipment.
  2. develop and implement a respiratory protection program per 29 CFR §1910.134 and 29 CFR §1926.103 for all workers authorized to wear respirators.
  3. record all air quality readings and maintain records on site.
  4. stop work and/or upgrade respiratory protection or personal protective equipment levels if action levels established in the HASP are exceeded.
  5. ensure that the degree and type of respiratory protection provided is protective for the monitored concentrations and individual chemical parameters.
  6. lawfully dispose of all personal protective equipment that cannot be decontaminated.
- G. Provide a Lead Exposure Control Plan in accordance with 29 CFR §1926.62(e)(2).

## 1.7 HEALTH & SAFETY PLAN (HASP) REQUIREMENTS

- A. The following items shall be included/addressed in the HASP:
  1. a safety and health risk or hazard analysis for each site task and operation in the workplan;
    - a. a physical hazard evaluation and hazard control plan shall be included covering, but not limited to the following, as applicable:

- 1) equipment operation;
  - 2) confined space entry;
  - 3) slips, trips, and falls;
  - 4) building collapse;
  - 5) falling debris;
  - 6) encountering unmarked utilities;
  - 7) cold and heat stress;
  - 8) hot work (cutting and welding);
  - 9) drum and container handling;
  - 10) trench and/or excavation entry.
2. the employee safety and health training program covering each site task and operation in the workplan.
  3. personal protective equipment to be used for each site task and operation in the workplan.
  4. site control measures to address visitors, delivery personnel, and to protect the worksite from unauthorized access.
  5. an emergency response plan for the safe and effective response to foreseeable emergencies;
    - a. including, but not limited to the following:
      - 1) a map indicating the route to a nearby hospital or medical clinic for emergency medical care;
      - 2) procedures for emergency medical treatment and first aid;
      - 3) site evacuation routes and procedures;
      - 4) emergency alerting and response procedures.

## **PART 2 PRODUCTS**

### **2.1 AIR MONITORING EQUIPMENT**

- A. If organic vapors or total hydrocarbons are known, likely, or suspected to be encountered during the work:
  1. provide and maintain a portable photo-ionization detector (PID) or flame-ionization detector (FID) capable of detecting organic vapors or total hydrocarbons. Equipment shall be sensitive to the 0.5 parts per million (PPM) level.
- B. If hazardous atmospheres (oxygen, hydrogen sulfide, carbon monoxide, methane, etc.) are known, likely, or suspected to be encountered during the work:

1. provide and maintain an applicable multi-gas analyzer to measure concentrations in applicable work environments (i.e. confined spaces, trenches, tunnels, buildings, etc.).
- C. If there is a potential for the accumulation of explosive gas:
1. provide and maintain an explosimeter (LEL meter).
- D. If there is a potential for visible dust emissions on the site, dust monitoring must be considered.
1. The Contractor is responsible for monitoring fugitive dust emissions in accordance with applicable local, state, and federal regulations.
  2. Equipment shall be sensitive to particulate matter less than 10 micrometer in size (PM<sub>10</sub>) at a level of 100 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ).
  3. Contractor shall outline the dust monitoring program in their HASP, including applicable action levels.
- E. All air monitoring equipment shall remain the property of the Contractor.
- F. All air monitoring equipment readings must be recorded and be available for federal, state, and/or local regulatory personnel to review.

## 2.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

- A. All PPE must conform to the OSHA requirements, as indicated in the previous Reference Standards Section. Various PPE to be furnished by the Contractor under different levels of protection for their own personnel and subcontractor's personnel include, but are not limited to, the following:
1. Level D Protection:
    - a. Coveralls or Tyvek
    - b. Gloves
    - c. Safety boots/shoes
    - d. Safety glasses
    - e. Hearing protection (for high noise operations)
    - f. Hard hat with optional face shield
  2. Level C Protection:
    - a. Air-purifying respirator
    - b. Chemical protective overalls or Coveralls (e.g., Saran coated Tyvek)
    - c. Gloves, inner (disposable, surgical type)
    - d. Gloves, outer (Neoprene, Nitrile, Viton or Butyl)
    - e. Boots, chemical protective, steel toe and shank (Neoprene or Nitrile)
    - f. Booties, chemical protective (disposable PVC)

- g. Hard hat
  - h. Face shield (if necessary)
3. Levels B and A represent increased levels of personal protection and are described in the Reference Standards.
  4. Contractor is fully responsible for all PPE selection (including the various stages of protection), proper use, maintenance, and continuous monitoring.

### **PART 3 EXECUTION**

#### **3.1 HEALTH AND SAFETY PLANNING AND IMPLEMENTATION**

- A. Implement the HASP throughout the execution of all applicable work.
- B. The Contractor shall perform all monitoring as detailed in the HASP.
- C. Contractor(s) shall implement routine health and safety meetings and any follow-up supplemental briefings.
- D. Provide applicable health and safety training for all personnel who may come in contact with or be exposed to various dangerous, hazardous, or changing site conditions.
- E. Personnel who have not received applicable training and who are not equipped with the required PPE, shall not be permitted access to the site by the Contractor during the course of the work that may result in potential exposures to unsafe or hazardous site conditions.

#### **3.2 PERSONNEL AND EQUIPMENT DECONTAMINATION**

- A. All equipment shall be provided to the work site free of contamination. Engineer may prohibit from the site any equipment which in his opinion has not been thoroughly decontaminated prior to arrival. Any decontamination of Contractor's equipment prior to arrival at the site shall be at the expense of Contractor. Contractor is prohibited from decontaminating equipment on the project site which is not thoroughly decontaminated prior to arrival.
- B. Contractor shall furnish labor, materials, tools, and equipment for decontamination of all personnel, equipment and supplies which are used to handle contaminated materials.
- C. Properly store and dispose of contaminated PPE and all other generated decontamination waste.

#### **3.3 INCIDENT REPORTING**

- A. The Contractor shall comply with all accident and/or incident reporting requirements, including the following:
  1. Should any unforeseen safety-related factor, hazard, or condition become evident during the course of the work, the Contractor must immediately take action to establish, maintain, and secure the site and working conditions. This shall be followed by immediate notice to the Owner and Engineer.

2. If injury to any person on-site occurs, the Contractor shall immediately report the incident to the Owner and Engineer. Corrective actions shall be implemented.

END OF SECTION

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## SECTION 01420

## REFERENCES

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Standards referenced in the Contract Documents.

## 1.2 GENERAL

- A. Comply with the requirements of standards referenced in the Contract Documents.

## 1.3 ABBREVIATIONS

## A. Abbreviations used in the Specifications are defined as follows:

1. AA - Aluminum Association
2. AABC - Associated Air Balance Council
3. AASHTO - American Association of State Highway and Transportation Officials
4. ACI - American Concrete Institute
5. ACOE - U.S. Army Corps of Engineers
6. ADA - Americans with Disabilities Act
7. ADC - Air Diffusion Council
8. AFBMA - Antifriction Bearing Manufacturers Association
9. AGA - American Gas Association
10. AGC - Associated General Contractors of America
11. AGMA - American Gear Manufacturer Association
12. AI - Asphalt Institute
13. AIA - American Institute of Architects
14. AISC - American Institute of Steel Construction
15. AISI - American Iron and Steel Institute
16. AITC - American Institute of Timber Construction
17. AMCA - Air Movement and Control Association
18. ANSI - American National Standards Institute
19. APA - American Plywood Association
20. API - American Petroleum Institute

21. ARI – Air Conditioning and Refrigeration Institute
22. ASCE – American Society of Civil Engineers
23. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers
24. ASME – American Society of Mechanical Engineers
25. ASPA – American Sod Producers Association
26. ASTM – American Society for Testing and Materials
27. AWG – American Wire Gauge
28. AWI - Architectural Woodwork Institute
29. AWPA – American Wood Preservers’ Association
30. AWS – American Welding Society
31. AWWA – American Water Works Association
32. BIA – Brick Institute of America
33. CDA – Copper Development Association
34. CLFMI – Chain Link Fence Manufacturer’s Institute
35. CPM - Critical Path Method
36. CPVC – Chlorinated Polyvinyl Chloride
37. CRSI – Concrete Reinforcing Steel Institute
38. CI – Cast Iron
39. DHI – Door and Hardware Institute
40. DI – Ductile Iron
41. EJCDC – Engineers’ Joint Contract Documents Committee
42. EJMA – Expansion Joint Manufacturers Association
43. EPDM – Ethylene Propylene Diene Monomer
44. EPT – Electrical Plastic Tubing
45. EVT – Equiviscous Temperature
46. FGMA - Flat Glass Marketing Association
47. FM – Factory Mutual
48. FS – Federal Specifications
49. GA – Gypsum Association
50. GFCI – Ground Fault Circuit Interrupter
51. GPR - Ground Penetrating Radar

52. GPS – Global Positioning System
53. HVAC – Heating, Ventilating and Air Conditioning
54. IBC – International Building Code
55. IBR – Institute of Boiler and Radiator Manufacturers
56. ICBO – International Conference of Building Officials
57. ICS – Industrial Control and Systems
58. IEEE – Institute of Electrical and Electronics Engineers
59. IMI – International Masonry Institute
60. ISA – Instrument Society of America
61. JIC – Joint Industrial Council
62. LCD – Liquid Crystal Display
63. MBMA – Metal Building Manufacturer’s Association
64. MFMA Maple Flooring Manufacturers Association
65. ML/SFA – Metal Lath/Steel Framing Association
66. MSS – Manufacturer’s Standardization Society
67. NAAMM – National Association of Architectural Metal Manufacturers
68. NAVD – North American Vertical Datum
69. NCMA – National Concrete Masonry Association
70. NEBB – National Environmental Balancing Bureau
71. NEC – National Electrical Code
72. NECA – National Electrical Contractors Association
73. NEMA – National Electrical Manufacturers Association
74. NFPA – National Fire Protection Association
75. NRCA – National Roofing Contractors Association
76. NRS – Non-rising Stem
77. NSF – National Sanitation Foundation
78. NSWMA – National Solid Waste Management Association
79. NWMA – National Woodwork Manufacturers Association
80. O&M – Operation and Maintenance
81. OSHA – Occupational Safety and Health Administration
82. PCA – Portland Cement Association



83. PCI – Precast/Prestressed Concrete Institute
84. PDOP – Positional Dilution of Precision
85. PLC – Programmable Logic Controller
86. PS – Product Standard
87. PVC – Polyvinyl Chloride
88. QA/QC – Quality Assurance/Quality Control
89. RCP – Reinforced Concrete Pipe
90. RCSHSB – Red Cedar Shingle and Handsplit Shake Bureau
91. RIS – Redwood Inspection Service
92. RTU – Remote Telemetry Unit
93. SCADA – Supervisory Control and Data Acquisition
94. SDI – Steel Deck Institute
95. SDS – Safety Data Sheets
96. SSPC – Steel Structures Painting Council
97. TCA – Tile Council of America
98. UL – Underwriter’s Laboratories
99. UPS – Uninterruptable Power Supply
100. USCS – Unified Soil Classification System
101. USDA – United States Department of Agriculture
102. WCLIB – West Coast Lumber Inspection Bureau
103. WOG – Water, Oil, Gas
104. WWPA – Western Wood Products Association

END OF SECTION

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## SECTION 01450

## QUALITY CONTROL

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Quality assurance and control of the Work
  - 2. Testing and inspection services
  - 3. Product test reports
  - 4. Manufacturer's field service
- B. Related Requirements
  - 1. Section 01451 - Independent Testing Services
  - 2. Testing requirements are described in various Sections of the Project Manual.

## 1.2 SUBMITTALS

- A. Informational Submittals
  - 1. Product test reports

## 1.3 QUALITY ASSURANCE

- A. Monitor quality control over Suppliers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. Comply fully with manufacturer's instructions. Should these instructions conflict with the Specifications, request clarification from the Owner before proceeding.
- C. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or requirements indicate higher standards or more precise workmanship.

## 1.4 TESTING SERVICES FURNISHED BY CONTRACTOR

- A. Furnish all testing services required for materials and equipment proposed to be used in the Work, and quality control tests made in the field including:
  - 1. Concrete materials and mix designs
  - 2. Concrete in place
  - 3. Modified proctor analyses for all borrow materials used on the Project
  - 4. Sieve analyses for all borrow materials used on the Project
  - 5. Field welded joints
  - 6. All other tests and engineering data as required in the Contract Documents.
- B. Testing agencies must meet the requirements of Section 01451.

- C. An independent commercial testing laboratory, with current Rhode Island certification, shall perform all tests that require the services of a laboratory to determine compliance with the Contract Documents. Independent testing laboratory requirements are defined under Section 01451.
- D. Secure and deliver the required number of samples to the laboratory as required by the Contract Documents.
- E. Notify Owner and Engineer of time, location and material being sampled.
- F. Schedule necessary testing laboratory services.
- G. Furnish written reports of each test within 48 hours of completion of testing.
- H. Notify the Engineer 48 hours prior to operations requiring inspections and laboratory testing services so the Engineer may witness testing. All failed test areas shall be re-worked and re-tested until passing results are obtained.
- I. The Owner may hire its own independent testing laboratory for quality control tests made in the field or laboratory on materials and equipment during and after their incorporation in the Work. Cooperate with the Owner and independent testing laboratory and furnish samples of materials, design, mix, equipment, tools, storage, and assistance as requested.
- J. Re-work all failed test areas until passing results are obtained. All re-tests required as a result of the Contractor's failure to perform the work in accordance with the Contract Documents shall be at the Contractor's expense.

#### 1.5 CODE COMPLIANCE TESTING

- A. Provide inspections and tests required by codes or ordinances, or by a legally constituted authority having jurisdiction over the Work.

#### 1.6 PRODUCT TEST REPORTS

- A. Submit 2 copies of product test reports where required by the Contract Documents.

#### 1.7 SUPPLIERS' FIELD SERVICE

- A. Provide qualified field service and installation personnel from material and equipment Suppliers to observe site conditions, installation techniques, quality of workmanship, equipment start-up, adjustment, and performance test where required by the Contract Documents. Observations are to be reported and incorporated in the Work procedures.

#### PART 2 PRODUCTS - NOT USED

#### PART 3 EXECUTION - NOT USED

END OF SECTION

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## SECTION 01451

## INDEPENDENT TESTING SERVICES

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Independent testing services including geotechnical, concrete, grout and mortar, and welding inspection and testing
2. Testing laboratory services

## B. Related Requirements

1. Section 01450 - Quality Control
2. Section 03300 - Cast-in-Place Concrete
3. Section 04810 - Unit Masonry Assemblies

## 1.2 REFERENCES

## A. General

1. ASTM E329 – Standard Specifications for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

## B. Concrete Testing

1. Cement and Concrete Reference Laboratory (CCRL)

## C. Welding Inspection

1. AWWA D-100-96 or latest version - AWWA Standard for Welded Steel Tanks for Water Storage
2. American Welding Society (AWS) B1.11 - Guide for the Nondestructive Examination of Welds
3. AWS B5.1 - Specifications for the Qualifications of Welding Inspectors
4. AWS B5.15 - Specifications for the Qualifications of Radiographic Interpreters
5. AWS ARE - 6 Test Methods for Evaluating Welded Joints
6. AWS ARE - 10 Monitoring and Control of Welding and Joining Processes

## D. Coating Inspection

1. National Association of Corrosion Engineers (NACE)
2. SSPC – The Society for Protective Coatings

## E. Masonry Inspection

1. ACI 530-02/ASCE 5-02 TMS 402-02 – Building Code Requirements for Masonry Structures

2. ACI 530.1-02/ASCE 6-02 TMS 602 – Specifications for Masonry Structures
3. ASTM C780 – Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Masonry
4. ASTM C1019 – Standard Test Methods for Sampling and Testing Grout

### 1.3 SUBMITTALS

#### A. Informational Submittals

1. Qualifications, experience, and certifications of each proposed testing service
2. Certificate of calibration for testing equipment
3. Inspection and test reports

### 1.4 QUALITY ASSURANCE

#### A. General

1. Comply with the requirements of Section 01450, Quality Control, for testing and inspection requirements.
2. Testing services shall have the following general qualifications:
  - a. Minimum five years as a firm with the type of testing specified.
  - b. Ability to provide timely field testing services to minimize the impact of the testing requirements on construction progress.
  - c. Certification to perform the specified services in the state in which the Work is to be performed.
3. Testing services proposed by the Contractor shall be subject to review by the Owner and Engineer. Any testing firm not acceptable to the Owner or Engineer will be rejected.

B. All testing agencies and laboratories must meet the requirements of ASTM E329.

C. Testing company shall have been in business for a minimum of the last 5 years providing applicable testing services.

D. Testing equipment shall be calibrated at maximum 12 month intervals by devices of accuracy traceable to National Bureau of Standards. Submit copy of certificate of calibration made by accredited calibration agency.

E. Testing shall be in accordance with applicable codes and regulations referenced in individual Specification Sections, and with selected standards of the American Society for Testing and Materials.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION

### 3.1 TESTING SERVICES – GENERAL

- #### A. Provide testing services meeting the following:

1. Provide qualified personnel promptly on notice.
  2. Perform inspections required by the Contract Documents. Sample and test materials and observe methods of construction to determine compliance with applicable standards and with the requirements of the Contract Documents.
  3. Take specimens and samples for testing, as required in individual Specification Sections. Provide all sampling equipment and deliver all specimens and Samples.
  4. Promptly notify the Owner and the Engineer of irregularities or deficiencies in the Work which are observed during performance of services.
  5. Promptly submit 2 copies of reports of inspections and tests to the Owner, and one copy to the Engineer including:
    - a. Date issued
    - b. Project title and number
    - c. Testing laboratory or agency name and address
    - d. Name and signature of inspector
    - e. Date of inspection or sampling
    - f. Record of temperature and weather
    - g. Date of test
    - h. Identification of product and Specification Section
    - i. Location of Project
    - j. Type of inspection or test
    - k. Results of tests and observations regarding compliance with Contract Documents
- B. Perform additional tests and services as required to assure compliance with the Contract Documents.
- C. Obtain Owner's approval of testing laboratory before performing testing services.
- D. Coordinate with testing laboratory.

### 3.2 CONCRETE TESTING

- A. Provide qualified independent field and laboratory testing service to perform the concrete testing required in Division 3 of the specifications.
- B. The concrete testing laboratory shall have been inspected by the CCRL within the past five years.
- C. The testing laboratory shall be licensed by the State of Rhode Island.
- D. Field testing technicians shall have a Grade 1 concrete field technician license as issued by the American Concrete Institute (ACI).

### 3.3 MASONRY TESTING

- A. Provide qualified independent field and laboratory testing service to perform the masonry testing required in Division 4 of the specifications.
- B. The testing laboratory shall be licensed by the State of Rhode Island.
- C. Field testing technicians shall have a Structural Masonry Special Inspectors Certificate (SMSI) as issued by the International Code Council (ICC).

### 3.4 WELDING INSPECTION AND TESTING SERVICES

- A. Provide qualified independent welding inspection services as required in Section 13200 of the specifications.
- B. The welding inspector(s) shall be qualified under the requirements of AWS B5.1. Radiographic interpretation shall be performed by persons qualified under AWS B5.15.

### 3.5 COORDINATION WITH TESTING LABORATORY

- A. Provide testing laboratory personnel access to site and manufacturer's operations.
- B. Provide laboratory with representative samples of materials to be tested in required quantities.
- C. Furnish labor and facilities:
  - 1. To provide access to Work to be tested.
  - 2. To facilitate inspections and tests.
  - 3. For laboratory's exclusive use for storage and curing of test samples.
  - 4. to provide forms for preparing concrete test beams and cylinders.
- D. Notify laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
- E. Arrange with laboratory and pay for additional inspections, samples, and tests required for Contractor's convenience.

END OF SECTION

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## SECTION 01520

## CONSTRUCTION FACILITIES

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Field office
  - 2. Temporary sanitary and first-aid facilities

## 1.2 QUALITY ASSURANCE

- A. Maintain temporary construction facilities in proper and safe condition throughout the progress of the Work.

## 1.3 FIELD OFFICE

- A. Space inside the Owner's facility will not be available for office work. Provide and maintain for the duration of the Work at a location approved by the Owner, a separate field office trailer or equivalent. The trailer shall be available for the Contractor and a representative from each sub-contractor working on the Project to conduct business. The trailer shall have adequate space to host project meetings attended by representatives from the Owner, General Contractor, each sub-contractor, and Engineer.
- B. Electrical service shall be provided to the trailer. Trailer shall have two means of egress.
- C. Thermostatically controlled heating units or central system of adequate capacity to maintain 70°F under all cold weather conditions. Thermostatically controlled refrigerant type air conditioners of adequate capacity to maintain a maximum temperature of not more than 68°F under all hot weather conditions.
- D. Maintain the office during construction of the Work. The cost for operation of the field office shall be the responsibility of the Contractor.
- E. Remove all field offices and temporary facilities from the site after the completion of the Work. The premises shall be restored to a condition equivalent to that which existed prior to installation of the facilities, as determined by the Engineer.

## 1.4 TEMPORARY SANITARY AND FIRST AID FACILITIES

- A. Provide suitably enclosed chemical or self-contained toilets for the use of the labor force employed on the Work. Toilets shall be located near the Work sites and secluded from observation insofar as possible. Toilets shall be serviced weekly, kept clean and supplied throughout the course of the Work.
- B. Contractor shall enforce proper use of sanitary facilities.
- C. Use of the Owner's sanitary facilities by the Contractor is prohibited.
- D. Provide a first aid station at the site.



PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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## SECTION 01570

## TEMPORARY CONTROLS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Dust control
- B. Related Requirements
  - 1. Section 02920 – Lawns and Grasses

## 1.2 SUBMITTALS

- A. Informational Submittals
  - 1. Materials proposed for use in dust control

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION

## 3.1 DUST CONTROL

- A. Ensure that the existing equipment, facilities, and occupied space adjacent to or nearby areas of the work do not come in contact with dust or debris as a result of concrete demolition, excavation or surface preparation for coatings.
- B. Control dust by the construction of temporary wooden frame/polyethylene sheeting walls and covering enclosures separating adjacent or nearby areas and equipment from the Work site.
- C. Submit for approval materials proposed for use for dust control, prior to start of the Work.

END OF SECTION

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## SECTION 01600

## PRODUCT REQUIREMENTS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Products and Materials
  - 2. Product Delivery Requirements
  - 3. Packaging, Handling and Storage Requirements
  - 4. Inspection of Offsite Work

## 1.2 QUALITY ASSURANCE

- A. Review all contract Drawings and Specifications with respect to specific system characteristics, applicability of materials and equipment for the intended purposes, sizes, orientation, and interface with other systems, both existing and proposed, and certify that the materials and equipment proposed will perform as specified prior to submitting shop drawings.
- B. Provide sworn certificates as to quality and quantity of materials where specified or requested by the Engineer.
- C. Obtain concurrence of the Engineer prior to processing, fabricating, or delivering material or equipment.

## 1.3 PRODUCTS AND MATERIALS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by a single manufacturer unless specified otherwise.
- B. Use only new and first quality material in the Work. Material shall conform to the requirements of these Specifications and be approved by the Engineer. If, after trial, it is found that sources of supply that have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved materials from other approved sources.
- C. Immediately remove defective materials and equipment from the site, at no additional cost to the Owner. The Contractor may be required to furnish sworn certificates as to the quality and quantity of materials before materials are incorporated in the Work.
- D. Engineer has the right to approve the source of supply of all material prior to delivery.

## 1.4 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

- D. Progressively deliver materials and equipment to the Site so there will be neither delay in progress of the Work nor an accumulation of material that is not to be used within a reasonable time.
- E. Deliver products to the Site in their manufacturer's original container, with labels intact and legible.
  - 1. Maintain packaged materials with seals unbroken and labels intact until time of use.
  - 2. The Engineer may reject as non-complying such material and products that do not bear identification satisfactory to the Engineer as to the manufacturer, grade, quality, source, and other pertinent information.

#### 1.5 PACKAGING, HANDLING AND STORAGE REQUIREMENTS

- A. Provide storage and handling of all materials and equipment required for the Work.
- B. Except as otherwise indicated in the Contract Documents, determine and comply with the manufacturer's recommendations on product storage, handling, and protection. Provide manufacturer's documentation on recommended storage procedures when requested by the Engineer.
- C. Properly store and protect all equipment immediately upon its arrival. All equipment shall be stored in a clean, dry, heated, secured, and insured indoor facility satisfactory to the Engineer. Equip drive motors with thermostatically controlled strip heaters. Outdoor storage with plastic, canvas, plywood or other cover will not be allowed except where specific approval for designated items not containing electrical components or bearings is obtained from the Engineer. This approval does not relieve the Contractor of responsibility for proper protection of materials.
- D. Familiarize workmen and subcontractors with hazards associated with materials, equipment, and chemicals specified herein and take all necessary safety precautions.
- E. Areas available on the construction site for storage of material and equipment shall be as shown on the Drawings or approved by the Owner.
- F. Materials and equipment to be incorporated in the Work shall be handled and stored by the manufacturer, fabricator, supplier, and Contractor before, during and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind to the material or equipment.
- G. Protect finished surfaces including floor surfaces, stairs, joints, and soffits of passageways from damage until accepted by the Engineer.
- H. Promptly remove materials from the site of the Work which have become damaged or are unfit for the use intended or specified. The Contractor will not be compensated for the damaged materials or their removal costs.
- I. Handle, haul, and distribute all materials and all surplus materials on the different portions of the Work, as necessary or required. Provide suitable and adequate storage room for materials and equipment during the progress of the Work, and be responsible for the protection, loss of, or damage to materials and equipment furnished, until the final completion and acceptance of the Work.

- J. Storage and demurrage charges by transportation companies and vendors shall be borne by the Contractor.
- K. All materials and equipment to be incorporated in the Work shall be placed so as to not damage any part of the Work or existing facilities and so that free access can be had at all times to all parts of the Work and to all public utility installations in the vicinity of the Work. Keep materials and equipment neatly piled and compactly stored in such locations as will cause a minimum of inconvenience to the Owner.
- L. No material or equipment will be permitted to be stored in any of the Owner's facilities, unless otherwise approved by the Engineer.
- M. Do not store material or equipment in any wetland or environmentally sensitive area. Stockpile sites shall be level, devoid of mature stands of natural vegetation, and removed from drainage facilities and features, wetlands, and stream corridors.
- N. Contractor shall be fully responsible for loss or damage to stored materials and equipment.
- O. No item judged rusty, corroded or otherwise damaged during storage will be accepted. Any electrical or instrumentation item determined by the Engineer to be damaged shall be removed from the Site and replaced by a completely new item in first class condition. Items not properly stored will not be considered for any partial payment.
- P. Provide protective and preventive maintenance during storage consisting of manually exercising equipment where required, inspecting mechanical surfaces for signs of corrosion or other damage, lubricating, applying any coatings as recommended by the equipment manufacturer as necessary for its protection and other precautions as necessary to assure proper protection of equipment stored.
- Q. Treat ferrous surfaces not receiving finish coats of paint with rust preventive coating, and protect non-ferrous metal work and devices with suitable wrappings.

#### 1.6 INSPECTION OF OFFSITE WORK

- A. The Owner and Engineer will inspect Work performed away from the construction site during fabrication, manufacture, or testing, or before shipment. Give 2 weeks written notice regarding the place and time where such fabrication, manufacture, testing, or shipping will be done.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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## SECTION 01630

## PRODUCT SUBSTITUTION DURING CONSTRUCTION

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Product substitution procedures

## 1.2 CONTRACTOR'S OPTIONS

- A. For materials or equipment (hereinafter products) specified only by performance or reference standard, select product meeting that standard, by any Supplier. To the maximum extent possible, provide products of the same generic kind from a single source.
- B. For products specified by naming several products or manufacturers, select any one of the products or Suppliers named, which fully complies with the Drawings and Specifications. Another "or-equal" product can also be considered by the Engineer if it complies with the provisions of Article 7.04, Section 00700. If a product proposed by the Contractor does not qualify as an "or-equal" item, then it can be considered as a proposed substitute item, and the Contractor must comply with the requirements of Article 7.05, Section 00700.
- C. For products specified by naming products or manufacturers and followed by words indicating that no "or-equal" item or substitution is permitted, there is no option and no substitution will be allowed.
- D. Where more than one choice is available as a Contractor's option, select product that is compatible with other products already selected or specified.

## 1.3 SUBSTITUTIONS

- A. If in the Engineer's sole discretion a product proposed by the Contractor does not qualify as an "or-equal" item under the provisions of Article 7.04 of Section 00700, it can be considered a proposed substitute item. Submit information required under Article 7.05, Section 00700 for proposed substitutes.
- B. The Engineer will consider written requests from the Contractor for substitutions within 30 days after the Notice to Proceed. After this period, requests will be considered only in case of unavailability of product or other conditions beyond control of the Contractor.
- C. Submit 5 copies of request for substitutions. Submit a separate request for each proposed substitution. In addition to the submittal requirements outlined in Article 7.05 of Section 00700, include the following in each substitution request:
  - 1. For products or Suppliers:
    - a. Product identification, including Supplier & manufacturer's name and address.

- b. Manufacturer's literature with product description, performance and test data, and reference standards.
    - c. Samples, if appropriate.
    - d. Name and address of similar projects on which product was used, and date of installation.
  2. For construction methods (if specified):
    - a. Detailed description of proposed method.
    - b. Drawings illustrating method.
  3. Such other data as the Engineer may require to establish that the proposed substitution is equal to the product, Supplier or method specified.
- D. The substitution request shall include written certification and statements that are outlined in Article 7.05 of Section 00700.
- E. A request constitutes a representation that Contractor:
  1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  2. Will provide same or better guarantees, warranties or bonds for proposed substitution as for specified product.
  3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  4. Waives all claims for additional costs or time extension which may subsequently become apparent.
  5. Will reimburse Owner for review or redesign services associated with re-approval by authorities having jurisdiction.
- F. A proposed substitution will not be accepted if:
  1. Acceptance will require changes in the design concept or a substantial revision of the Contract Documents.
  2. It will delay completion of the Work.
  3. It is intended or implied on a Shop Drawing and is not accompanied by a formal request for substitution from the Contractor.
- G. The Contractor is responsible for all costs relating to substitution requests.
- H. Approval of a substitution does not relieve the Contractor from the requirement for submission of Shop Drawings as set forth in the Contract Documents.

**PART 2 PRODUCTS – NOT USED**

**PART 3 EXECUTION – NOT USED**

**END OF SECTION**

## SECTION 01770

## CLOSEOUT PROCEDURES

## 1.1 SUMMARY

## A. Section Includes

1. Documentation required for the transfer of the completed Work to the Owner
2. Final Cleaning

## 1.2 SUBMITTALS

## A. Closeout Submittals

1. As-built drawings
2. Operation and maintenance manuals
3. Evidence of payment and release of liens
4. List of Subcontractors, service organizations, and principal vendors

## 1.3 SUBSTANTIAL COMPLETION

- A. Refer to Article 15.03 in 00700, General Conditions, for procedures relating to obtaining Substantial Completion. Refer to 00520, Agreement, for Contract times.

## 1.4 PROJECT CLOSEOUT DOCUMENTS

- A. As-built Drawings - Submit as-built drawings review, approval, or comment. The as-built drawings shall show the completed work, including all deviations from the Drawings. The as-built drawings shall depict the location of all conduit and devices exterior from the motor control centers, the location of valves, small diameter piping, relocated devices and all field changes.

1. Locate all utilities and appurtenances concealed in construction. Provide detail not shown on Contract Documents. Use colored pencils or felt tipped pens to record all revisions to the as-built drawings. Use the following color code unless otherwise approved by the Engineer:

- a. Structural: Purple
- b. Plumbing: Brown
- c. HVAC: Green
- d. Electrical: Orange
- e. Other: Black

- B. Operation and Maintenance manuals – Submit both digital and four hard copies of Operation and Maintenance Manuals for items listed in other sections of these Specifications and for other items when directed by the Engineer.



1. Manuals shall be in three-ring binders. However, manuals which consist of 20 or fewer pages may be bound using three-hole, plastic, clear-front report covers.
2. Manuals shall include, as a minimum:
  - a. The Operations and Maintenance Manual Certification Form (copy attached at the end of this Section) which shall be attached to every copy of each Operations and Maintenance Manual submitted.
  - b. A comprehensive index broken down into sections and sub-sections
  - c. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data
  - d. Full specifications on each item
  - e. Detailed service, maintenance and operation instructions for each item supplied
  - f. System schematic drawings “as Constructed,” illustrating all components, piping and electrical connections of the systems supplied under Division 16
  - g. Clearly defined special maintenance requirements particular to this system, along with special calibration and test procedures
  - h. Operating instructions with a functional description of the entire system, with references to the systems schematic drawings and instructions
  - i. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier
  - j. A complete “As Constructed” set of approved shop drawings
  - k. The format of the O&M manual shall meet the following general requirements:
    - 1) Complete, comprehensive index
    - 2) Section with operating instructions including complete overview of the system
    - 3) Section with a complete parts list as described above
    - 4) Section that includes all schematic diagrams, wiring diagrams etc. of the “As Constructed System”
    - 5) Product information
  - l. Section and sub-section dividers
  - m. Separate divider for each product
  - n. Data sheets indicating the tag names (as used on the Drawings), manufacturer, complete model number, complete specifications, and parameter setup sheet with the parameter setup sheets following the manufacturers O&M manual in its entirety

- o. Final documentation written specifically for this project including standard and modified standard documentation, with modifications to existing hardware or software manuals made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated, and all portions that do not apply shall be lined out.
  - p. All illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment, with illustrated parts numbered for identification and all information applying specifically to the equipment furnished and only including instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- C. Final Documentation – Submit the following final documentation:
- 1. As-Built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as-built system.
  - 2. The maintenance documentation shall describe the detailed preventative and corrective procedures required to keep the system in good operating condition. All hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The hardware maintenance documentation shall include, as a minimum, the following information:
    - a. Operation information – This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
    - b. Preventative-maintenance instructions – These instructions shall include all applicable visual examinations, hardware testing and diagnostics routines, and the adjustments necessary for periodic preventative maintenance of the system.
    - c. Corrective-maintenance instructions – These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
    - d. Parts information – This information shall include the identification of each replaceable or field-repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between the Contractor’s part number and manufacturer’s part numbers shall be provided. All PC boards shall be identified by; manufacturer and model number, slot number, part name and configuration (if applicable).

- D. Provide warranties and bonds for items so listed in pertinent other sections of the Project Manual. Provide all warranties and bonds in a three-ring binder.
- E. Provide keys and keying schedule, where applicable.
- F. Provide evidence of compliance with requirements of governmental agencies having jurisdiction including:
  - 1. Certificates of Inspection.
  - 2. Certificates of Occupancy.
- G. As specified in Article 15.06.A of Section 00700, provide evidence that all Work, materials and equipment will pass to Owner free and clear of any Liens or other title defects upon final payment. Such evidence may take the form of receipts or releases from all Subcontractors and Suppliers and an affidavit from Contractor as to the completeness of the receipts and releases as described in Section 00700 Article 15.06.A.3.
- H. List of Subcontractors, service organizations, and principal vendors, including names, addresses, and telephone numbers where they can be reached for emergency service at all times including nights, weekends, and holidays.
- I. Equipment start-up reports shall be submitted in duplicate to the Engineer for each piece of equipment installed. The report shall include detailed descriptions of the points inspected, tests, and adjustments made, quantitative results obtained and maintenance suggestions. The report shall certify that the equipment (1) has been satisfactorily installed and conforms to the Contract requirements; (2) is in accurate alignment and free from undue stress; (3) has been operated under full load and operates satisfactorily; and (4) nothing in the installation will render the manufacturer's warranty null and void. Equipment start-up reports shall be included in the appropriate equipment O&M manuals.
- J. Provide records of all Owner training/instruction sessions conducted in accordance with paragraph 1.5 of this Section and as required in the project Specifications. The record for each training session shall include reference to the relevant specification section, a summary of the topics covered in the training session, and a sign-in sheet listing all attendees in attendance for the training.
- K. Provide color charts, legends, instructions, special tools and other requirements specifically requested in sections of the Specification.

#### 1.5 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide instruction by qualified manufacturers' representatives in the proper operation, maintenance, adjustment and the safety aspects of the equipment and materials furnished. Specific instruction requirements may be included within the sections of the Specification.

#### 1.6 FINAL CLEANING & REPAIRS

- A. Complete cleaning prior to final inspection. Cleaning shall include all interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces. Thoroughly wipe clean all ductwork, piping, equipment, devices, and exposed surfaces. Clean debris from

lawns, roofs, downspouts and gutters. Sweep paved surfaces and rake lawns and landscaped areas.

- B. Use only cleaning materials that will not create hazards to health or property.
- C. Remove and entirely dispose of material or debris that has washed, flowed or has been placed in existing watercourses, ditches, gutters, drains, pipe, or structures, for work done under the Contract work limits. Leave ditches, channels, drains, pipes, structures, and watercourses in a clean and neat condition upon completion of the Work.
- D. On or before the completion of the Work, tear down and remove all temporary buildings and structures, remove all temporary works, tools, and machinery or other construction equipment, remove all rubbish from any grounds which has been occupied and leave the roads and all parts of the premises and adjacent property in a neat and satisfactory condition.
- E. Restore or replace any public or private property damaged or removed during the course of the Work. Property shall be returned to a condition at least equal to that existing immediately prior to the beginning of operations. Complete all highway or driveway, walk, and landscaping work using suitable materials, equipment and methods. Perform restoration of existing property, signs or structures promptly as work progresses; do not leave restoration work until the end of the Contract Time.

#### 1.7 COMPLETION

- A. The Contract shall be considered complete and final payment made, only when:
  - 1. All provisions of the Contract Documents have been strictly adhered to.
  - 2. All damage to adjoining areas caused by the Work has been repaired.
  - 3. The project and premises have been left in good order, including removal of all temporary construction, Contractor-owned and extraneous materials as required.
  - 4. All warranties, Operation and Maintenance Manuals, maintenance instructions, releases, and permits called for in the Contract have been submitted to the Owner and Engineer as applicable.
  - 5. All as-built drawings as required by the Contract Documents have been submitted to the Owner.
  - 6. All monies owed the Owner for services performed for the Contractor by Owner's forces in connection with the Contract have been paid.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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**O&M MANUAL CERTIFICATION FORM**

PROJECT: \_\_\_\_\_  
ENGINEER: \_\_\_\_\_ ENGINEER'S PROJECT NO.: \_\_\_\_\_  
CONTRACTOR: \_\_\_\_\_ CONTRACTOR'S PROJECT  
NO.: \_\_\_\_\_

TRANSMITTAL NO.: \_\_\_\_\_ SHOP DRAWING NO.: \_\_\_\_\_  
SPECIFICATION NO.: \_\_\_\_\_ DRAWING NO.: \_\_\_\_\_  
DESCRIPTION: \_\_\_\_\_  
MANUFACTURER: \_\_\_\_\_

The above referenced O&M manual has been reviewed by the undersigned and I/we certify that the manual is customized as needed for this project, and contains the following items, where applicable for the materials or equipment provided:

- |  |   |
|--|---|
| <input type="checkbox"/> 3-ring binder with title on binder and binding edge | <input type="checkbox"/> Complete parts list of equipment supplied      |
| <input type="checkbox"/> Electronic CD, when specified                       | <input type="checkbox"/> Complete specifications/data on each item      |
| <input type="checkbox"/> Comprehensive index broken down into sections       | <input type="checkbox"/> Detailed maintenance & operations instructions |
| <input type="checkbox"/> Dividers for sections and sub-sections              | <input type="checkbox"/> "As constructed" layout & schematic drawings   |
| <input type="checkbox"/> Warranties  | <input type="checkbox"/> Wiring diagrams                                |
| <input type="checkbox"/> Troubleshooting information                         | <input type="checkbox"/> Lubrication & maintenance schedules            |
| <input type="checkbox"/> Startup, operation & shutdown procedures            | <input type="checkbox"/> Equipment performance curves                   |
| <input type="checkbox"/> Safety procedures                                   | <input type="checkbox"/> List of spare parts supplied and current cost  |
| <input type="checkbox"/> Manufacturer's contact information                  | <input type="checkbox"/> Parts & service contact information            |

SUBMITTED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

GENERAL CONTRACTOR'S STAMP

**DIVISION 2 - SITE WORK**

## SECTION 02225

## SELECTIVE DEMOLITION

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Interior selective demolition including but not limited to interior walls, floors, partitions, windows, electrical, plumbing, mechanicals, etc. Refer to Drawings for selective demolition scope.
- B. Removal and lawful disposal of miscellaneous debris and solid waste located within the Limit of Work.

## 1.2 RELATED SECTIONS

- A. Section 01350 – Health & Safety Plan

## 1.3 DEFINITIONS

- A. Demolish – To tear down, segregate waste streams and lawfully recycle or dispose of all debris generated in the process including structure contents.
- B. Limit of Work – Area delineated on Drawings that defines the extent of demolition work under the Contract.
- C. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- D. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- E. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- F. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- G. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

## 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

## 1.5 REGULATORY REQUIREMENTS

- A. Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied.

- B. Notify and obtain such permits or approvals from all agencies having jurisdiction over the Work, but not limited to Health, Building, and Fire Departments of the municipality and local, state and federal agencies.
- C. Comply with all applicable federal, state, and local environmental, safety and health requirements regarding the renovation or demolition of structures and other site features and recycling or disposal of demolition debris, as applicable.
- D. Conform to procedures identified in Section 01350 – Health and Safety Plan related to site hazards associated with the project with particular attention towards maintaining compliance with OSHA 1926.62 Lead in Construction regulations when impacting and creating lead dust during impact of any painted surface or component throughout the building.

#### 1.6 JOB CONDITIONS – SELECTIVE DEMOLITION

- A. Conduct selective demolition work in a manner that will minimize need for disruption of owner's normal operations. Provide minimum of two (2) weeks advance notice to owner of demolition activities which will impact owner's normal operations.
- B. The Owner assumes no responsibility for actual condition of items or structures to be demolished. However, variations within the structure may occur by Owner's removal and salvage operations prior to start of selective demolition work.
- C. Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.
  - 1. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to and from occupied portions of the facility.
  - 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure of element to be demolished, and adjacent facilities or work to remain.
  - 3. Protect from damage existing finish work that is to remain in place which will become exposed during demolition operations.
  - 4. Protect floors with suitable coverings when necessary.
  - 5. Remove protections at completion of work.
- D. Promptly repair damages caused to adjacent facilities by demolition work at no additional cost to the Owner.
- E. Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
- F. Do not close, block or otherwise obstruct roadways, walks or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- G. Maintain existing utilities, keep in service, and protect against damage during demolition operations.



- H. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

## 1.7 FIELD CONDITIONS

- A. Owner will occupy the building at all times. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Hazardous Building Materials have not been identified with the limits of the work areas.
  - 1. Refer to the attached Hazardous Building Materials inspection report of materials sampled.
  - 2. If suspected hazardous materials are encountered during construction, do not disturb; immediately notify Engineer and Owner.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. HEPA-Filtered Exhausts – Air inside the work area, if applicable, shall be exhausted through a High Efficiency Particulate Air (HEPA) filter.
- B. Commercially manufactured HEPA-filtered exhaust units, with specification plates intact, must be provided for each work area to attain, at a minimum, four air volume changes per hour and an inward flow of clean air into each work area of at least 100 feet per minute. The HEPA filter shall be preceded by replaceable pre-filters and the unit must be designed so that it cannot be operated unless all filters are in place. The purpose of the containment system is to capture fugitive particulate while performing selective demolition.
- C. Warning Signs and Labels - Work areas shall be properly demarcated in accordance with OSHA requirements. The contractor's specific containment approaches may also include the following products:
  - 1. Plastic Sheeting ("Poly") - shall be polyethylene or equivalent with two layers with a thickness of at least 6 mil for all applications.
- D. Tape and Glue – Shall be capable of sealing plastic joints and attaching plastic to finished surfaces. The bonding strength and resulting seal integrity shall not be affected by mist or water, wetting or encapsulating agent, or any other materials to be used in the work area
- B. All materials or equipment delivered to the site shall be unloaded, temporarily stored, and transferred to the work area in a manner that shall not interfere with operation of others at the facility, or employee's access and safety.
- C. Damaged or deteriorated materials shall not be used and shall be promptly removed from the premises.
- D. Waste Containers and Transportation shall be suitable for loading, temporary storage, transport, and unloading of contaminated waste without risk of ripping, rupture, or exposure to persons, or emissions to the atmosphere.

## 2.2 SAFETY SUPPLIES AND EQUIPMENT

- A. Contractor shall comply with Section 01350 and is fully responsible for the implementation and monitoring of all health and safety measures.
- B. Respirator Types: As applicable, provide workers with a full or half facepiece respirator that is approved by NIOSH/MSHA for protection against airborne dust and other hazards that may be present, and meets the requirements of the OSHA standard.
- C. Protective Clothing: As applicable, provide workers and approved visitors with disposable coveralls, head and foot coverings, gloves and eye protection (i.e. safety glasses) and half-face respiratory protection including HEPA cartridges.

## PART 3 EXECUTION

### 3.1 INSPECTION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations. Perform lock-out/tag-out procedures as necessary.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
  - 1. Unknown Site Conditions - The information provided on the Drawings and in the Specifications is believed accurate. Field verify all information. Bear full responsibility for obtaining all locations of underground structures, utilities and their connections. Maintain services to buildings outside the limits of work, at no additional cost to the Owner.
  - 2. Interior Elements - Interior features including but not necessarily limited to structural elements, walls, partitions, equipment, piping or other building facilities are not shown on the drawings and must be visually inspected. Inspect and appraise all features and facilities to be demolished or removed for salvage. Investigate to assure the condition of the work to be demolished and take all precautions necessary to ensure safety of people and property.
- C. Retain a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform engineering surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with selected demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
  - 1. Comply with requirements specified in Section 01320 "Construction Photographs."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

### 3.2 SITE PREPARATION

- A. Remove and/or stabilize all overhead hazards, prior to commencing work near any building. Where hazards cannot be stabilized, mark and control areas below hazards to prohibit access below the hazards. Similarly, all holes through the floors or weak sections of the floor shall either be covered or clearly marked to prohibit entry. If necessary, floor coverings shall be capable of supporting heavy equipment use.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
    - h. Where removed piping or ductwork passes through walls to remain, repair, in-fill, and surface patch openings using approved methods that match existing conditions.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of structures and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being selectively demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
  2. Cease operations and notify the Owner and the Engineer immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
  3. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. As necessary, erect and maintain dust-proof partitions and closures as required to prevent spread of dust, fumes or debris to adjacent portions of the building.
  5. Keep outdoors work sprinkled with water to minimize dust. Provide hoses and water connections for this purpose.
  6. Provide temporary weather protection during selective demolition and construction activities until such time that the new infill is constructed.
  7. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Engineer in written, accurate detail.

Pending receipt of directive from Engineer, rearrange selective demolition schedule as necessary to continue overall job progress.

8. Perform selective demolition work in a systematic manner. Provide scaffolding as necessary. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.
  9. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  10. Contact local fire department with respect to flame -cutting operations and maintain fire watch as directed by the local fire department.
  11. Maintain adequate ventilation when using cutting torches.
  12. Repair selective demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition work.
  13. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area designated by Owner.
  5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage during selective demolition. When permitted by Architect, items may be removed to suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." [ Do not use methods requiring solvent-based adhesive strippers.]
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Remove existing roof membrane, flashings, copings, and roof accessories.
  - 1. Remove existing roofing system down to substrate.

### 3.7 DISPOSAL OF DEMOLISHED MATERIAL

- A. General
  - 1. Contractor shall perform any necessary analytical testing to support facility acceptance of the wastes.
  - 2. Remove demolition waste materials from Project site and legally manage off-site in accordance with the contractor's submitted Waste Management Plan.
  - 3. Comply with Section 02226 - Construction Waste Management
  - 4. Do not allow demolished materials to accumulate on-site.
  - 5. Burning of demolition waste is not permitted.
  - 6. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 7. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Provide evidence that the demolition materials have been received at a legal disposal, recycle, reuse or salvage location. Such proof may include truck weight slips from an approved disposal facility or documentation of transfer of title. Transport of all materials off site shall be in accordance with applicable Department of Transportation Regulations. All materials leaving the site shall become the property of the Contractor.

### 3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

**DIVISION 5 - METALS**

## SECTION 05050

## WELDING

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Welding for fabrication and installation of metals
- B. Related Sections
  - 1. Section 05500 – Miscellaneous Metals.

## 1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
  - 1. BPVC SEC V, Nondestructive Examination.
  - 2. BPVC SEC IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. American Society of Nondestructive Testing (ASNT): SNT-TC-IA, Personnel Qualification and Certification in Nondestructive Testing.
- C. American Welding Society (AWS):
  - 1. B2.1, Specification for Welding Procedure and Performance Qualification.
  - 2. D1.1, Structural Welding Code - Steel.
  - 3. QC 1, Standard for AWS Certification of Welding Inspectors.

## 1.3 DEFINITIONS

- A. CWI-Certified Welding Inspector.
- B. NDT-Nondestructive Testing.

## 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. Shop and field welding procedure specifications (WPS).
  - 2. Procedure qualification records (PQR).
  - 3. Welding Documentation: Submit on appropriate forms in referenced welding codes.
  - 4. Nondestructive testing procedure specifications prepared in accordance with ASME BPVC SEC V.
- B. Quality Control Submittals:
  - 1. Welder/welding operator performance qualifications (WPQ).
  - 2. Certified welding inspector (CWI) credentials.



3. Testing agency personnel credentials.
4. Welding inspector's reports.
5. Shop inspection and quality control records when requested.

## 1.5 QUALITY ASSURANCE

### A. Qualifications:

1. Welding Procedure Specifications: In accordance with AWS D1.1 (Annex E) or AWS B2.1 (App. A) or ASME BPVC SEC IX (Forms QW-482 and QW-483).
2. Welding Inspector: Certified in accordance with AWS QC 1, and having prior experience with the welding codes specified.
3. Testing Agency: Personnel performing tests shall be NDT Level II Certified in accordance with ASNT SNT-TC-1A.

## 1.6 SEQUENCING AND SCHEDULING

- ### A. Unless otherwise specified, Submittals required in this Section shall be submitted and approved prior to commencement of welding operations.

## PART 2 PRODUCTS

### 2.1 SOURCE QUALITY CONTROL

- A. Welding fabrication, materials, and workmanship shall be subjected to inspection and testing during the fabrication process.
- B. Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown, specified, or permitted by the Engineer.
- C. Welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code.
- D. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.
- E. Notify the Owner's Project Representative prior to the start of any fabrication or other phases of the work to afford them reasonable opportunity to inspect work.
- F. A Certified Welding Inspector (CWI) shall be retained by the fabricator to visually inspect all fabrication welds in accordance with AWS D1.1, Section 6 and Table 6.1, Visual Acceptance Criteria.
- G. The CWI shall be present whenever shop welding is performed. The CWI shall perform inspection before, during, and after welding. CWI duties include:
  1. Verifying conformance of specified job material and proper storage.
  2. Monitoring conformance with approved WPS.
  3. Monitoring conformance of WPQ.
  4. Inspecting weld joint fit-up and in-process inspection.

5. Providing 100 percent visual inspection of all welds.
  6. Supervising nondestructive testing personnel and evaluating test results.
  7. Maintaining records and preparing report confirming results of inspection and testing comply with the Work.
- H. Maintain inspection and quality control records of shop work.
- I. Acceptance of work at the shop shall not prevent its final rejection at the jobsite, even after erection, if it is found to be defective in any way.
- J. Nondestructive testing of fabrication welds will be conducted by an independent Testing Agency, retained by the Owner, in accordance with the criteria specified below and in conjunction with the testing required for field welding.

### PART 3 EXECUTION

#### 3.1 GENERAL

- A. Welding and Fabrication by Welding:
1. Conform to governing welding codes referenced in the attached Welding and Nondestructive Testing Requirements Data Sheet.
  2. Each welder working on the project, whether in the shop or in the field, shall be assigned an identification symbol or mark. Each welder shall mark or stamp his identification symbol at each weldment completed, whether in the shop or in the field.

#### 3.2 WELDING STRUCTURAL STEEL

- A. Where structural joints are required to be welded, details of joints, technique of welding employed, appearance and quality of welds made, and methods used in correcting defective work shall conform to AWS D1.1.
- B. Welds shall be sound throughout and have no cracks or imperfections. The face of welds shall be dressed flush and smooth.
- C. Welded joints shall be rigid and continuously welded or spot welded as specified or shown. Exposed joints shall be close fitting and jointed where least conspicuous.
- D. Base metals shall be checked by Contractor to ensure absence of laminations or other defects.
- E. Groove and butt joint welds shall be full penetration welds, unless otherwise indicated.
- F. Shop Welding Process:
1. Shielded metal arc.
  2. Submerged arc.
  3. Gas metal-arc.
  4. Flux cored-arc
  5. Other process as approved by the Engineer.

### 3.3 FIELD QUALITY CONTROL

- A. Welding fabrication, materials, and workmanship shall be subjected to inspection and testing during the erection and installation process.
- B. Nondestructive testing of erection, installation and fabrication welds will be conducted by an independent Testing Agency, retained by the Owner, in accordance with the weld inspection criteria specified below.
- C. The Contractor shall facilitate inspection and testing by the Testing Agency. Furnish the Testing Agency, upon request, with the following:
  - 1. Complete sets of approved shop drawings and corrective work procedures at shop(s) and in the field.
  - 2. Cutting lists, order lists, material bills and shipping lists.
  - 3. Information as to time and place of all rollings and shipment of materials to the shop(s) and the field.
  - 4. Full and ample means and assistance for testing, including access to all field and shop welds required to be tested.
- D. Notify the Engineer prior to the start of any erection or installation or other phases of the work to afford reasonable opportunity to inspect the work.
- E. Maintain inspection and quality control records of field work.

### 3.4 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

- A. Weld Inspection Criteria:
  - 1. Selection of Welds to be Tested: As agreed upon between Engineer and Contractor.
  - 2. Unless otherwise specified, perform NDT of welds at a spot testing frequency as determined in the attached table in Data Sheet 05050 – A, in accordance with the referenced welding codes, as follows:
    - a. Butt Joint Welds: All butt welds to be provided shall be radiographically tested and repaired.
    - b. Groove Welds: All groove welds to be provided shall be ultrasonically tested and repaired.
    - c. Fillet Welds: A randomly sampled percentage of all fillet welds to be provided shall be examined and repaired, using either dye penetrant or magnetic particle inspection methods.
    - d. All Welds: 100 percent visually inspected.
  - 3. Weld Acceptance:
    - a. Visual Inspection (VT):
      - 1) Structural Tubing: AWS D1.1, paragraph 6.9, Visual Inspection, Tubular Connections;

- 2) All Other Structural Steel: AWS D1.1, paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
- b. Ultrasonic Testing (UT): Perform UT of groove welds in accordance with AWS D1.1, paragraph 6.13.3, Class R Indications.
- c. Radiographic Testing (RT): Perform RT of butt joint welds in accordance with AWS D1.1, paragraph 6.12.1.
- d. Magnetic Particle (MT):
  - 1) Perform on fillet and partial penetration groove welds in accordance with AWS D1.1, paragraph 6.10.
  - 2) Acceptance shall be in accordance with VT standards specified above.
- e. Liquid Penetrant (PT):
  - 1) Perform on fillet and partial penetration groove welds per AWS D1.1, paragraph 6.10.
  - 2) Acceptance shall be in accordance with VT standards specified above.

### 3.5 WELD DEFECT REPAIR

- A. Deficient welds shall be cut out to sound material and rewelded.
- B. Verify by retesting that rejected weld defects have been repaired and are acceptable in accordance with the appropriate welding codes.

### 3.6 SUPPLEMENTS

- A. The supplements listed below, following “END OF SECTION,” are a part of this Specification.
  1. DATA SHEET 05050 – A , Welding and Nondestructive Testing Requirements.

END OF SECTION

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**DATA SHEET 05050-A**

Welding and Nondestructive Testing Requirements

Specification Section	Governing Welding Codes or Standards	Submit Welding Procedure Spec.	Submit Welder/ Welding Operator Qual.	Onsite Welding Inspector Req'd	Submit Written Nondestructive Testing Procedure Specifications	Nondestructive Testing Requirements
05500 Miscellaneous Metals	AWS D1.1, Structural Welding Code-Steel	Yes	Yes	Yes	Yes	100% VT <sup>5</sup> ; 100% UT <sup>1</sup> or RT <sup>2</sup> of all groove-and-butt joint welds; 10% MT <sup>3</sup> or PT <sup>4</sup> of all fillet welds; see Section 05120

<sup>1</sup>UT-Ultrasonic Testing.

<sup>2</sup>RT-Radiographic Testing.

<sup>3</sup>MT-Magnetic Particle Testing.

<sup>4</sup>PT-Liquid Dye Penetrant Testing.

<sup>5</sup>VT-Visual Testing

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## SECTION 05500

## MISCELLANEOUS METALS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Galvanized steel plates, fasteners, anchor bolts and structural shapes.
  - 2. Electrolysis isolators.
- B. Related Sections
  - 1. Section 05050 – Welding.
  - 2. Section 09900 – Painting.

## 1.2 REFERENCES

- A. The Latest Rhode Island State Building Code, RISBC-1
- B. American Iron and Steel Institute (AISI), Stainless Steel Types
  - 1. AISI Type 316 - Stainless Steel Bolts, Bars, Sheets and Shapes
  - 2. AISI Type 316L - Stainless Steel Bars, Shapes, Plates and Pipe
- C. American Society for Testing and Materials (ASTM)
  - 1. A36, Standard Specification for Carbon Structural Steel
  - 2. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - 3. A143, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement
  - 4. A148, Standard Specification for Steel Castings, High Strength, for Structural Purposes
  - 5. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 6. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
  - 7. A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service
  - 8. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
  - 9. A276, Standard Specification for Stainless Steel Bars and Shapes
  - 10. A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

11. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
  12. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  13. A384, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
  14. A385, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
  15. A490, Standard Specification for Structural bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
  16. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
  17. A568, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
  18. A572, Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel
  19. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
  20. A992, Standard Specification for Steel for Use in Buildings
  21. F436, Standard Specification for Hardened Steel Washers
  22. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
  23. F594, Standard Specification for Stainless Steel Nuts
  24. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
  25. F1554, Standard Specification for Anchor Bolts, Steel, 36-, 55-, and 105-ksi Yield Strength
- D. International Conference of Building Officials (ICBO): Evaluation Reports for Concrete and Masonry Anchors.
- E. Occupational Safety and Health Administration (OSHA):
1. 29 CFR 1910.27, Fixed Ladders.
- F. National Association of Architectural Metal Manufacturers (NAAMM):
1. ANSI MBG 531, Metal Bar Grating Manual.
  2. ANSI MBG 532, Heavy-Duty Metal Bar Grating Manual.
  3. Metal Stairs Manual.
- G. Steel Structures Painting Council (SSPC)
- H. The Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities.

### 1.3 SUBMITTALS

#### A. Product Data:

1. Concrete and Masonry Drilled Anchors:
  - a. Manufacturer's product descriptions.
  - b. Specific installation instructions, including drilled hole size, preparation, placement procedures, and instructions for safe handling of anchoring systems.
2. Prime Paint.
3. Bitumastic Troweling for Surfaces in Contact with Concrete.
4. Fasteners (when requested by the Engineer).
5. Galvanizing touch-up / repair materials.

#### B. Shop Drawings:

1. Detailed shop drawings, including erection drawings, for all metal fabrications, including welding and fastener information:
  - a. Submit for approval before fabrication.
  - b. Identify sizes of structural members, method of assembly, anchorage, and connection to other members.

#### C. Quality Control Submittals:

1. Connection Design Calculations: stamped by a licensed professional structural engineer, registered in the State where the work will be performed, properly coordinated with Shop Drawings.
2. Concrete and Masonry Drilled Anchors:
  - a. Current test data or ICBO evaluation report.
  - b. Adhesive Anchor Installer Certification.
3. Hot-Dip Galvanizing:
  - a. Certificate of compliance, signed by the galvanizer, referencing the specific project, with a description of the material processed and the ASTM standard used for coating.
  - b. Certificate shall verify the level of pre-galvanizing cleaning and the minimum coating thickness achieved.
4. Welding: In accordance with the requirements of Section 05050.
5. Provide Certificates of Compliance on other materials as requested by the Engineer.

### 1.4 QUALITY ASSURANCE

- A. Shop Assembly: Pre-assemble items in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.



- B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. Qualifications for Welding Work: In accordance with the requirements of Section 05050.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and stack materials carefully to prevent deformation or damage.
- B. Store materials carefully on substantial timbers and blocking, so arranged that materials will be free from earth and properly drained, preventing any splattering with dirt or accumulation of water or snow in or about materials.
- C. Prevent accumulation of mud, dirt, or other foreign matter on materials. Any accumulation shall be completely removed prior to erection.
- D. Protect painted, hot-dip galvanized, and other finishes from damage due to metal banding and rough handling. Use padded slings and straps.
- E. Adhesive Anchor Systems:
  - 1. Store adhesive cartridges on pallets or shelving in covered storage area, in accordance with manufacturer’s written instructions.
  - 2. Cartridge Markings: Include manufacturer’s name, product name, material type, batch or serial number, and adhesive expiration date.
  - 3. Dispose of cartridges if shelf life has expired.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Unless otherwise indicated, meet the following requirements:

<b>Item</b>	<b>ASTM Reference</b>
Steel Shapes:	
W-Shapes	A992
M-, S-, and HP-Shapes	A36
Channels	A36
Angles	A36
Plates	A36
Stainless Steel:	
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts A153 for galvanized components
Anchor Bolts and Rods	F1554, Grade 55, with weldability supplement S1

Item	ASTM Reference
Threaded Rods	A36
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193, Grade B7
Nuts	A194, Grade 2H
Plate	A283, Grade D

2.2 MANUFACTURED UNITS

A. Concrete and Masonry Drilled Anchors

1. General: Materials shall be AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown in Data Sheet – 05500 – A, FASTENER MATERIALS SCHEDULE, at end of this section.
2. Wedge Anchors:
  - a. Manufacturers and Products:
    - 1) ITW Ramset/Red Head, Wood Dale, IL; Trubolt Wedge Anchor.
    - 2) Hilti, Inc., Tulsa, OK; Kwik-Bolt II Stud Anchor.
    - 3) Powers Rawl, New Rochelle, NY; Power-Stud Anchor.
    - 4) Simpson Strong-Tie Co., Inc., Pleasanton, CA; Wedge-All Anchor.
    - 5) Wej-It Corp., Tulsa, OK; ANKRtite Wedge Anchor.
    - 6) U.S. Anchor, Pompano Beach, FL; Kingpin Wedge Anchor.
3. Expansion Anchors:
  - a. Self-drilling anchors, snap-off or flush type, zinc-plated.
  - b. Nondrilling Anchors: Flush type for use with zinc-plated or stainless steel bolt, or stud type with projecting threaded stud.
  - c. Manufacturers and Products:
    - 1) ITW Ramset/Red Head, Wood Dale, IL; Multi-Set II Drop-In and Self Drill Anchor.
    - 2) Hilti, Inc., Tulsa, OK; Hilti HDI Drop-In Anchor.
    - 3) Powers Rawl, New Rochelle, NY; Steel Drop-In Anchor.
    - 4) Simpson Strong-Tie Co., Inc., Pleasanton, CA; Drop-In Anchor.
4. Sleeve Anchors:
  - a. Manufacturers and Products:
    - 1) ITW Ramset/Red Head, Wood Dale, IL; Dynabolt Hex Nut Sleeve Anchor.

- 2) Powers Rawl, New Rochelle, NY; Hex Head Power-Bolt Anchor.
- 3) Simpson Strong-Tie Co., Inc., Pleasanton, CA; Sleeve-All Hex Head Anchor.
- 4) Wej-It Corp., Tulsa, OK; Wej-It Sleeve Anchor.

5. Adhesive Anchors:

a. Threaded Rod:

- 1) ASTM F593 stainless steel threaded rod, diameter as shown on Drawings.
- 2) Length as required, to provide minimum depth of embedment.
- 3) Clean and free of grease, oil, or other deleterious material.
- 4) For hollow-unit masonry, provide galvanized or stainless steel wire cloth screen tube to fit threaded rod.

b. Adhesive:

- 1) Disposable, self-contained cartridge system capable of dispensing both components in the proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
- 2) Two-component, designed to be used in adverse freeze/thaw environments, with gray color after mixing.
- 3) Cure Temperature, Pot Life, and Workability: Compatible for intended use and environmental conditions.
- 4) Nonsag, with selected viscosity base on installation temperature and overhead application where applicable.

c. Manufacturers and Products:

- 1) ITW Ramset/Red Head, Wood Dale, IL; Epcon Ceramic 6 Epoxy or A7 Adhesive Anchor System. (Use only Epcon A7 Adhesive System for hollow masonry.)
- 2) Hilti, Inc., Tulsa, OK; HIT Injection Adhesive System, HIT HY 200 (HIT HY 70 for hollow masonry).
- 3) Simpson Strong-Tie Co., Inc., Pleasanton, CA; Epoxy-Tie Adhesive ET.

6. Adhesive Threaded Inserts:

- a. Stainless steel, internally threaded insert.
- b. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-R Insert with HIT HY 200 adhesive.

B. Fasteners:

1. Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Data Sheet – 05500 – A, FASTENER MATERIALS SCHEDULE, at the end of this section.

2. Bolts, Nuts and Washers: ASTM A325, galvanized to ASTM A153 for galvanized members.
3. Anchor Bolts: ASTM F1554, Grade 36
4. High-Strength Bolts: ASTM A325 or ASTM A490, Type 1, plain uncoated. Bolt length and thread length shall be as required for the connection type shown, with hardened washers as required.

### 2.3 ACCESSORIES

- A. Welding Materials: In accordance with the requirements of Section 05050.
- B. Electrolysis Isolators: All dissimilar metals shall be isolated over their full length with 1/8 inch thick neoprene unless otherwise noted.

### 2.4 SHOP FABRICATION

#### A. General

1. All dimensions shall be verified at the site before fabrication is started.
2. Galvanized items shall be shop fabricated and completely welded prior to galvanizing.
3. Fit and shop assemble items in largest practical sections, for delivery to site.
4. Fabricate items with joints tightly fitted and secured.
5. Welding shall be in accordance with the requirements of Section 05050.
6. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
7. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with the design of the component, except where specifically noted otherwise.
8. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
9. Miscellaneous metals work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability.
10. Metal Surfaces: For fabrication of miscellaneous metal work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
11. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by fittings.
12. No splicing of any member or part of the work will be allowed where full-length members are commercially available.

13. Screws, bolts, studs and other connecting devices required in the work shall be concealed wherever possible. On all finish work where fasteners must be exposed to view, they shall be countersunk and finished flush with the exposed surfaces. All screws, bolts and other fastening devices used for exterior work shall be aluminum, bronze or stainless steel, whichever is appropriate for the work in which it is to be used.

B. Fabrication Tolerances:

1. Squareness: 1/8 inch maximum difference in diagonal measurements.
2. Maximum Offset Between Faces: 1/16 inch.
3. Maximum Misalignment of Adjacent Members: 1/16 inch.
4. Maximum Bow: 1/8 inch in 48 inches.
5. Maximum Deviation From Plane: 1/16 inch in 48 inches.

## 2.5 FINISHES

A. Hot Dip Galvanizing

1. Material for galvanizing shall be geometrically suitable as specified in ASTM A384 and A385.
2. To be chemically suitable for galvanizing, steel should contain carbon below 0.25%, phosphorous below 0.5%; and manganese below 1.35%. Contact galvanizer if steel does not comply to determine suitability for processing.
3. To safeguard against warpage or distortion of steel members, in conformance with ASTM A384, miscellaneous metals fabricator shall submit shop drawings of non-standard fabrications, all tubular fabrications, all fabrications involving any dimension that exceeds the size of the galvanizer's kettle, and any fabrication involving materials of different thickness. These drawings shall be submitted to the galvanizer prior to fabrication to determine the suitability of the material for galvanizing.
4. All ferrous metals specified herein or indicated on the drawings as galvanized shall be hot-dipped galvanized after fabrication in compliance with ASTM A123 as modified to include 0.5% nickel, A143, A153, A384, or A385 as applicable. Galvanizing bath shall include zinc, nickel, and other state of the art alloys designed to ensure homogeneous metallurgical growth and greater corrosion resistance.
5. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the name of the galvanizer, the ASTM number, and the weight of the zinc coating in ounces per square foot. Coating shall be not less than 2.3 oz. per square foot of surface. After galvanizing, steel to be painted shall be dipped in a 0.2% chromic acid solution.
6. Within 12 hours of galvanizing, a factory prime coating shall be applied to all galvanized steel that is to be painted. Prime paint shall conform to the requirements and be of the same manufacturer as that provided under Section 09900. Finish painting is included under the Work of Section 09900.

7. To minimize distortion, material less than thirty feet in length shall be preheated in a suitable chamber maintaining a constant heat of no less than 200°F immediately prior to immersion into the molten zinc.
8. To minimize surface imperfections (e.g., flux inclusions) material to be galvanized shall be dipped into a solution of Zinc Ammonium Chloride prior to galvanizing. The type of galvanizing kettle utilizing a flux blanket overlaying the molten zinc shall not be permitted.

**B. Surface Preparation and Painting**

1. Surface Preparation and prime painting shall be as specified in Section 09900.
  - a. Prepare structural component surfaces in accordance with SSPC-SP-6 commercial sandblast, as a minimum.
  - b. All structural steel is to be thoroughly cleaned of dust and grit after sand blasting and before the primer is applied.
  - c. Prime paint utilized by the Miscellaneous Metals fabricator shall conform to the requirements and be of the same manufacturer as that provided under Section 09900.
2. Apply shop primer to top flange surfaces of composite steel beams unless indicated otherwise.

**C. Steel To Be Left Unpainted**

1. Clean steel surfaces in accordance with SSPC-SP3 for the following surfaces:
  - a. Faying surfaces of slip critical (SC) bolted connections.
  - b. Surfaces within 2 inches of field-welded connections.
  - c. Steel members to be completely encased in reinforced concrete, coated with cementitious fireproofing, or hot-dipped galvanized.
  - d. Bearing surfaces.
  - e. Surfaces to be weld-spliced in field.

**2.6 SOURCE QUALITY CONTROL**

- A. Miscellaneous Metals fabrications, materials, and workmanship shall be subjected to inspection and testing in mill, shop and/or field by the Engineer.
- B. Inspection and testing of shop welding shall be in accordance with the requirements of Section 05050. Repair and retest defective welds as specified in Section 05050.
- C. Maintain inspection and quality control records of shop and field work.
- D. Notify the Engineer prior to start of any fabrication, the start of sandblasting and painting, or other phases of work so as to afford them reasonable opportunity to inspect work.
- E. Furnish the Engineer upon request, with the following:
  1. Complete sets of approved Shop Drawings and corrective work procedures at fabricating shop(s) and in field.

2. Cutting lists, order lists, material bills, and shipping lists.
  3. Information as to time and place of all rollings and shipments of material to shops and field.
  4. Representative sample pieces requested for testing.
  5. Full and ample means and assistance for testing materials, and proper facilities for inspection of work, in mill, shop and field.
- F. Do not remove any marks or tags identifying rejected work.
- G. Any work found deficient shall be corrected or replaced in accordance with these specifications. Deficient welds shall be cut out to sound material and re-welded. Deficient assemblies shall be taken apart, corrected and reassembled, using new materials as required. ASTM A490 bolts shall not be reused. ASTM A325 bolts may be retightened once only.
- H. Miscellaneous Metals work that has been rejected by the Engineer in the mill or shop shall be corrected without delay and at no expense to the Owner.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify that anchor bolts, bearing plates, and other items furnished to be installed by others have been installed correctly.

#### 3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. All steel and aluminum surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling applied in accordance with manufacturer's instructions prior to installation.

#### 3.3 FIELD FABRICATION

- A. No fabricated section shall be cut in the field without the permission of the Engineer.
- B. All miscellaneous metals work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability.
- C. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by fittings.
- D. No splicing of any member or part of the work will be allowed where full-length members are commercially available. Jointing shall meet the approval of the Engineer.
- E. Screws, bolts, studs and other connecting devices required in the work shall be concealed wherever possible. On finish work where fasteners must be exposed to view, they shall be countersunk and finished flush with the exposed surfaces. Screws, bolts and other fastening devices used for exterior work shall be aluminum, bronze or stainless steel, whichever is appropriate for the work in which it is to be used.

3.4 INSTALLATION

- A. Install all items furnished except items to be imbedded in concrete or masonry. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
- B. Pack grout solidly between concrete or masonry bearing surfaces and plates to ensure that no voids remain.
- C. Make no openings without the specific written approval of the Engineer. All re-entrant corners shall be shaped notch-free to a radius of at least ½ inch at blocks, copes, cuts and openings.
- D. Openings in structural steel shall be cut and/or reinforced only by the structural steel Contractor, and only with the specific prior written approval of the Engineer.

3.5 CONCRETE AND MASONRY DRILLED ANCHORS

- A. Begin installation only after concrete or masonry to receive anchors has attained design strength.
- B. Install in accordance with manufacturer's instructions.
- C. Provide minimum embedment, edge distance, and spacing as follows, unless indicated otherwise by anchor manufacturer’s instructions or shown otherwise on Drawings:

Anchor Type	Min. Embedment (bolt diameters)	Min. Edge Distance (bolt diameters)	Min. Spacing (bolt diameters)
Wedge	9	6	12
Expansion and Sleeve	4	6	12
Undercut	9	12	16
Adhesive	9	9	13.5

- D. Use only drill type, bit type, and diameter recommended by anchor manufacturer. Clean hole of debris and dust with brush and compressed air.
- E. For undercut anchors, use special undercutting drill bit and rotary hammer drill and apply final torque as recommended by anchor manufacturer.
- F. When embedded steel or rebar is encountered in the drill path, slant drill to clear obstruction. If drill must be slanted more than 10 degrees to clear obstruction, notify Engineer for direction on how to proceed.
- G. Adhesive Anchors:
  - 1. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.
  - 2. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry where required by manufacturer’s instructions.
  - 3. Do not disturb anchor during recommended curing time.
  - 4. Do not exceed maximum torque as specified in manufacturer’s instructions.



### 3.6 FIELD QUALITY CONTROL

- A. The fact that Miscellaneous Metals work has been accepted at the shop shall not prevent its final rejection at the job site, even after it has been erected, if it is found to be defective in any way.
- B. Miscellaneous Metals erection, materials, and workmanship shall be subjected to inspection and testing in mill, shop and/or field by the Engineer.
- C. Inspection and testing of field welding shall be in accordance with the requirements of Section 05050.
- D. Maintain inspection and quality control records of shop and field work.
- E. Notify the Engineer prior to start of any miscellaneous metals erection, or other phases of work so as to afford them reasonable opportunity to inspect work.
- F. Furnish the Engineer upon request, with the following:
  - 1. Complete sets of approved Shop Drawings and corrective work procedures at fabricating shop(s) and in field.
  - 2. Full and ample means and assistance for testing materials, and proper facilities for inspection of work, in mill, shop and field.
- G. Do not remove any marks or tags identifying rejected work.
- H. Any work found deficient shall be corrected or replaced in accordance with these specifications, without delay and at no expense to the Owner.
- I. High-Strength Bolted Connections:
  - 1. An independent testing agency shall be retained by the Contractor and approved by the Engineer to perform the following inspection and testing in accordance with the AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts:
    - a. Marking identification and conformance to ASTM standards.
    - b. Alignment of boltholes.
    - c. Placement, type, and thickness of hardened washers.
    - d. Tightening of bolts.
  - 2. Bearing-Type Connections Not Fully Tensioned (N, X): Snug tight condition with plies of joint in firm contact.
  - 3. Pre-installation Test:
    - a. Conduct jobsite test prior to start of work using a bolt tension measuring device.
    - b. Select representative sample of not less than three bolts of each diameter, length, and grade.
    - c. Include DTIs and flat hardened washers as required to match actual connection assembly.

- d. Conduct test in accordance with Specification for Structural Joints Using ASTM A325 or A490 Bolts.
  - 4. Nondestructive Testing (NDT) Report: Prepare and submit a written NDT report identifying location of inspected bolted connections and summary of corrections as required to meet code acceptance criteria.
  - 5. Deficient assemblies shall be taken apart, corrected and reassembled, using new materials as required. ASTM A490 bolts shall not be reused. ASTM A325 bolts may be retightened once only.
  - 6. Re-inspect defective and improperly tightened high-strength bolted connections. Retest fully tensioned bolts as necessary to demonstrate compliance of the completed work.
- J. Welded Connections shall be tested in accordance with Section 05050.

### 3.7 ADJUST AND CLEAN

- A. Touch-Up Painting - Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as approved for use for shop painting.
- B. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- C. For galvanized surfaces, clean field welds, bolted connections and abraded areas and touch-up all damage using suitable touch up material complying with ASTM A780.

### 3.8 FASTENERS

- A. Anti-seizing Lubricant: Use on all stainless steel threads.
- B. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.
- C. Provide fasteners in accordance with Data Sheet – 05500 – A, following this section, unless otherwise noted on the drawings.

**DATA SHEET 05500-A**  
Fastener Materials Schedule

<b>Service Use and Location</b>	<b>Product</b>	<b>Remarks</b>
<b>Anchor Bolts Cast Into Concrete for Equipment Bases</b>		
All Areas	Stainless steel headed anchor bolts, unless otherwise specified with equipment	
<b>Drilled Anchors for Metal Components to Concrete (Ladders, Handrail Posts, Electrical Panels, and other Equipment)</b>		
Exterior and Interior Wet and Dry Areas	Hot-dip galvanized steel or stainless steel sleeve, wedge, or expansion anchors, or stainless steel adhesive anchors	Use zinc-plated undercut anchors for overhead and ceiling installations.
Submerged or Corrosive Areas	Stainless steel adhesive anchors	
<b>Anchors in Grout-Filled Concrete Masonry Units</b>		
All Areas	Hot-dip galvanized steel headed anchor bolts, zinc-plated or stainless steel sleeve anchors, or stainless steel adhesive anchors	
<b>Anchors in Hollow Concrete Masonry Units</b>		
All Areas	Zinc-plated or stainless steel sleeve anchors, or stainless steel adhesive anchors with screen tube	
<b>Connections for Structural Steel Components</b>		
All Areas	High-strength steel bolts	

END OF SECTION

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**DIVISION 7 - THERMAL AND MOISTURE PROTECTION**

## SECTION 07920

## JOINT SEALANTS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:
    - a. Perimeter joints of wall openings where indicated
    - b. Joints through fire-rated partition and floor/ceiling assemblies
    - c. Joints between piping and adjoining walls, floors, and counters
    - d. Other joints as indicated
- B. Related Sections
  - 1. Only Section 15181 – Hydronic Piping
  - 2. Section 15810 – Ducts and Casings

## 1.2 REFERENCES

- A. ASTM C717 - Standard Terminology of Building Seals and Sealants
- B. ASTM C719 - Standard Test Method for Adhesion Cohesion of Elastomeric Joint Sealants under Cyclic Movement (Hockman Cycle)
- C. ASTM C834 - Standard Specification for Latex Sealants
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants
- G. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
- H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stop
- I. Underwriters Laboratories, Inc.

## 1.3 PERFORMANCE

- A. Provide joint sealants that have been produced and installed to establish and maintain watertight and air tight continuous seals.

## 1.4 SUBMITTALS

- A. Submit Product Data from manufacturers for each joint sealant product required, including instructions for joint preparation and joint sealant application.

- B. Submit samples for Initial Selection Purposes - Manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available, for each product exposed to view.
- C. Submit samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples in ½-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealant.
- D. Submit certificates from manufacturers of joint sealants attesting that their products comply with Specification requirements and are suitable for use indicated.
- E. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project name, addresses, names of Engineers and Owners, plus other information specified.
- F. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
- G. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

#### 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications - Company specializing in performing the work of this Section who has successfully completed within the last 3 years at least 3 joint sealant applications similar in type and size to that of this Project.
- B. Single Source Responsibility for Joint Sealant Materials - Obtain joint sealer materials from a single manufacturer for each different product required.
- C. All sealants shall be used as received from the manufacturer and no thinning or other alterations will be allowed at the job site.
- D. Preconstruction Compatibility and Adhesion Testing - Submit samples of all materials that will contact or affect joint sealants to joint sealant manufacturers for compatibility and adhesion testing, as indicated below:
  - 1. Use test methods standard with manufacturer to determine if priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
    - a. Perform tests under normal environmental conditions that will exist during actual installation.
  - 2. Submit not less than 9 pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the Work.
  - 4. Investigate materials failing compatibility or adhesion tests and obtain joint sealant manufacturer's written recommendations for corrective measures, including use of specially formulated primers.

5. Testing will not be required when joint sealant manufacturer is able to submit joint preparation data required above which is acceptable to the Engineer and is based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- E. Product Testing - Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of submittal of test results.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Conditions - Do not proceed with installation of joint sealants under the following conditions:
  1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40°F (4.4°C).
  2. When joint substrates are wet due to rain, frost, condensation or other causes.
- B. Joint Width Conditions - Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions - Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

#### 1.8 SEQUENCING AND SCHEDULING

- A. Sequencing installation of joint sealers to occur not less than 21 or more than 30 days after completion of waterproofing, unless otherwise indicated.

### PART 2 PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Compatibility - Provide joint sealants that are compatible with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors - Provide color of exposed joint sealants as selected by the Engineer from manufacturer's standard colors.

#### 2.2 FIRE-RESISTANT JOINT SEALERS

- A. General - Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

- B. Foamed-In-Place Fire-Stopping Sealant - Two-part, foamed-in-place, silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around cables, conduit, pipes and similar penetrations through walls and floors.
- C. One-Part Fire-Stopping Sealant - One part elastomeric sealant formulated for use in a through-penetration fire-stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors.
- D. Products - Subject to compliance with requirements, provide one of the following:
  - 1. One-part fire-Stopping Sealant:
    - a. 3M Fire Barrier Caulk CP-25 - Electrical Products Div./3M.
    - b. Pensil® PEN300 Silicone Sealant - SpecSeal.
    - c. or equal.
- E. Available Products - Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
  - 1. Foamed-In-Place Fire-Stopping Sealant:
    - a. Pensil® 200 Firestop Foam (PEN200) – SpecSeal.
    - b. 2001 Silicone RTV Foam – 3M.
    - c. or equal.

### 2.3 JOINT SEALANT BACKING

- A. General - Provide sealant backings of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers - Preformed, compressible, resilient, nonwaxing, nonextruding strips of flexible, nonglassing plastic foam of material indicated below; nonabsorbent to water and gas; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  - 1. Either open cell polyurethane foam or closed-cell polyethylene foam, unless otherwise indicated, subject to approval of sealant manufacturer, for cold-applied sealants only.
- C. Elastomeric Tubing Joint-Fillers - Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, non-absorbent to water and gas, capable of remaining resilient at temperatures down to -26°F (-15°C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape - Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

### 2.4 MISCELLANEOUS MATERIALS



- A. Primer - Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated.
- B. Cleaners for Nonporous Surfaces - Provide nonstaining, chemical cleaners of type which are acceptable to manufacturer of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oil residues or otherwise have detrimental effect on a sealant adhesion or in-service performance.
- C. Masking Tape - Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.
- D. Accessory Materials for Fire-Stopping Sealants - Provide forming, joint-fillers, packing and other accessory materials required for installation of fire-stopping sealants as applicable to installation conditions indicated.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints - Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturers and the following requirements.
  - 1. Remove all foreign material from joint substrates, which could interfere with adhesion of joint sealant.
  - 2. Clean concrete joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
  - 3. Remove laitance and form release agents from concrete.
  - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile and other nonporous surfaces by chemical cleaners or other means, which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.
- B. Joint Priming - Prime joint substrates as recommended by joint sealant manufacturer. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape - Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

#### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General - Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard - Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Solvent-Release-Curing Sealant Installation Standard - Comply with requirements of ASTM C1193 use of solvent-release-curing sealants.
- D. Acoustical Sealant Application Standard - Comply with recommendations of ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications and conditions indicated.
- E. Latex sealant Installation Standard - Comply with requirements of ASTM C717 for use of latex sealants.
- F. Installation of Sealant Backings - Install sealant backings to comply with the following requirements:
  - 1. Install joint-fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths, which allow optimum sealant movement capability.
    - a. Do not leave gaps between ends of joint-fillers.
    - b. Do not stretch, twist, puncture or tear joint fillers.
    - c. Remove absorbent joint fillers, which have become wet prior to sealant application and replace with dry material.
  - 2. Install bond breaker tape between sealants and joint fillers, compression seals or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.
  - 3. Install compressible seals serving as sealant backings to comply with requirements indicated above for joint fillers.
- G. Installation of Sealants - Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.
- H. Tooling of Nonsag Sealants - Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform bends of configuration indicated, to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Do not use tooling agents, which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
  - 1. Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.
- I. Installation of Preformed Foam Sealants - Install each length of sealant immediately after removing protective wrappings, taking care not to pull or stretch material, and complying with sealant manufacturer's directions for installation methods, materials

and tools which produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperature where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

- J. Installation of Fire-Stopping Sealant - Install sealant, including forming, packing and other accessory materials to fill openings around mechanical and electrical services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.

**JOINT SEALER SCHEDULE**

Foamed-in-Place Fire-Stopping Sealant	Through penetrations in floor and wall assemblies involving multiple pipes, conduits, including the perimeter joint between walls and slabs and the preformed wall panels.
One-Part Fire-Stopping Sealant	Through penetrations in floor and wall assemblies involving single pipes, conduits where joint widths are narrow and of uniform width.

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Provide a joint seal at all joints subject to weather infiltration whether shown or scheduled. Joints not shown or scheduled shall receive a joint sealant as selected by the Engineer from the sealants listed above.

END OF SECTION

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**DIVISION 9 - FINISHES**

## SECTION 09900

## PAINTING

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Surface preparation and application of coatings.

## 1.2 REFERENCES

## A. The Society for Protective Coatings (SSPC):

1. Surface Preparation Specifications
  - a. SP-1 - Solvent Cleaning
  - b. SP-2 - Hand Tool Cleaning
  - c. SP-3 - Power Tool Cleaning
  - d. SP-5 - White Metal Blast Cleaning
  - e. SP-6 - Commercial Blast Cleaning
  - f. SP-7 - Brush-Off Blast Cleaning
  - g. SP-10 - Near-White Blast Cleaning
2. SP-16 – Brush Off Blast of Galvanized and Non-Ferrous Metals
3. National Association of Pipe Fabricators (NAPF):
  - a. NAPF 500-03-01 - Solvent Cleaning
  - b. NAPF 500-03-02 – Hand Tool Cleaning
  - c. NAPF 500-03-03 – Power Tool Cleaning
4. SSPC-PA 1 – Shop, Field and Maintenance Painting
5. SSPC-PA 2 - Measurement of Dry Coating Thickness with Magnetic Gages
6. SSPC Visual Standards SSPC VIS 1-89
7. SSPC Guide 4 – Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems
8. SSPC Guide 6 – Guide for Containing Debris Generated During Paint Removal Operations

## B. Occupational Safety and Health Administration (OSHA) Standards

## 1.3 SCOPE OF WORK

## A. Items of work include but are not limited to the surface preparation and coating of the following:

1. Structural steel

2. Exposed electrical conduit, conduit fittings, and outlet boxes
  3. Ferrous metal equipment provided by the Contractor and non-insulated ferrous metal ductwork
  4. Exposed exterior piping
  5. Interior piping, fittings and valves with the exception of plastic and stainless steel, unless noted otherwise
  6. Fabric covered insulated pipes and ductwork
  7. Piping and duct support systems
  8. Touch-up painting of shop primers
  9. Galvanized metal, at the locations specified on the Drawings
  10. Back painting items that will be inaccessible to finish painting once installed including but not limited to lintels, clip angles, structural steel, miscellaneous metals
  11. Miscellaneous steel fabrications
  12. Previously painted surfaces to be recoated:
    - a. Steel
    - b. Other surfaces so noted or scheduled on the Drawings
- B. Coatings are not required for glass, stainless steel, chrome, cadmium plate or aluminum that is not in contact with concrete.
- C. Ventilation, dehumidification, and temperature control equipment required to provide and maintain the proper environment for worker protection and for coating application and curing.
- D. The Contractor shall furnish to the Owner, at no charge, for use duration of this Project, dry film thickness gauge, wet film thickness gauge, adhesion testing, surface preparation testing, temperature / climate condition detectors, electrical flaw gauge and / or holiday detection equipment.

#### 1.4 SUBMITTALS

- A. Applicator qualifications for general coatings.
- B. List of coating products and systems proposed, giving brand, type and manufacturer.
- C. Product for product listing of the manufacturer's coating system showing a comparison with the specified coating systems in Schedules 09900-A and 09900-B.
- D. Manufacturer's current printed recommendations and product data sheets for each system, and ASTM performance criteria.
- E. Paint manufacturer's compatibility guide, to be a complete listing of all compatible paint systems/combinations produced by the paint manufacturer.
- F. Copies of manufacturer's complete color charts for each coating system.
- G. When requested by the Engineer, provide product container labels and labeled mixing instructions for products utilized in the Work.

- H. Method and equipment to be used for dehumidification.
- I. Ventilating plan describing procedures and equipment that will be used.
- J. Method to be used, and the size and type of abrasive media to be used for the abrasive blast cleaning.
- K. Method and equipment to be used for temperature control.

#### 1.5 QUALITY ASSURANCE

- A. Use adequate number of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this Section.
- B. Applicator Qualifications – Minimum 5 years experience in application of specified products.
- C. Regulatory Requirements – Meet federal, state and local requirements limiting the emission of volatile organic compounds.
- D. A qualified and experienced representative of the paint manufacturer shall meet with Contractor and Engineer to coordinate items requiring painting and to schedule the Work. Monthly field visits shall occur to ensure proper application of the painting system. The Contractor shall coordinate with the paint manufacturer to schedule site visits.
- E. Use equipment of adequate size, capacity, and quantity to accomplish the work of this Section in a timely manner.

#### 1.6 DELIVERY, HANDLING, STORAGE AND PROTECTION

- A. Deliver materials to painter's area in original, unbroken, containers with name and analysis of product, manufacturer's name, and shelf life date. Do not use or retain contaminated, outdated, prematurely opened, or diluted materials.
- B. Storage of materials shall be in accordance with the paint manufacturer's recommendations.
- C. Store coated items carefully. Store paints and painter's materials only in areas designated solely for this purpose. Avoid damaging or dirtying coatings by contact with soil, pavement or other harmful materials that might necessitate special cleaning. Use suitable blocking during storage.
- D. Confine mixing, thinning, clean-up and associated operations, and storage of painting debris before authorized disposal, to these areas.
- E. Do not expose primed surfaces to weather for more than six months before top coating. Allow less time if recommended by coating manufacturer.
- F. Do not use plumbing fixtures, piping or mechanical equipment for mixing or disposal of paint materials.
- G. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in painter's area longer than 24 hours. Finally, dispose of waste in an approved disposal system.
- H. During surface preparation, cleaning and painting operations, protect all surfaces not to be painted.

- I. Protect coated items, whether prime or finish, from damage due to shipping and handling. Use padding, blocking, fabric slings and extra care as required.
- J. Upon completion of field painting, ensure coatings are undamaged and in good condition. Repair damaged or deteriorated coating, resulting from failure to observe foregoing requirements.

#### 1.7 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
  - 1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
  - 2. Do not apply coatings when dust is being generated.
- B. Cover or otherwise protect work by other trades and surfaces not being painted during all painting operations.
- C. All shop primed ferrous metals shall be primed using the same coatings specified in the paint schedule.

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

- A. Coating systems are designated by reference to Tnemec Company, Inc. and Sherman Williams products to establish the type and quality required. Equal products as manufactured by International Protective Coatings, PPG Industries, Carboline Company or equal will be considered if provided with a "Product for Product" listing with the submittal. The Engineer reserves the right to request and receive detailed technical literature of each proposed coating system before approval.
- B. No coating systems will be considered that decrease the film thickness, decrease the number of coats, decrease the effectiveness of the surface preparation or change the type of coating specified in the schedule of this section.

##### 2.2 MATERIALS, GENERAL

- A. Paint Coatings - Suitable for intended use, recommended by their manufacturer for intended service. All coatings, unless otherwise specified, shall be suitable for severe service.
- B. Products Used - Minimum of five years satisfactory use under similar service conditions.
- C. Use products of one manufacturer in any one paint coating system; all coating materials compatible. Coatings for touch-up - same as original.
- D. Equipment prime or finish painted by the equipment manufacturer shall be painted in strict accordance with this Section and the equipment's individual specification section.
- E. Bear entire responsibility in providing complete compatibility of all shop and field painting systems.
- F. It is recognized that the specific application of the coating products varies for each specific manufacturer (number of coats, mil thickness per coat, etc.). Therefore, these Specifications represent the minimum to be provided under this contract and shall be increased in accordance with each manufacturer's recommendations.



## 2.3 COLORS AND FINISHES

- A. All finish colors will be selected from manufacturer's color chips. The Owner will select the colors. Match final colors to selected color chips, as scheduled.
- B. To provide contrast between successive coats, lightly tint each coat to distinguish it from preceding coats.
- C. Unless otherwise indicated, use gloss or semi-gloss for finish paint.

## 2.4 COATING TYPES

- A. Coating types and minimum acceptable percent (by volume) of component solids are described in Schedule 09900-A Coating Types. Description of coating systems including surface preparation and dry film thicknesses are included in Schedule 09900-B Coating Systems.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work.
- B. Do not proceed with surface preparation or coating application until conditions are suitable.
- C. The following shop and field instruments shall be used to inspect surface preparation and dry film thickness.
  - 1. SSPC visual standards SSPC-VIS 1-89
  - 2. Testex Press-O-Film replica type x-coarse
  - 3. Surface temperature thermometer
  - 4. Sling psychrometer and psychrometric tables
  - 5. Type I or Type II dry film thickness gauges
  - 6. SSPC-PA2 methods

### 3.2 PREPARATION

- A. Basic Steps
  - 1. Arrange to do all preparation and paint work in heated enclosure unless ambient weather conditions ensure still, dry air and a minimum of 50 degree F temperature. Do not apply paints to surfaces in direct sunlight.
  - 2. Coordinate cleaning and painting operations to eliminate contamination of one by the other.
  - 3. Maintain all coating materials at manufacturer's recommended mixing and application temperatures for not less than 24 hours before use. Have clean, proper containers, spray equipment, applicators and accessory items ready for use before decanting or mixing paint materials.

4. Ensure proper coordination of materials to be applied hereunder with previous coatings on affected surfaces. Have all manufacturer's written directions on hand, and follow them strictly, except where otherwise specified.
  5. Carefully coordinate preparation and material compatibility requirements of paint systems used by manufacturers to shop prime equipment.
- B. Before any paint application, carefully clean all surfaces to be coated of dust, dirt, grease, rust, mill scale, paint unsuitable for top coatings, efflorescence, oil, moisture, foreign matter or conditions detrimental to coating bond and durability.
1. Following cleaning, apply preparatory treatment in strict accordance with manufacturer's written instructions.
  2. Fill imperfections and holes in surfaces to be painted.
- C. Metals
1. Prepare all field and shop primed ferrous metals, including galvanized ferrous metals, in accordance with Schedule 09900-B Coating System Schedule included under this Section.
  2. A needle gun may be used for field welds and shop welds which occur in narrow, unprimed areas in an otherwise shop primed surface.
  3. Prepare non-ferrous and galvanized metal surfaces for finishing in accordance with SSPC-SP16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steels, Stainless Steels and Non-Ferrous Metals. Provide minimum uniform anchor profile of 1 mil. Apply coatings as outlined on the Paint Schedule.
- D. Provide higher degree of cleaning for acceptable equivalent paint products when paint manufacturer recommends in his printed surface preparation recommendations.
- E. Before applying field coat, touch-up abraded areas of shop coats with paint of the same type. Apply an entire coat if necessary. Touch-up coats are in addition to, and not a substitute for first field coat. Clean deteriorated surfaces to bare metal before applying touch-up coat.
- F. After installation and before applying field coats, touch-up all scratches and blemishes on equipment, motors, pumps, instrumentation panels, electrical switchgear, and similar items with shop coats, paint filler, enamel or other treatment customary with manufacturer.
- G. After installation, touch up all scratches and blemishes on all steel.
- ### 3.3 VENTILATION
- A. Particular care shall be exercised during the cleaning and painting of each room. Means of adequately removing air from each room shall be provided, in order to remove dust and solvent vapors.
  - B. During the cleaning and painting operations, the painters shall be provided with proper respiratory protection in accordance with OSHA regulations.
  - C. In addition to meeting the minimum requirements listed above, the Contractor shall be responsible for complying with all applicable regulations of the various local, state, and federal agencies.

### 3.4 DEHUMIDIFICATION

- A. Continuous dehumidification of areas where paint coatings will be applied may be required twenty-four hours per day during all surface preparation, painting, and curing. The equipment used must be capable of maintaining the interior air quality at or below 20 percent relative humidity during surface preparation and between 40% and 80% during the coating application and curing process of interior finish coat(s). The surfaces must be dry and 5 degrees above the dew point.
- B. Humidity shall be monitored using a strip chart recorder that provides continuous measurement of humidity and air temperature.
- C. In the event of dehumidification equipment failure, prepared surfaces that have been approved for priming will not be allowed to stand uncoated and must be painted before the end of the shift.

### 3.5 TEMPERATURE CONTROL

- A. Auxiliary heat and/or cooling may be necessary to maintain the room temperature at an acceptable level for the coating manufacturer's application parameters. The equipment must be compatible with the required dehumidification equipment and meet the following requirements.
  - 1. The air from heaters and refrigerant type systems shall be connected to the process air supply duct from the dehumidifier.
  - 2. Only electric, indirect fired combustion, or steam coil auxiliary heaters may be used. Direct-fired space heaters are not permitted during the blasting, coating or curing phases.
  - 3. Heaters shall be equipped with controls that automatically turn the heaters off if the airflow is interrupted or the internal temperature exceeds its design temperature or that of the supply duct.
  - 4. The area where dehumidification is introduced shall be sealed to allow the air to escape away from the entry point while maintaining a slight positive pressure unless dust from the operation is hazardous. The design of the filter system, if necessary, shall be such that it does not interfere with the dehumidification equipment's ability to control the dew point and temperature parameters in that space. Do not recirculate the air from the space or from the filtration equipment back through the dehumidifier during the coating application or when solvent vapors are present.
  - 5. Maintain a minimum temperature of 50 degrees F for a minimum of seven (7) days after a coating application.

### 3.6 APPLICATION

- A. Conditions
  - 1. Do not apply paints or other finish to wet or damp surfaces, except in accordance with instructions of manufacturer. Do not apply exterior paint during cold, rainy, or frosty weather, or when temperature is likely to drop to freezing within the paint coatings curing time as specified by the paint manufacturer. Avoid painting of surfaces while they are exposed to direct sunlight.

2. Paint surfaces which have been cleaned, pretreated, or otherwise prepared for painting with first finish coat as soon as practicable after such preparation has been completed, but in any event prior to deterioration of prepared surface.
3. Coat blast cleaned metal surfaces immediately after cleaning, before any rusting or other deterioration or contamination of the surface occurs. Do not coat blast cleaned surfaces later than 8 hours after cleaning under ideal conditions or sooner if conditions are not ideal.
4. Work shall conform to SSPC-PA 1.

**B. Methods**

1. Prepare surfaces, mix and apply paint materials in strict accordance with manufacturer's printed instructions and recommendations, except where specifically directed otherwise. Control temperature of materials upon mixing and application, surface temperature and condition, thinning and modifying.
2. Protect surfaces to be coated, before, during and after application unless ambient weather conditions are favorable.

**C. Workmanship**

1. Apply coating materials to meet manufacturer's spreading rate and dry film thickness recommendations. Dry film thicknesses specified are constant for brush, spray, roller or other form of application.
  - a. Control thinning for spray use and to manufacturer's printed instructions, and produce specified dry film thickness on level surfaces, interior and exterior angles.
  - b. Record quantities of materials of each type, for each coat used.
2. Apply paints and coatings using skilled painters, brushed or rolled or sprayed out carefully to a smooth, even coating without runs or sags. Allow each coat of paint to dry thoroughly, on the surface and throughout the film thickness, before the next coat is applied. High polymer coatings may be exempted from the drying requirement if recoat time is specified by manufacturer.
3. Finish surfaces - Uniform in finish and color, and free from flash spots and brush marks.
4. Accessory items, finish hardware, lighting fixtures, escutcheons, plates, trim and similar finish items not to be painted: Remove or carefully mask before painting adjacent surfaces; carefully replace and reposition upon completion of adjacent painting and cleaning work.

**3.7 EXISTING SURFACES TO BE RECOATED**

- A. Previously painted surfaces so noted or scheduled shall be completely recoated. Painted surfaces containing PCBs or suspected to contain PCBs shall have the paint removed and any PCBs impacted substrates removed in accordance with Section 13286. Do not proceed with work under this section until the work of Section 13286 has been completed for a given area to be recoated.
- B. Surface preparation for steel shall, in general, be as specified in SSPC Guide 4. Surface preparation for other substrates shall, in general, be as specified for new surfaces. For

existing lead-based paints, collection and disposal of paint shall be completed in accordance with Section 13282 and SSPC Guide 6.

- C. Coatings used for a particular surface shall, in general, be as scheduled for that type of new surface unless otherwise noted. Confirm with the coating manufacturer that the coating proposed for a particular recoating condition will be compatible with the existing painted surface. Perform adhesion and compatibility tests on existing substrates. Recoated areas shall be covered by the same guarantee specified for the remainder of the project.

### 3.8 PROTECTION, CLEAN-UP

- A. Protect all materials and surfaces painted or coated under this Section, from the time of surface preparation until the final coat has fully dried. Also protect all adjacent work and materials from touch-up painting by the use of sufficient drop cloths during the progress of this work. Upon completion of the work, clean up all paint spots, oil, and stains from floors, glass, hardware, and similar finished items.

### 3.9 PAINT SCHEDULE

- A. Coordinate, schedule and confirm the various cleaning, touch-up and finishing operations. Ensure the transmission of materials data, color selections and coating system methods between the coating applicators. Take responsibility for not exceeding exposure and recoat time limits.
- B. Color code all piping in accordance with Schedule 09900-C, Color Schedule.

### 3.10 FIELD QUALITY CONTROL

- A. Leave staging and lighting in place until the Engineer has inspected surface or coating. Replace staging removed prior to approval by the Engineer. Provide additional staging and lighting as requested by the Engineer.
- B. Unsatisfactory Application
  1. If surface has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
  2. Evidence of runs, bridges, shiners, laps or other imperfections is cause for rejection.
  3. Repair defects in accordance with written recommendations of coating manufacturer.
- C. Damaged coatings, Pinholes and Holidays
  1. Feather edges and repair in accordance with recommendations of paint manufacturer.
  2. Hand or power sand visible areas of chipped, peeled or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on the extent of repair and appearance, a finish sanding and topcoat may be required.
  3. Apply finish coats, including touchup and damage repair coats in a manner that will present a uniform texture and color-matched appearance.

3.11 FINAL TOUCH-UP

- A. Prior to final completion and acceptance, examine painted and finished surfaces and retouch or refinish as necessary to leave surfaces in perfect condition.
- B. After doors have been fitted and hung, refinish edges, tops and bottoms.

<b>Schedule 09900-A - Coating Types</b>		
<b>Tnemec Company Inc.</b>	<b>Sherwin-Williams</b>	<b>Type of Coating System (Solids Content by Volume)</b>
Series 1026 Enduratone	DTM Acrylic Primer-Finish or Pro Industrial Pro-Cryl Universal Acrylic Primer	Acrylic Emulsion (43.0 ± 2.0%).
Series 20HS Pota-Pox	Macropoxy 646 PW Potable Water Epoxy or Macropoxy 5500 Low VOC Epoxy	Polyamide Epoxy (77.0 ± 2.0%)
Series FC20HS Pota-Pox (Fast Cure)	Macropoxy 646 PW Potable Water Epoxy or Macropoxy 5500 Low VOC Epoxy	Polyamide Epoxy (77.0 ± 2.0%)
Series 1029 Enduratone	Sher-Cryl HPA High Performance Acrylic-Semi-Gloss	HDP Acrylic Polymer (40.0 ± 2.0%)
Series 66HS Hi-Build Epoxoline	Macropoxy 5500 Low VOC Epoxy	Polyamide Epoxy (78.0 ± 2.0%)
Series 73 Endura Shield	Acrolon 218 HS Acrylic Polyurethane-Semi-Gloss	Aliphatic Acrylic Polyurethane (58.0 ± 2.0%)
Series 94-H2O Hydro-Zinc	Corothane I Galvapak 2K 100 Zinc Primer (NSF)	Aromatic Urethane, Zinc Rich (63.0 ± 2.0%)
Series 151 Elasto-Grip	Preprite ProBlock Interior/Exterior Latex Primer	Waterborne Modified Polyamine Epoxy (17.0 ± 2.0%)
Series 435 Perma-Glaze	Dura-Plate 5900 HB Epoxy (formerly Cor Cote SC Plus).	Modified Polyamine Epoxy (100%)
Series 1 Omnithane	Corothane I Galvapak Two Pack Zinc Primer (NSF).	MIO/Zinc-Filled Urethane (61.0 ± 2.0%)
Series 215 Surfacing Epoxy	Steel Seam FT910 Epoxy Patching and Surfacing Compound.	Modified Polyamine Epoxy (100%)
Series 1528 Endura-Heat DTM	Heat Flex 1200 / Heat Flex 3500	Inert Multipolymeric Matrix (65%)

<b>Schedule 09900-B - Coating Systems</b>				
<b>Surface</b>	<b>System Surface Preparation (Shop/Field)</b>	<b>System Finishes</b>		
		<b>Primer</b>	<b>2nd</b>	<b>Final</b>
		<b>DFT = Dry Film Thickness, Mils</b>		
Ferrous Metals, Interior Non-Submerged	SSPC-SP-6	Series 1 (2.5-3.5 DFT)	Series 66HS (4.0-6.0 DFT)	Series 73 (2.5-5.0 DFT)
		<i>Corothane I Galvapac 2K</i>	<i>Macropoxy 646 FC Epoxy</i>	<i>Acrolon 218 HS Polyurethane</i>
Ferrous Metals, Submerged or Intermittently Submerged - Potable	SSPC-SP-10	Series 94-H2O (2.5-3.5 DFT)	Series 20HS or FC20HS (6.0-8.0 DFT)	Series 20HS or FC20HS (6.0-8.0 DFT)
		<i>Corothane I Galvapac 2K</i>	<i>Macropoxy 5500 or 646 PW</i>	<i>Macropoxy 5500 or 646 PW</i>
Ductile and Cast Iron Pipe, Interior and Exterior, Non-submerged	NAPF 500-03-04 / SSPC-SP-6	Series 66HS (3.0-5.0 DFT)	Series 66HS (3.0-5.0 DFT)	Series 73 (2.5-5.0 DFT)
		<i>Macropoxy 646 FC Epoxy</i>	<i>Macropoxy 646 FC Epoxy</i>	<i>Acrolon 218 HS Polyurethane</i>
Non-Ferrous Metal (Other Than Galvanized), Interior and Exterior Non-Submerged	SSPC-SP-16 Surface Preparation of Galvanized Steel (Minimum 1 mil anchor profile)	Series 66HS (2.0-3.0 DFT)		Series 73 (2.5-3.0 DFT)
		<i>Macropoxy 646 FC Epoxy</i>		<i>Acrolon 218 HS Polyurethane</i>
Galvanized Steel, Interior and Exterior	SSPC-SP-16 Surface Preparation of Galvanized Steel 1.0-1.5 mil profile	Series 1 for field touch-up (2.5-3.5 DFT)	Series 66HS (2.0-3.0 DFT)	Series 73 (2.5-3.0 DFT)
		<i>Corothane I Galvapac 1K for field touch up</i>	<i>Macropoxy 646 FC Epoxy</i>	<i>Acrolon 218 HS Polyurethane</i>
<i>Notes</i>				
(1) Tnemec Products are listed in the first row for each surface and Sherwin-Williams products are listed in italics on the second row for each surface without a dry film thickness. Refer to Paragraph 2.1 for “or equal” products.				

END OF SECTION

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**DIVISION 15 - MECHANICAL**

## SECTION 15077

## IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2.
  - 3. Pipe labels.
  - 4. Duct labels.

## 1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment and Piping Label Schedule: Include a listing of all equipment and piping to be labeled with the proposed content for each label.
- D. ASME A13.1 – Latest pipe marking standard guide for the identification of pipes.

## PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. Labels and Warning Signs
  - 1. Brady Corp.
  - 2. Seton Identification Products
  - 3. National Marker Company
  - 4. Or Equal

## 2.2 GENERAL

- A. When Owner's labeling standards are different from those specified, observe and follow Owner's standard labeling system.

## 2.3 EQUIPMENT LABELS

- A. Metal Labels for equipment
  - 1. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Label text shall be engraved or stamped.

3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  5. Fasteners: Stainless-steel rivets or self-tapping screws.
  6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick for labels up to 20 sq. inches or 8 inches in length and 1/8 inch thick for larger labels, and having predrilled holes for attachment hardware.
  2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  4. Fasteners: Stainless-steel rivets or self-tapping screws.
  5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content:
1. Equipment identification tag: Use equipment's Drawing designation tag.
  2. Manufacturer, model number, serial number.
  3. Capacity and operating characteristics.
  4. Electrical power characteristics.
  5. Certification labels.
- D. Equipment marker color schedule:
1. Green: For cooling equipment and components.
  2. Yellow: For heating equipment and components
  3. Yellow and Green: For dehumidification, combination cooling and heating equipment and components.
  4. Brown: For energy-reclamation equipment and components

## 2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawing legend; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
- E. Pipe Label Color Schedule:
  - 1. Cooling Coil Condensate-Water Piping: Green band, white letters on a safety-green background.

## 2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick for labels up to 20 sq. inches or 8 inches in length and 1/8 inch thick for larger labels, and having predrilled holes for attachment hardware.
- B. Letter Color: Black
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
- I. Duct label color schedule:

1. Supply ducts: White letters on a safety-green background.
2. Exhaust ducts: Black letters on a yellow background.
3. Return-, outside-, and relief-air ducts: White letters on a blue background.
4. ASME A13.1 colors and designs: For hazardous material or grease duct exhaust.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### **3.3 EQUIPMENT LABEL INSTALLATION**

- A. Install and permanently fasten labels on all major equipment scheduled on drawings and on each major item of HVAC equipment that does not have a nameplate or has nameplate that is damaged or located where not easily visible.
- B. Include nameplates for the following general categories of equipment:
  1. Pumps, duct mounted coils, heat recovery units and similar equipment.
  2. Dehumidifiers and condensing units.
  3. Air handlers, rooftop units, fans, and blowers.
- C. Locate equipment labels where accessible and visible.

### **3.4 PIPE LABEL INSTALLATION**

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run.
    - a. Reduce intervals to 25 feet in areas of congested piping and equipment.
    - b. Reduce intervals to 20 feet for all refrigerant piping.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. The termination of concealed condensate piping shall be marked to indicate whether the piping is connected to the primary or secondary drain.

### 3.5 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts. Labels shall be installed on the insulation of insulated ductwork.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.6 ADJUSTING

- A. Relocate mechanical identification tags and provide additional labels where tags and labels have been visually blocked by other work.

### 3.7 CLEANING

- A. Clean all identification tags and labels.

END OF SECTION

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## SECTION 15080

## MECHANICAL INSULATION

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Piping Systems Insulation:
    - a. Closed cell elastomeric.
  - 2. Ductwork Insulation:
    - a. Fiberglass.
  - 3. Protective saddles, shields, and thermal hanger shields.
  - 4. Field applied jackets.
- B. Related Sections
  - 1. Section 15181 – Hydronic Piping
  - 2. Section 15810 - Duct

## 1.2 REFERENCES

- A. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- B. ASTM C 547 - Specification for Mineral Fiber Preformed Pipe Insulation.
- C. ASTM C 553 - Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type).
- D. ASTM C 612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
- E. ASTM C 921 - Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- F. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.

## 1.3 SUBMITTALS

- A. Manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.
- B. Installers' Qualifications - Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for the project.
- C. Flame/Smoke Ratings - Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
  - 1. Exception - Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
  - 2. Exception - Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturer - Subject to compliance with requirements, provide products of one of the following:
  - 1. Knauf Fiber Glass GmbH.
  - 2. Manville Products Corp.
  - 3. Owens-Corning Fiberglass Corp.
  - 4. Childers Products Co.
  - 5. Specialty Products and Insulation Co.
  - 6. Or equal
- B. Manufacturers for Closed Cell Elastomeric Insulation Products:
  - 1. Aeroflex, Aerocell.
  - 2. Armacell, LLC. Armaflex.
  - 3. K-Flex USA LLC
  - 4. Or equal.
- C. Weatherproof Jacketing for Ducts :



1. Polyguard – Alumaguard
2. 3M Venture Cladding
3. HiCube Coatings
4. Or Equal.

## 2.2 MATERIALS

### A. Piping Insulation

1. Fiberglass Piping Insulation - ASTM C 547, Type 1, ASTM E84, unless otherwise indicated.
  - a. Thermal Conductivity: 0.24 Btu-in/ (h-sq. ft-degrees F) at 75 degrees F.
  - b. Operating Temperature Range: 0 to 850 degrees F.
  - c. Jacket: Factory applied vapor retarder, 0.02 maximum vapor permeance, ASTM C1136
2. Type I, flexible, closed cell elastomeric insulation, tubular.
  - a. Thermal Conductivity: maximum of 0.24Btu-in/ (h-sq. Ft-degrees F) at 75 degrees F.
  - b. Operating Temperature Range: Minus 70 to 180 degrees F.
  - c. Manufactured without CFCs, HFCs, HCFCs, or formaldehyde
  - d. Water vapor permeability less than 0.05 perm-inches
  - e. Flame spread index less than 25 and smoke spread index less than 50 tested to ASTM E84.
  - f. Material: Nitrile butadiene rubber / PVC or EPDM rubber. Polyethylene insulation is not acceptable.
3. Jackets for Piping Insulation - ASTM C921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
  - a. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations.
  - b. Encase exterior piping insulation with aluminum jacket with weather-proof construction.
4. Vapor-Barrier Mastic: Water based, suitable for indoor use on below-ambient services.
  - a. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - b. Service Temperature Range: Minus 20 to plus 180 deg F.
  - c. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

- d. Color: White.
5. Vapor-Barrier Mastic: Solvent based, suitable for indoor use on below-ambient services.
  - a. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  - b. Service Temperature Range: 0 to 180 deg F.
  - c. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  - d. Color: White.
6. Vapor-Barrier Mastic: Solvent based, suitable for outdoor use on below-ambient services.
  - a. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  - b. Service Temperature Range: Minus 50 to plus 220 deg F.
  - c. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  - d. Color: White.
7. Breather Mastic: Water based, suitable for indoor and outdoor use on above-ambient services.
  - a. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - b. Service Temperature Range: Minus 20 to plus 180 deg F.
  - c. Solids Content: 60 percent by volume and 66 percent by weight.
  - d. Color: White.
8. FSK and Metal Jacket Flashing Sealants:
  - a. Materials shall be compatible with insulation materials, jackets, and substrates.
  - b. Fire- and water-resistant, flexible, elastomeric sealant.
  - c. Service Temperature Range: Minus 40 to plus 250 deg F.
  - d. Color: Aluminum.
9. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - a. Materials shall be compatible with insulation materials, jackets, and substrates.
  - b. Fire- and water-resistant, flexible, elastomeric sealant.
  - c. Service Temperature Range: Minus 40 to plus 250 deg F.

- d. Color: White.
10. Factory-Applied Jackets
- a. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
    - 1) ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
    - 2) ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
    - 3) FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
11. Piping Insulation Accessories - Provide staples, bands, wires, and cement as recommended by insulation manufacturer for applications indicated.
12. Piping Insulation Compounds - Provide adhesives, sealers, and protective finishes as recommended by insulation manufacturer for applications indicated.
- B. Process and HVAC Ductwork Insulation
- 1. Rigid Fiberglass Ductwork Insulation - ASTM C 612, Class 1.
  - 2. Flexible Fiberglass Ductwork Insulation - ASTM C 553, Type I, Class B-4.
  - 3. Jackets for Ductwork Insulation - ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.
  - 4. Ductwork Insulation Accessories - Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
  - 5. Ductwork Insulation Compounds - Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.
- C. HVAC Field applied jackets.
- 1. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
  - 2. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
  - 3. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
  - 4. Aluminum Jacket – minimum 0.016 inch thickness with aluminum fitting coverings.

5. Exterior Ductwork Weatherproof Jacket: Water-tight, impact & puncture resistant, zero permeability, aluminized coating, flexible, self-healing type membrane material.
6. Adhesive: As recommended by jacket material manufacturer.
7. Color: White
8. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
9. Refrigerant Line Set cover system:
  - a. Material - PVC, meeting UL94v-0 fire rating.
  - b. Color – match exterior of building, coordinate color with architect and owner.
  - c. Where line set cover systems are used, duct end fittings must be used to enclose system. Line set cover ends left open are not allowed.
  - d. Assembly screws - Stainless steel.
  - e. Warranty - 1 year for installation.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

#### **3.2 INTERIOR PIPING INSULATION APPLICATION**

##### **A. HVAC System Piping**

1. Condensate Drain Piping:
  - a. Operating Temperature: 35 to 75 degrees F.
  - b. Insulation material: Fiberglass with ASJ.
  - c. Thermal conductivity: 0.21 – 0.27 Btu-in./(h-ft<sup>2</sup>-°F)
  - d. Insulation thickness:
    - 1) All sizes: 1/2 inch

##### **B. HVAC Ductwork**

1. Insulation Omitted - Do not insulate internally lined ductwork or exposed ductwork traveling through air conditioned or heated spaces, or as noted on plans.
2. Insulate the following ductwork and accessories:
  - a. Ductwork as noted on the plans.
  - b. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.

- c. Exhaust air ductwork between exterior penetration and backdraft damper, or motor operated damper.
  - d.
  - e. All exterior supply and return air ductwork.
  - f. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation: Ductwork and duct plenums located in unconditioned spaces: Fiberglass to R-8
  - g. Ductwork located outside: Fiberglass to R-12
- C. Indoor field applied HVAC jacket schedule.
- 1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - 2. Mechanical and service rooms, all exposed insulated hydronic piping:
    - a. PVC: 30 mils thick.
  - 3. Occupied areas at any height, all exposed insulated hydronic piping:
    - a. PVC: 30 mils thick.
- D. Outdoor field applied HVAC jacket schedule.
- 1. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - 2. Outdoor Ducts: Aluminum asphaltic self-healing membrane.
  - 3. All Piping, Exposed or Concealed:
    - a. PVC: 30 mils thick.
    - b. Aluminum jacket secured with aluminum straps.

### 3.3 INSTALLATION

#### A. General

- 1. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

#### B. Piping Insulation

- 1. Install insulation on pipe systems subsequent to painting, testing, and acceptance of tests.
- 2. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- 3. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

4. Maintain integrity of vapor-barrier jackets on pipe insulation and protect to prevent puncture or other damage.
5. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
6. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
7. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.
8. On cold piping and where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - a. Install insulation continuously through hangers and around anchor attachments.
  - b. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - c. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
9. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

#### C. Ductwork Insulation

1. Install insulation materials with smooth and even surfaces.
2. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
3. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage.
4. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
5. Ductwork Exposed to Weather - Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.
6. Corner Angles - Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

### 3.4 REPAIR/RESTORATION

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units, at no additional cost to the Owner.

3.5 PROTECTION

- A. The Contractor shall provide the required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

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## SECTION 15181

## HYDRONIC PIPING

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Piping systems for hot water heating, make-up water for these systems, blow-down drain lines, and condensate drain piping including
  - a. Pipes, fittings, and specialties
  - b. Hydronic specialties

## B. Related Sections

1. Section 07920- Joint Sealants
2. Section 15060 - Hangers and Supports
3. Section 15077 - Identification for Hvac Piping and Equipment.
4. Section 15080 - Mechanical Insulation.

## 1.2 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

## 1.3 SYSTEM DESCRIPTION

- A. General - The hydronic piping systems are the "water-side" of an air-and-water or all-water heating and air conditioning system. Hydronic piping systems specified in this Section include condenser water piping systems. These systems are classified by ASHRAE as Low Water Temperature, Forced, Recirculating systems.

## 1.4 SUBMITTALS

- A. Product data, including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions for each hydronic specialty and special duty valve specified.
  1. Furnish flow and pressure drop curves for diverting fittings and calibrated plug valves, based on manufacturer's testing.
- B. Maintenance data for hydronic specialties and special duty valves.
- C. Welding procedures, procedure qualification records and certified welder certificates that comply with the quality requirements specified in Quality Assurance below.
- D. Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.
- E. Manufacturers certification of training to install press type fittings.
- F. Reports specified in Part 3 of this Section.



1.5 QUALITY ASSURANCE

- A. Regulatory Requirements - comply with the provisions of the following:
  - 1. ASME B 31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.
- B. Coordinate the installation of pipe sleeves for foundation wall penetrations and floor openings in wood and concrete decking.

1.7 EXTRA MATERIAL

- A. Maintenance Stock - Furnish a sufficient quantity of chemical for initial system start-up and for preventive maintenance for one year from Substantial Completion.

PART 2 PRODUCTS

2.1 PIPE AND TUBING MATERIALS

- A. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.

2.2 FITTINGS

- A. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

- A. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

PART 3 EXECUTION

3.1 PIPE APPLICATIONS

- A. Cooling coil condensate piping: PVC schedule 40 pipe and fittings with cemented joints.

3.2 PIPING INSTALLATIONS

- A. Locations and Arrangements - Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

- B. Use fittings for all changes in direction and all branch connections.
- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- E. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4 inch ball valve, and short 3/4 inch threaded nipple and cap.
- H. Exterior Wall Penetrations - Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves shall be stainless steel or aluminum.
- I. Fire Barrier Penetrations - Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Section 07920 for special sealers and materials.
- J. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side up.
- K. Install branch connections to mains using Tee fittings or welded threadolets in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.
  - 1. Mechanical tees shall not be used.
  - 2. Piping shall not be drilled and tapped for branch or sensor connections.
- L. Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- M. Install dielectric unions to joint dissimilar metals.
- N. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Non-pressure Piping: Join according to ASTM D 2855.

**3.3 HANGERS AND SUPPORTS**

- A. General - Hanger, supports, and anchors devices are part of the work of this section and shall be provided in accordance with the requirements of Section 15060.

**3.4 ANCHOR BOLTS**

- A. Anchor bolts, nuts, washers, and bolt sleeves shall be Type 316 stainless steel. Expansion bolts shall be "Thunderstuds", as manufactured by Unifast Industries, Inc., Hauppauge, NY 11788, Redhead "Wedge Anchors" as manufactured by ITT Phillips; Michigan City, Indiana 46360, Molly parabol or equal. All expansion bolts and associated hardware are to be stainless steel.

**3.5 PIPE JOINT CONSTRUCTION**

- A. Soldered Joints - Comply with the procedures contained in the AWS "Soldering Manual".
- B. Threaded Joints - Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
  - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
  - 2. Align threads at point of assembly.
  - 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
  - 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
    - a. Damaged Threads - Do not use pipe with threads that are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

**3.6 INSULATION**

- A. Pipe, fitting and device insulation is included in the work of this section. Insulation shall be provided in accordance with the requirements of Section 15080.

**3.7 PIPE MARKING IDENTIFICATION**

- A. Pipe marking and valve identification is included in the work of this section. All identification systems shall be provided in accordance with the requirements of Section 15077.

**END OF SECTION**

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## SECTION 15700

## BASIC HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section includes basic HVAC requirements and general conditions.
- B. Contractor to provide VFD's and disconnects for all HVAC equipment as shown in equipment schedules and/or equipment specifications.
- C. Related Sections
  - 1. Section 01140 – Work Restrictions
  - 2. Section 01770 - Closeout Procedures
  - 3. Section 11000 - Equipment – General
- D. Related Sections
- E. Commissioning
  - 1. This project will be commissioned. Refer to the Commissioning specification(s) for information and responsibilities of the Division 23 Contractor.

## 1.2 REFERENCES

- A. International Building Code – IBC 2018
- B. International Mechanical Code – IMC 2018
- C. International Energy Conservation Code – IECC 2018
- D. Rhode Island State Building Code, SBC-1, 2021, and Amendments.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

## 1.3 SUBMITTALS

- A. Comply with the requirements in Section 01330, Submittal Procedures.
- B. Submit manufacturer's drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.
- D. Submit manufacturer's drawings, bill of material, equipment layouts, catalog data, wiring diagrams and other documentary or descriptive information for each assembly.
- E. Provide a schedule of all HVAC system related Owner training. Confirm the date(s) and time(s) with Owner two weeks prior to actual training session(s) and resubmit

schedule. At a minimum, for each piece of equipment or system to be demonstrated, the schedule should include the following,

1. Equipment or system to be demonstrated
2. Related specification section
3. Anticipated date of training
4. Anticipated duration of training session
5. Name and company of instructor providing the training
6. Date completed
7. Actual duration of training session

Resubmit schedule upon completion of all training.

#### 1.4 CLOSEOUT PROCEDURES

- A. Prior to final acceptance of the Work, provide all closeout documentation in accordance with Section 01770 .

#### 1.5 REGULATORY REQUIREMENTS

- A. Conform to all codes listed under References in this Section.
- B. Conform to all applicable Local Building Codes.
- C. Obtain and pay for all applicable permits.

#### 1.6 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner's Project Representative before proceeding.
- C. Location of heating, ventilation, and air conditioning equipment, piping and ductwork are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is significantly different from that indicated (greater than 5 feet away from location shown on Drawings), the Owner's Project Representative must give approval to the change.

#### 1.7 WORK RESTRICTIONS

- A. Refer to section 01140 Work Restrictions, for restrictions during construction.

#### 1.8 DRAWINGS AND SPECIFICATIONS

- A. Drawings and specifications are typical of work done and of arrangement desired. Provide all accessories and appurtenances necessary to provide a complete system.
- B. Record Drawings: Maintain a master set of record drawings showing the changes and deviations from the contract drawings or the approved shop drawings. Make markups

as the changes are made. Submit record documentation to Engineer by substantial completion.

- C. Where underground facilities are installed (such as to condensing units), measure, record, and submit final dimensions.
- D. The term “Provide” shall mean “To furnish, install, and connect completely”.
- E. Where the Contractor proposes to use equipment other than that specified in the Contract Documents which requires any redesign of architectural, structural, mechanical, HVAC, plumbing, fire protection, electrical systems or other systems not listed, all redesign efforts and all new drawings and specifications required shall be prepared by the Engineer at the Contractor’s expense and are subject to the review and approval of the Owner. Owner reserves the right to have the Architect or Engineer of their choice prepare any redesign work.

#### 1.9 WARRANTY

- A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts, and adjustments required due to failure in materials or workmanship within one year from final acceptance of the Work.
- B. During this warranty period, Contractor shall answer all service calls at no expense to the Owner. All defects developing through faulty materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Owner’s satisfaction.
- C. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty is in addition to all other warranties existing under either the Contract Documents or required by Law.
- D. Turn over to the Owner all manufacturer’s warranties for equipment and materials provided.

#### 1.1 BASES AND SUPPORTS

- A. Unless otherwise specifically noted in the Contract Documents, provide all necessary supports, rails, framing, and bases required for all equipment furnished under this Division.
- B. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.
- C. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement..

#### 1.2 FIRE – STOPS AND SEALS

- A. Fire-stopping systems shall be submitted as shop drawing.

- B. Penetrations through fire-rated walls, ceiling or floors shall be sealed with a UL approved fire- stop fitting classified for an hourly rating equivalent to the fire rating of the wall, ceiling, or floor.
- C. Thru wall and floor seals shall be used to provide a positive means of sealing pipes or ducts which pass through the concrete foundation of a structure below grade or below ground water level. Seals shall also be used at entry points through concrete walls or floors which must be sealed.
- D. All piping and conduit penetrations through the roof shall be provided with Pate Type PCA pipe curb assemblies or acceptable equivalent. Coordinate installation details with the roofing system being used for the project.

### 1.3 ACCESSIBILITY AND PANELS

- A. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, fans, controllers, coils, terminal equipment, valves, actuators, filters, sensors, drain points, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.
- B. Upon completion of the Project, physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels at no additional cost to the Owner.

### 1.4 TEMPORARY OPENINGS

- A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

### 1.5 QUIET OPERATION

- A. If objectionable noises or vibrations of any magnitude are produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of the mechanical work, the Contractor shall make such changes or additions as necessary without extra cost to the Owner.

### 1.6 LUBRICATION

- A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner. Units furnished with sealed bearings are exempted.

- B. Furnish and install, as appropriate on all equipment requiring lubrication, Zerk pressure gun grease fittings or sight gravity-feed oilers equipped with shutoff and needle valve adjustment. Units furnished with sealed bearings and lifetime lubrication are exempted. All fittings and oilers are to be fully accessible for lubrication with equipment which does not require special adapters. Where fittings would be otherwise inaccessible, furnish and install extended grease lines.

#### 1.7 RESTRICTIONS

- A. Mechanical equipment provided under this Division may not be used for temporary heating/cooling requirements due to premature wear and dirt/dust infiltration. Written approval may be obtained from the Owner only after submission of a written cleaning plan and guarantee extension.
- B. Piping shall not be run in any concrete floor slab. Written approval from the Structural Engineer may be obtained only after submission and approval of a layout shop drawing.

### PART 2 PRODUCTS

#### 2.1 GENERAL

- A. Equipment Ampere Interrupting Capacity (AIC) and/or Short Circuit Current Rating (SCCR): HVAC equipment, including but not limited to control panels, VFDs, starters, and disconnect switches furnished by Division 15 shall be labeled in accordance with NFPA 70 and have an AIC or SCCR equal to or greater than the following:
  - 1. 480-volt equipment: 65,000 amps
  - 2. 208 or 240 volt equipment: 22,000 amps
- B. Requirements for fan and pump motors:
  - 1. Brake horsepower at design conditions shall be less than 80% of rated motor horsepower.

### PART 3 EXECUTION - NOT USED

END OF SECTION

J:\P\0740 Providence Water\47 - HVAC Upgrades Holton Water Works\Specifications\Div 15\Save for CD\15700 Basic Heating, Ventilation, and Air Conditioning Requirements.docx



## SECTION 15735

## PACKAGED ROOF TOP AIR CONDITIONING UNIT

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Packaged roof top air conditioning unit
  - a. Casings
  - b. Fans
  - c. Motors
  - d. Coils
  - e. Heat exchangers
  - f. Air filtration
  - g. Refrigerant circuit components
  - h. Air Cooled Condenser
  - i. Dampers
  - j. Electrical power connections
  - k. Controls
  - l. Accessories
  - m. Roof curbs

## B. Related Sections

1. Section 15700 – Basic Heating, Ventilation and Air Conditioning Requirements
2. Section 15910 - Direct Digital Controls: Controls remote from unit.
3. Section 15935 – HVAC Control System: Control components.
4. Section 15950 – Testing, Adjusting and Balancing
5. Section 15951 – HVAC Variable Frequency Drives (VFDs)
6. Section 16060 - Grounding and Bonding.
7. Section 16120 - Conductors and Cables.
8. Section 16220 – AC Motors: Product requirements for electric motors for placement by this section.

## 1.2 REFERENCES

- A. American Bearing Manufacturers Association:
  - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
  - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
  - 1. AMCA 99 - Standards Handbook.
  - 2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - 3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
  - 4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
  - 5. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. Air-Conditioning, Heating, and Refrigeration Institute:
  - 1. AHRI Standard 340/360- Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
  - 2. AHRI Standard 920 - Direct Expansion-dedicated Outdoor Air System Units
  - 3. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
  - 4. AHRI Guideline D - Application and Installation of Central Station Air-Handling Units.
  - 5. AHRI 1060 - Air to Air Energy Recovery Ventilators.
- D. National Electrical Manufacturers Association:
  - 1. NEMA MG 1 - Motors and Generators.
- E. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. Underwriters Laboratories Inc.:
  - 1. UL 900 - Air Filter Units.
  - 2. UL - Fire Resistance Directory.

## 1.3 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- B. Product Data, Submit the following:

1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements. Capacity ratings shall reflect the design conditions noted in the Construction Documents.
  2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
  4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
  5. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.
  6. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
  7. Included accessories.
- C. Manufacturer's Installation Instructions: Submit.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Wind Restraint Details:
1. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
  2. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind events. Indicate association with vibration isolation devices.
  3. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- F. Maintenance data and parts lists for each unit, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual.

#### 1.4 QUALITY ASSURANCE

- A. Unit shall be UL listed and CSA certified as a total package for safety requirements.
- B. Roof curb shall be designed to conform to NRCA Standards.
- C. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled per manufacturer's recommendations.

- B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

#### 1.6 WARRANTY

- A. Compressors shall carry a 5 year non-prorated warranty.
- B. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.
- C. Optional epoxy polymer coil coating shall carry a 5 year warranty

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Addison
- B. AAON
- C. Daikin Applied
- D. Valent

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
  - 1. Basic Wind Speed: 137.
  - 2. Building Classification Category: III.
  - 3. Minimum pressure as required by IBC 2018.

#### 2.3 GENERAL

- A. DOAS-1 Supply air configuration (starting at air inlet):
  - 1. Outside air intake with damper (motorized)
  - 2. Filter section with 2" pre-filters and 4" filters.
  - 3. Heat Recovery Section
  - 4. DX Cooling/heating (heat pump) coil.
  - 5. Subcooling coil.
  - 6. Hot gas reheat coil.
  - 7. Fan section.
  - 8. Electric Heating coil.
- B. DOAS-1 Exhaust air configuration (starting at air inlet):
  - 1. Return / Exhaust air intake section.
  - 2. Exhaust air Filter section with 2" pre-filters.
  - 3. Heat Recovery Section.

4. Exhaust Fan section.
  5. Exhaust air damper (motorized).
- C. MAU-1 Supply air configuration (starting at air inlet):
1. Outside air intake with damper (motorized)
  2. Filter section with 2” pre-filters and 4” filters.
  3. DX Cooling/heating (heat pump) coil.
  4. Subcooling coil.
  5. Hot gas reheat coil.
  6. Fan section.
  7. Electric Heating coil.
- D. Provide multiple access doors as required for access to each component listed above.
- E. Fabrication: Conform to AMCA 99 and ARI 430.
- F. Air handling units will be shipped stretch-wrapped to protect unit from in-transit rain and debris.
- G. Description:
1. Factory assembled single piece heating, cooling, and ventilating unit designed for outdoor application and included a weatherproof cabinet. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge, and special features required prior to field start-up.
- H. AHRI Compliance:
1. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
  2. Comply with AHRI 270 for testing and rating sound performance for RTUs.
  3. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
- I. AMCA Compliance:
1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
  2. Damper leakage tested in accordance with AMCA 500-D.
  3. Operating Limits: Classify according to AMCA 99.
- J. ASHRAE Compliance:
1. Comply with ASHRAE 15 for refrigeration system safety.
  2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

## 2.4 CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels with thermal break, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Double-Wall Construction: Fill space between walls with 2 inch thick foam insulation and seal moisture tight for R-13 performance.
- C. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- D. Service doors shall be provided on the fan section, filter section, coils sections, heat recovery section, and control panel section. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a lockable latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.
- E. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.
- F. Optional Corrosion Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a minimum of 10,000-hour salt-spray test according to ASTM B 117.
  1. Standards:
    - a. ASTM B-117 for salt spray.
    - b. ASTM D-2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
    - c. ASTM B-3359 for cross-hatch adhesion of 5B.
- G. Inner Casing Fabrication Requirements:
  1. Inside Casing: Stainless Steel or G-90-coated galvanized steel, 0.028 inch, perforated 40 percent free area].
- H. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g
- I. Continuous sealing shall be included between panels and between access doors and openings.
- J. Refrigerant piping and electrical conduit through cabinet panels shall include sealing

## 2.5 OUTDOOR/RETURN AIR SECTION

- A. Motorized exhaust damper and bird screen shall be provided to exhaust air out of the unit.
- B. Unit shall be provided with a 100% outdoor air hood. The 100% outdoor air hood shall allow outdoor air to enter from the back of the unit, at the draw-through filter section. The outdoor air hood shall be factory installed and constructed from

galvanized steel finished with the same paint finish as the main unit. The hood shall include a bird screen and a rain lip to drain water away from the entering air stream.

## 2.6 SUPPLY FANS

- A. Unit shall include direct drive, unhooded, backward curved, plenum fans.
- B. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
- C. Motors shall be standard (premium) efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
- D. Options:
  - 1. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
    - a. Motor shall include shaft grounding.
  - 2. EC Motors. The fan motor shall be a totally enclosed electrically commutated motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency

## 2.7 EXHAUST FANS

- A. Exhaust dampers shall be sized for 100% relief.
- B. Fans and motors shall be dynamically balanced.
- C. Unit shall include direct drive, unhooded, backward curved, plenum fans.
- D. Motors shall be standard (premium) efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
- E. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn handles.
- F. Options:
  - 1. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
    - a. Motor shall include shaft grounding.
  - 2. EC Motors. The fan motor shall be a totally enclosed electrically commutated motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency

## 2.8 COILS

- A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
  2. Coil Split: Interlaced.
  3. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a minimum 10,000-hour salt-spray test according to ASTM B 117 to frame, casing, and coils.
    - a. Standards:
      - 1) ASTM B-117 for salt spray.
      - 2) ASTM D-2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
      - 3) ASTM B-3359 for cross-hatch adhesion of 5B.
  4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.
  5. Coils shall be furnished with a factory installed expansion valves.
  6. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
- B. Electric Heating Coils
1. Nichrome element type, open wire coils with 0.375 in. inside diameter, insulated with ceramic bushings, frame and control panel mounted in the unit discharge. Coil ends will be staked and welded to terminal screw slots. Control panel includes hinged access door, fuses, airflow switch, disconnecting contactors and safeties. Power and control wiring is fed back to the unit control panel:
    - a. Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). Supply air temperature sensor shall be factory provided and field installed in the supply air ductwork. A setpoint adjustment potentiometer shall be factory provided.
- C. Outdoor-Air (Condensing Unit) Refrigerant Coil:
1. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.
  2. Heat pump outdoor coil shall be constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
  3. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
  4. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a minimum 10,000-hour salt-spray test according to ASTM B 117 to base, frame, and casing, coils and fan guards.
    - a. Standards:



- 1) ASTM B-117 for salt spray.
- 2) ASTM D-2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
- 3) ASTM B-3359 for cross-hatch adhesion of 5B.

**D. Hot Gas Reheat Coils**

1. Hot gas reheat coils shall be a microchannel design. The aluminum tube shall be a microchannel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.
2. Each coil shall be factory leak tested with high- pressure air under water.
3. Reheat Coil shall have a flexible, epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 hours each (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing, with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the coating.

**E. Liquid sub-cooling Coils**

1. The unit shall be equipped with a factory-installed liquid sub-cooling coil on all circuits. The coil shall be located immediately downstream of the evaporator coil. Coil circuit(s) shall be switchable. Operation of sub-cooling coil shall increase the total cooling capacity and offer first stage of reheat. Refer to the equipment schedule for increase in capacity MBH and resultant improvement in EER .
2. Corrosion coating: Ultra low VOC coating specifically developed for heat exchangers rated for 10,000 hr. Salt Spray.

**2.9 TOTAL ENERGY ROTARY HEAT EXCHANGERS**

A. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.

**B. Casing:**

1. Galvanized steel, stainless steel, or aluminum with manufacturer's standard factory-painted finish.
2. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
3. Casing seals on periphery of rotor and on duct divider and purge section.

4. Support vertical rotor on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings. Support horizontal rotors on tapered roller bearings.
- C. Type and Media
1. Wheel constructed of polymer media with silica gel desiccant.
  2. Integral enthalpy wheel for sensible and latent heat transfer between air streams.
- D. Rotor - Aluminum, Metallic, or Polymer: Aluminum, metallic, or polymer segmented wheel, strengthened with radial spokes impregnated with nonmigrating, water-selective, molecular-sieve desiccant coating.
- E. Maximum Solid Size for Media to Pass: 4 angstrom.
- F. Drive: Fractional horsepower motor and gear reducer, with speed changed by variable-frequency controller or EC Motor controller and self adjusting multilink belt around outside of. Provide permanently lubricated wheel bearings.
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.10 AIR FILTRATION

- A. Minimum arresstance and a minimum efficiency reporting value according to ASHRAE 52.2.
- B. Flat Panel Filters:
1. Description: Factory-fabricated, self-supported, flat, nonpleated, panel-type, disposable air filters with holding frames.
  2. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.
    - a. Adhesive: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.
    - b. Media shall be coated with an antimicrobial agent.
    - c. Metal Retainer: Upstream side and downstream side.
- C. Pleated Panel Filters:
1. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
  2. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.
  3. Adhesive: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.
  4. Media shall be coated with an antimicrobial agent.
  5. Separators shall be bonded to the media to maintain pleat configuration.
  6. Welded-wire grid shall be on downstream side to maintain pleat.
  7. Media shall be bonded to frame to prevent air bypass.

8. Support members on upstream and downstream sides to maintain pleat spacing.

## 2.11 REFRIGERANT CIRCUIT COMPONENTS

1. Refrigerant shall be R-410.
2. Compressor: Unit shall include dual scroll, dual circuit with lead circuit VFD controlled, variable speed scroll compressor on the refrigeration circuit, which shall be capable of modulating refrigerant capacity. One compressor shall be On/off.
3. Unit shall include factory provided and installed compressor sound jackets on all compressors.
4. Lead (Lag) (All) refrigeration circuit(s) shall be provided with aluminum microchannel hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space. Reheat coil shall be piping in a (series) (parallel) configuration.
5. Unit shall be configured as an air-source heat pump. Each refrigeration circuit shall each be equipped with a factory installed liquid line filter drier with check valve, reversing valve, accumulator, and expansion valves on both the indoor and outdoor coils. Reversing valve shall energize during the heat pump cooling mode of operation.
6. Hot Gas Reheat and liquid subcooling:
  - a. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser and liquid sub cooling on all circuits.
  - b. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.
7. Heat Pump Heating:
  - a. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heat pump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heat pump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.
  - b. The refrigerant system shall have a pump-down cycle.
  - c. The unit shall have an electric resistance coil for hybrid heating. When the heat pump operation cannot maintain the discharge air temperature setpoint the electric resistance coil shall temper the airstream to the discharge air temperature setpoint.

## 2.12 PACKAGED DX CONDENSER SECTION

- A. Air-Cooled Condenser

- B. Condenser fans shall be vertical discharge, axial flow, direct drive fans.
- C. Options:
  - 1. Condenser fans shall be electronically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
  - 2. Coils shall have a flexible, epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 hours each (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing, with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the polymer coating.

### 2.13 DAMPERS

- A. Performance: Test in accordance with AMCA 500.
- B. Frame: Aluminum, or stainless steel.
- C. Blade Material: Aluminum or stainless steel airfoil.
- D. Blade Seals: Close cell neoprene mechanically attached, field replaceable.
- E. Bearings: Synthetic.
- F. Outside Air and Exhaust Air Damper Leakage (no damper between outside air connection and building envelope): Class 1 motorized, maximum leakage rate of 4.0 cfm per square foot at 1.0 inches wg pressure differential when tested in accordance with AMCA 500D.
- G. Damper Actuators: Furnish factory installed electronic damper actuators for outside air, and exhaust air dampers.

### 2.14 CONTROLS AND SAFETIES

- A. Each unit shall be equipped with a complete microprocessor based control system. The unit control system shall include all required temperature and pressure sensors, input/output boards, main microprocessor and operator interface. All boards shall be individually replaceable. All microprocessors, boards, and sensors shall be factory mounted, wired and tested.
- B. Manufacturer shall provide DDC controller to control all unit functions with BACnet compatible interface for BMS control and monitoring of the following. See control drawings.
- C. Refer to Section 15951 for VFD and PM motor controller requirements.
- D. Modes and Temperature Setting
  - 1. Occupied mode: as scheduled / set by BMS.
- E. Microprocessor Controls:

1. Shall include application logic to control unit in several standalone modes:
    - a. Supply Fan control,
    - b. DX Cooling control
    - c. Heating control (DX Heat Pump and/or Electric)
    - d. Dehumidification
    - e. ERV/Desiccant wheel operation and bypass damper operation
    - f. Outdoor Damper control.
  2. Shall support BACnet IP, BACnet Ethernet, and BACnet MS/TP.
  3. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1, energy standard.
  4. Shall include a color HMI touchscreen (Equipment Touch).
  5. HMI shall include user access differentiation via passcodes.
  6. Shall provide at least 28 configurable inputs and 16 configurable outputs for unit control
  7. Shall provide field configurable Input/Outputs via HMI
  8. Shall provide and display a current alarm list and an alarm history list.
  9. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) shall be provided.
  10. Shall have service run test capability
  11. Shall support Hand/Off/Auto switches on controller inputs and outputs for troubleshooting.
  12. Unit controls shall be in electrically isolated low voltage control section.
- F. Sequence of Operation (DOAS-1 and MAU-1)
1. See drawings for sequences of operation to be provided by manufacturer.
- G. Safeties: Compressor shall incorporate a solid-state compressor protector that provides reset capability at the space thermostat.
- H. Compressor with low ambient controls shall be capable of operation down to 0 degrees F ambient outdoor temperature.
- I. All digital inputs and outputs shall be protected against damage from transients or wrong voltages. Each digital input and digital output shall be equipped with an LED for ease of service. All field wiring shall be terminated at a separate, clearly marked terminal strip.

## 2.15 ELECTRICAL REQUIREMENTS

- A. All unit power wiring shall enter unit cabinet at a single location.

- B. Provide a single point power connection to power all components, except a convenience outlet as described below.
- C. NEMA 3R Non-Fused Disconnect Switch: Factory mount on equipment.
- D. Duplex GFCI Outlet: Mounted on casing exterior, requiring a field power connection independent from the air handler's main power block and/or disconnect. Outlet shall be wired in field by the Electrical Contractor.
- E. Equipment Ampere Interrupting Capacity (Short Circuit Current Rating): HVAC equipment Ampere Interrupting Capacity (AIC) rating or Short Circuit Current Rating (SCCR) shall meet minimum requirements specified in 15700.
- F. Motors
  - 1. Compressor motors shall be of the refrigerant cooled type with line break thermal and current overload protection.
  - 2. Fan motors shall have permanently lubricated bearings, and inherent automatic reset thermal overload protection.
  - 3. Outdoor (condenser) fan motor shall be totally enclosed.

#### 2.16 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- C. Return-air bypass damper.
- D. Safeties:
  - 1. Smoke detector.
  - 2. Condensate overflow switch.
  - 3. Phase-loss reversal protection.
  - 4. High and low pressure control.
  - 5. Electric coil airflow-proving switch.
- E. Door switches to disable heating or reset set point when open.
- F. Outdoor air intake weather hood with moisture eliminator.

#### 2.17 ROOF CURBS (MAU-1)

- A. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb to meet local wind restraint requirements, and designed for loads at Project site.

- B. The roof curb shall be a full perimeter, gasketed type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high.
- C. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

## 2.18 ROOF CURBS (DOAS-1)

- A. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb to meet local wind restraint requirements, and designed for loads at Project site.
- B. The roof curb shall be a plenum curb, full perimeter, gasketed type with complete perimeter support of the air handling section and condensing section.
- C. Curbs shall be manufactured from 12 ga.G60 galvanized sheet metal, reinforced and cross braced as required. All side & end seams between sheets shall be continuously welded, corner joints to be bolted.
- D. Curb height shall be minimum 24" and shall provide custom sloped plenum divider as necessary to allow for supply and air flow paths to transition from DOAS openings to the openings in the roof.. Plenum curb sections to allow for equal CFM of unit openings.
- E. Curbs shall have provision for up to 2" external insulation.
- F. Galvanized steel duct supports shall be provided as required. Supports shall be capable of supporting the ductwork with a maximum deflection over the width of the curb of L/360.
- G. The interior plenum curb walls shall be acoustically lined with 2" thick fiber glass acoustical duct liner with reinforced coating system designed to withstand up to 6000 fpm air velocity. Insulation acoustical performance shall be as shown as follows. Liner shall not support microbial growth and shall be EPA registered and pass ASTM C 1071 & ASTM G21 bacterial tests conducted in accordance with ASTM G22. Liner shall be fastened in strict accordance with liner manufacturer's instructions utilizing weld pins not self-adhesive stick clips. Submit liner manufacturer's installation instructions for approval. Sound Absorption Coefficient at Frequency (Cycles per second) of (125)=.23, (250)=.64, (500)=.99, (1000)=1.05, (2000)=1.00, (4000)=.98, (NRC)=.9
- H. Interior curb insulation shall be faced with 22 ga. solid sheet metal.
- I. Provide 2" top pan and floor pan double wall aluminum sound barrier panels to seal plenum curbs. Transmission Loss & STC shall be as shown as follows for each layer. Sound Transmission loss at Frequency (Cycles per second) of (125)=7, (250)=7, (500)=20, (1000)=34, (2000)=42, (4000)=52, (STC)=20.
- J. Curbs shall be fully assembled at the factory and shipped as one piece.
- K. Model "SeisCurb" as manufactured by NOVIA CORPORATION or equal.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install the unit in accordance with AHRI 340/360 and manufacturer's instructions.
- B. Roof Curb:
  - 1. Assemble roof curb.
  - 2. Install roof curb level.
  - 3. Coordinate curb installation and flashing with General Contractor.
  - 4. Coordinate sizes and locations of roof curbs with actual equipment provided.
  - 5. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
  - 6. Install gasket material between unit base and roof curb.
- C. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 1 inch flex between ductwork and fan while running.
- D. Provide seismic support if applicable.
- E. Install condensate drainage system as indicated on drawings.

### 3.3 CONNECTIONS

- A. Install condensate drain, minimum connection size per drawing details to nearest roof drain or area drain.
- B. Install piping adjacent to RTUs to allow service and maintenance.
- C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination at top of roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 15820 "Ductwork Accessories."
  - 4. Install return-air duct continuously through roof structure.



- D. Connect electrical wiring according to Section 16120 "Conductors and Cables."
- E. Ground equipment according to Section 16060 "Grounding and Bonding."

3.4 TESTING

- A. Test the unit in accordance with manufacturer's instructions and Section 15950 .

3.5 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.6 CLEANING

- A. Vacuum clean coils and inside of unit cabinet.
- B. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.7 DEMONSTRATION

- A. Demonstrate unit operation, adjusting and maintenance.
- B. Furnish services of manufacturer's technical representative for 8 hours to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days' notice to Engineer of training date.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

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Packaged Rooftop Air Conditioning Units.docx

## SECTION 15735

## PACKAGED ROOF TOP AIR CONDITIONING UNIT-LARGE

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Packaged roof top air conditioning unit
2. Casings
3. Fans
4. Motors
5. Coils
6. Heat exchangers
7. Air filtration
8. Refrigerant circuit components
9. Air Cooled Condenser
10. Dampers
11. Electrical power connections
12. Controls
13. Accessories
14. Roof curbs

## B. Related Sections

1. Section 15700 – Basic Heating, Ventilation and Air Conditioning Requirements
2. Section 15910 - Direct Digital Controls: Controls remote from unit.
3. Section 15935 – HVAC Control System: Control components.
4. Section 15940 - Sequence of Operation: Sequences of operation applying to units in this section.
5. Section 15950 – Testing, Adjusting and Balancing
6. Section 15951 – HVAC Variable Frequency Drives (VFDs)
7. Section 16060 - Grounding and Bonding.
8. Section 16120 - Conductors and Cables.
9. Section 16220 – AC Motors: Product requirements for electric motors for placement by this section.

## 1.2 REFERENCES

- A. American Bearing Manufacturers Association:
  - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
  - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
  - 1. AMCA 99 - Standards Handbook.
  - 2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - 3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
  - 4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
  - 5. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. Air-Conditioning, Heating, and Refrigeration Institute:
  - 1. AHRI Standard 340/360- Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
  - 2. AHRI Standard 920 - Direct Expansion-dedicated Outdoor Air System Units
  - 3. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
  - 4. AHRI Guideline D - Application and Installation of Central Station Air-Handling Units.
  - 5. AHRI 1060 – Air to Air Energy Recovery Ventilators.
- D. National Electrical Manufacturers Association:
  - 1. NEMA MG 1 - Motors and Generators.
- E. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. Underwriters Laboratories Inc.:
  - 1. UL 900 - Air Filter Units.
  - 2. UL - Fire Resistance Directory.

## 1.3 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- B. Product Data, Submit the following:
  - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements. Capacity ratings shall reflect the design conditions noted in the Construction Documents.

2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
  4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
  5. Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.
  6. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
  7. Included accessories.
- C. Manufacturer's Installation Instructions: Submit.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Wind Restraint Details:
1. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
  2. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during wind events. Indicate association with vibration isolation devices.
  3. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- F. Maintenance data and parts lists for each unit, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual.
- 1.4 QUALITY ASSURANCE
- A. Unit shall be UL listed and CSA certified as a total package for safety requirements.
  - B. Roof curb shall be designed to conform to NRCA Standards.
  - C. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. Unit shall be stored and handled per manufacturer's recommendations.
  - B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- 1.6 WARRANTY
- A. Compressors shall carry a 5 year non-prorated warranty.

- B. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.
- C. Optional epoxy polymer coil coating shall carry a 5 year warranty

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Addison
- B. AAON
- C. Daikin Applied
- D. Valent

### 2.2 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
  - 1. Basic Wind Speed: 130.
  - 2. Building Classification Category: III.
  - 3. Minimum pressure as required by IBC 2018.

### 2.3 GENERAL

- A. DOAS-1 Supply air configuration (starting at air inlet):
  - 1. Outside air intake with damper (motorized)
  - 2. Filter section with 2" pre-filters and 4" filters.
  - 3. Heat Recovery Section with access to both sides
  - 4. DX Cooling/heating (heat pump) coil.
  - 5. Subcooling coil.
  - 6. Hot gas reheat coil.
  - 7. Fan section with access.
  - 8. Electric Heating coil.
- B. DOAS-1 Exhaust air configuration (starting at air inlet):
  - 1. Return / Exhaust air intake section.
  - 2. Exhaust air Filter section with 2" pre-filters.
  - 3. Heat Recovery Section with access to both sides.
  - 4. Exhaust Fan section with access.
  - 5. Exhaust air damper (motorized).
- C. MAU-1 Supply air configuration (starting at air inlet):
  - 1. Outside air intake with damper (motorized)

2. Filter section with 2" pre-filters and 4" filters.
  3. DX Cooling/heating (heat pump) coil.
  4. Subcooling coil.
  5. Hot gas reheat coil.
  6. Fan section with access.
  7. Electric Heating coil.
- D. Fabrication: Conform to AMCA 99 and ARI 430.
- E. Air handling units will be shipped stretch-wrapped to protect unit from in-transit rain and debris.
- F. Description:
1. Factory assembled single piece heating, cooling, and ventilating unit designed for outdoor application and included a weatherproof cabinet. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge, and special features required prior to field start-up.
- G. AHRI Compliance:
1. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
  2. Comply with AHRI 270 for testing and rating sound performance for RTUs.
  3. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
- H. AMCA Compliance:
1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
  2. Damper leakage tested in accordance with AMCA 500-D.
  3. Operating Limits: Classify according to AMCA 99.
- I. ASHRAE Compliance:
1. Comply with ASHRAE 15 for refrigeration system safety.
  2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

## 2.4 CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels with thermal break, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Double-Wall Construction: Fill space between walls with 2 inch thick foam insulation and seal moisture tight for R-13 performance.

- C. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- D. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a lockable latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.
- E. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.
- F. Optional Corrosion Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a minimum of 3,000-hour salt-spray test according to ASTM B 117.
  - 1. Standards:
    - a. ASTM B-117 for salt spray.
    - b. ASTM D-2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
    - c. ASTM B-3359 for cross-hatch adhesion of 5B.
- G. Inner Casing Fabrication Requirements:
  - 1. Inside Casing: Stainless Steel or G-90-coated galvanized steel, 0.028 inch, perforated 40 percent free area].
- H. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g
- I. Continuous sealing shall be included between panels and between access doors and openings.
- J. Refrigerant piping and electrical conduit through cabinet panels shall include sealing

## 2.5 OUTDOOR/RETURN AIR SECTION

- A. Motorized exhaust damper and bird screen shall be provided to exhaust air out of the unit.
- B. Unit shall be provided with a 100% outdoor air hood. The 100% outdoor air hood shall allow outdoor air to enter from the back of the unit, at the draw-through filter section. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same paint finish as the main unit. The hood shall include a bird screen and a rain lip to drain water away from the entering air stream.

## 2.6 SUPPLY FANS

- A. Unit shall include direct drive, unhooded, backward curved, plenum fans.
- B. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
- C. Motors shall be standard (premium) efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
- D. Options:
  - 1. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

- a. Motor shall include shaft grounding.
2. EC Motors. The fan motor shall be a totally enclosed electrically commutated motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency

## 2.7 EXHAUST FANS

- A. Exhaust dampers shall be sized for 100% relief.
- B. Fans and motors shall be dynamically balanced.
- C. Unit shall include direct drive, unhooded, backward curved, plenum fans.
- D. Motors shall be standard (premium) efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
- E. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn handles.
- F. Options:
  1. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
    - a. Motor shall include shaft grounding.
  2. EC Motors. The fan motor shall be a totally enclosed electrically commutated motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency

## 2.8 COILS

- A. Supply-Air Refrigerant Coil:
  1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
  2. Coil Split: Interlaced.
  3. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a minimum 3,000-hour salt-spray test according to ASTM B 117 to frame, casing, and coils.
    - a. Standards:
      - 1) ASTM B-117 for salt spray.
      - 2) ASTM D-2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
      - 3) ASTM B-3359 for cross-hatch adhesion of 5B.



4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.
5. Coils shall be furnished with a factory installed expansion valves.
6. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

**B. Electric Heating Coils**

1. Nichrome element type, open wire coils with 0.375 in. inside diameter, insulated with ceramic bushings, frame and control panel mounted in the unit discharge. Coil ends will be staked and welded to terminal screw slots. Control panel includes hinged access door, fuses, airflow switch, disconnecting contactors and safeties. Power and control wiring is fed back to the unit control panel:
  - a. Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). Supply air temperature sensor shall be factory provided and field installed in the supply air ductwork. A setpoint adjustment potentiometer shall be factory provided.

**C. Outdoor-Air (Condensing Unit) Refrigerant Coil:**

1. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.
2. Heat pump outdoor coil shall be constructed of copper tubes with aluminum (copper) fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
3. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
4. Corrosion-Resistant Coating: Apply a corrosion-resistant coating capable of withstanding a minimum 3,000-hour salt-spray test according to ASTM B 117 to base, frame, and casing, coils and fan guards.
  - a. Standards:
    - 1) ASTM B-117 for salt spray.
    - 2) ASTM D-2794 for minimum impact resistance of 100 in-lb (11.3 N-m).
    - 3) ASTM B-3359 for cross-hatch adhesion of 5B.

**D. Hot Gas Reheat and Liquid sub-cooling Coils**

1. Hot gas reheat and liquid subcooling coils shall be a microchannel design. The aluminum tube shall be a microchannel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.
2. Each coil shall be factory leak tested with high- pressure air under water.
3. Reheat Coil shall have a flexible, epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 hours each (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through

testing, with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the coating.

## 2.9 TOTAL ENERGY ROTARY HEAT EXCHANGERS

- A. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.
- B. Casing:
  - 1. Galvanized steel, stainless steel, or aluminum with manufacturer's standard factory-painted finish.
  - 2. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
  - 3. Casing seals on periphery of rotor and on duct divider and purge section.
  - 4. Support vertical rotor on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings. Support horizontal rotors on tapered roller bearings.
- C. Type and Media
  - 1. Wheel constructed of polymer media with silica gel desiccant.
  - 2. Integral enthalpy wheel for sensible and latent heat transfer between air streams.
- D. Rotor - Aluminum, Metallic, or Polymer: Aluminum, metallic, or polymer segmented wheel, strengthened with radial spokes impregnated with nonmigrating, water-selective, molecular-sieve desiccant coating.
- E. Maximum Solid Size for Media to Pass: 4 angstrom.
- F. Drive: Fractional horsepower motor and gear reducer, with speed changed by variable-frequency controller or EC Motor controller and self adjusting multilink belt around outside of. Provide permanently lubricated wheel bearings.
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.10 AIR FILTRATION

- A. Minimum arrestance and a minimum efficiency reporting value according to ASHRAE 52.2.
- B. Flat Panel Filters:
  - 1. Description: Factory-fabricated, self-supported, flat, nonpleated, panel-type, disposable air filters with holding frames.
  - 2. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.
    - a. Adhesive: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

- b. Media shall be coated with an antimicrobial agent.
  - c. Metal Retainer: Upstream side and downstream side.
- C. Pleated Panel Filters:
- 1. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
  - 2. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.
  - 3. Adhesive: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.
  - 4. Media shall be coated with an antimicrobial agent.
  - 5. Separators shall be bonded to the media to maintain pleat configuration.
  - 6. Welded-wire grid shall be on downstream side to maintain pleat.
  - 7. Media shall be bonded to frame to prevent air bypass.
  - 8. Support members on upstream and downstream sides to maintain pleat spacing.

## 2.11 REFRIGERANT CIRCUIT COMPONENTS

- 1. Refrigerant shall be R-410.
- 2. Compressor: Unit shall include dual scroll, dual circuit with lead circuit VFD controlled, variable speed scroll compressor on the refrigeration circuit, which shall be capable of modulating refrigerant capacity. One compressor shall be On/off.
- 3. Unit shall include factory provided and installed compressor sound jackets on all compressors.
- 4. Lead (Lag) (All) refrigeration circuit(s) shall be provided with aluminum microchannel hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space. Reheat coil shall be piping in a (series) (parallel) configuration.
- 5. Unit shall be configured as an air-source heat pump. Each refrigeration circuit shall each be equipped with a factory installed liquid line filter drier with check valve, reversing valve, accumulator, and expansion valves on both the indoor and outdoor coils. Reversing valve shall energize during the heat pump cooling mode of operation.
- 6. Hot Gas Reheat and liquid subcooling:
  - a. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser and liquid sub cooling on all circuits.
  - b. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

7. Heat Pump Heating:
  - a. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heatpump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heatpump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.
  - b. The refrigerant system shall have a pump-down cycle.
  - c. The unit shall have a natural gas furnace for hybrid heating. When the heat pump operation cannot maintain the discharge air temperature setpoint the natural gas furnace shall temper the airstream to the discharge air temperature setpoint.

## 2.12 PACKAGED DX CONDENSER SECTION

- A. Air-Cooled Condenser
- B. Condenser fans shall be vertical discharge, axial flow, direct drive fans.
- C. Options:
  1. Condenser fans shall be electronically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
  2. Coils shall have a flexible, epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 hours each (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing, with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the polymer coating.

## 2.13 DAMPERS

- A. Performance: Test in accordance with AMCA 500.
- B. Frame: galvanized steel, aluminum, or stainless steel.
- C. Blade Material: Galvanized Steel or aluminum airfoil.
- D. Blade Seals: Close cell neoprene mechanically attached, field replaceable.
- E. Bearings: Synthetic.
- F. Outside Air and Exhaust Air Damper Leakage (no damper between outside air connection and building envelope): Class 1 motorized, maximum leakage rate of 4.0 cfm per square foot at 1.0 inches wg pressure differential when tested in accordance with AMCA 500D.
- G. Damper Actuators: Furnish factory installed electronic damper actuators for outside air, and exhaust air dampers.

## 2.14 CONTROLS

- A. Manufacturer shall provide dampers with actuators factory installed and wired to a terminal strip within the unit electrical cabinet.
- B. Manufacturer shall provide factory installed and wired PM motor controllers and/or VFD's within the unit electrical cabinet for:
  - 1. Supply Fan
  - 2. Exhaust Fan
  - 3. Energy Recovery Wheel
- C. Refer to Section 15951 for VFD and PM motor controller requirements.
- D. DOAS/RTU Manufacturer factory mounted unit controller (basis of design).
- E. Provide with BACnet/MSTP Card
- F. Modes and Temperature Setting
  - 1. Occupied mode: as scheduled / set by BMS.
- G. Sequence of Operation (DOAS-1 and MAU-1)
  - 1. Summary
    - a. DOAS-1 and MAU-1 are single zone, constant volume units that provide heating, ventilation, cooling, and dehumidification for the building. The packaged Rooftop Units shall be controlled through the controllers supplied by the RTU manufacturer.
  - 2. Unit Controls:
    - a. Building Management System (BMS) interface: The factory unit controller will interface with the existing building management system (may require optional communication card). The BMS will set occupied/unoccupied mode, heating, cooling, and humidity setpoints, and enable/disable the AHU.
    - b. Head Pressure Control: The condenser head pressure will be monitored by the unit controller to maintain head pressure and the compressor operating envelope at all times to avoid high pressure trips on high load days. Condenser fans with ECM motors shall be provided as well as factory sensors to provide this protection.
    - c. Compressor Envelope Control: The unit controller will continually monitor the suction and discharge pressure and temperature conditions during compressor operation. The unit will modulate the compressor, condenser head pressure, and electronic expansion valve to maintain a safe compressor operating conditions to add reliability, and limit unit shut down during fringe operating conditions.
  - 3. SUPPLY FAN:
    - a. The supply fan will be factory supplied with a direct drive electrically commutated motor (ECM) or motor with variable frequency drive (VFD). The Supply fan will operate continuously at a constant speed.

**4. HEATING MODE:**

- a. The DOAS/MAU Discharge air control (DAC) unit in heating will operate to supply a heating discharge air temperature set point adjustable at the unit controller.
  - 1) Heat Pump: Heat pump units for DOAS applications are required to have supplemental heat to maintain DAC at all times during heating operation.
  - 2) Heat pump will be allowed down to 45F OAT for DOAS units. Below 45F the supplemental heat will be activated.
  - 3) The heat pump will activate to serve as primary heat and will modulate the compressor to meet the discharge air temperature heating set point. If the heat pump capacity is cannot satisfy the set point the Supplemental Electric heat will modulate as required to maintain the heating discharge air set point.
  - 4) DOAS/MAU Defrost: Defrost will only be activated when a factory mounted temperature sensor determines frost build up. During the defrost cycle the unit will reverse operation into cooling to send hot gas to the outdoor coil for defrost. The heating discharge air temperature set point will be maintained by the supplemental electric heat.
- b. Energy Recovery Wheel (DOAS only): When the heat pump has an energy recovery wheel, the unit will no longer lock out heat pump operation at 45 F OAT. The unit will instead use the Leaving wheel temperature sensor and will lockout heat pump operation when this temperature is less than 45F.
- c. Supplementary Electric Heat:
  - 1) SCR Electric Heat: The SCR electric heat will be modulated by the unit controller to maintain the space heating set point.

**5. COOLING:**

- a. Discharge Air Control: In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.
- b. Cooling DAT reset: The cooling DAT setpoint may be reset by space, return, OAT or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

**6. DEHUMIDIFICATION/REHEAT:**

- a. Dehumidification: Dehumidification will be activated when the relative humidity or dew point in the return duct, space, or outdoor air hood rises above the dehumidification set point. Upon activation, the compressor will energize to a capacity to maintain a leaving coil temperature while

modulating the capacity of the liquid subcooling and hot gas reheat coil to maintain the reheat discharge air temperature set point. The minimum leaving coil temperature, cooling DAT set point, and humidity activation set point are all adjustable at the unit controller.

- b. Reheat Always: A neutral DAT will be provided in the Cooling and Fan only modes by setting the reheat control to always. The unit will control the compressors to maintain the minimum leaving coil temperature/dew point and the reheat coil to provide the cooling DAT setpoint at neutral conditions.
7. ENERGY RECOVERY (DOAS only):
- a. Variable Speed Wheel:
    - 1) Wheel Effectiveness Control: The energy recovery wheel will modulate speed to meet the discharge air temperature set point using a vfd and factory mounted temperature sensors. The energy wheel is the first form of heating or cooling when active. Compressors or heat will only be active when the energy recovery wheel cannot satisfy the DAT.
    - 2) VFD defrost: The energy wheel will modulate speed to defrost the wheel during frost conditions. The wheel will use factory mounted temperature sensors and modulate the wheel speed to maintain the dry bulb temperature of the exhaust air leaving the enthalpy wheel high enough to eliminate the frost conditions while maintain partial wheel effectiveness allowing energy recovery to continue.
8. Exhaust Fan Speed Control (DOAS only): the exhaust fans are provided with direct drive electrically commutated motors (ECMs) or VFDs.
- a. Speed Control: The Exhaust fan can be set to provide a fixed capacity. This set point can be written through a network.
9. Occupancy Override: Upon a signal from the push button override on any of the space temperature sensors, the space shall revert to occupied mode for a period of 2 hours (adjustable).
- H. Safeties: Compressor shall incorporate a solid-state compressor protector that provides reset capability at the space thermostat.
- I. Compressor with standard controls shall be capable of operation down to 40 degrees F ambient outdoor temperature.
- J. Each unit shall be equipped with a complete microprocessor based control system. The unit control system shall include all required temperature and pressure sensors, input/output boards, main microprocessor and operator interface. All boards shall be individually replaceable. All microprocessors, boards, and sensors shall be factory mounted, wired and tested.
- K. The microprocessor shall be a stand-alone DDC controller not dependent on communications with any on-site or remote PC or master control panel. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All

factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

- L. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/ disable, heat indication, cool indication, and fan operation.
- M. The main microprocessor shall support an RS-232 direct connection to a product service tool or a modem. A communications module shall be provided for direct communication into the BAS network.
- N. All digital inputs and outputs shall be protected against damage from transients or wrong voltages. Each digital input and digital output shall be equipped with an LED for ease of service. All field wiring shall be terminated at a separate, clearly marked terminal strip.
- O. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.
- P. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include Zone sensor with tenant override switch, or Zone sensor with tenent override switch and heating/cooling set point adjustment.

## 2.15 ELECTRICAL REQUIREMENTS

- A. All unit power wiring shall enter unit cabinet at a single location.
- B. Provide a single point power connection to power all components, except a convenience outlet as described below.
- C. Disconnect Switch: Factory mount on equipment.
- D. Duplex GFCI Outlet: Mounted on casing exterior, requiring a field power connection independent from the air handler's main power block and/or disconnect. Outlet shall be wired in field by the Electrical Contractor.
- E. Equipment Ampere Interrupting Capacity (Short Circuit Current Rating): HVAC equipment Ampere Interrupting Capacity (AIC) rating or Short Circuit Current Rating (SCCR) shall meet minimum requirements specified in 15700.
- F. Motors
  - 1. Compressor motors shall be of the refrigerant cooled type with line break thermal and current overload protection.
  - 2. Fan motors shall have permanently lubricated bearings, and inherent automatic reset thermal overload protection.
  - 3. Outdoor (condenser) fan motor shall be totally enclosed.



## 2.16 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- C. Remote potentiometer to adjust minimum economizer damper position.
- D. Return-air bypass damper.
- E. Factory- or field-installed demand-controlled ventilation.
- F. Safeties:
  - 1. Smoke detector.
  - 2. Condensate overflow switch.
  - 3. Phase-loss reversal protection.
  - 4. High and low pressure control.
  - 5. Electric coil airflow-proving switch.
- G. Door switches to disable heating or reset set point when open.
- H. Outdoor air intake weather hood with moisture eliminator.

## 2.17 ROOF CURBS

- A. Wind Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb to meet local wind restraint requirements, and designed for loads at Project site.
- B. The roof curb shall be a full perimeter, gasketed type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high.
- C. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
  - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install the unit in accordance with AHRI 340/360 and manufacturer's instructions.
- B. Roof Curb:
  - 1. Assemble roof curb.
  - 2. Install roof curb level.
  - 3. Coordinate curb installation and flashing with General Contractor.
  - 4. Coordinate sizes and locations of roof curbs with actual equipment provided.
  - 5. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
  - 6. Install gasket material between unit base and roof curb.
- C. Install flexible connections between unit and inlet and discharge ductwork. Install metal bands of connectors parallel with minimum 1 inch flex between ductwork and fan while running.
- D. Provide seismic support if applicable.
- E. Install condensate drainage system as indicated on drawings.

### 3.3 CONNECTIONS

- A. Install condensate drain, minimum connection size per drawing details to nearest roof drain or area drain.
- B. Install piping adjacent to RTUs to allow service and maintenance.
- C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination at top of roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 15820 "Ductwork Accessories."
  - 4. Install return-air duct continuously through roof structure.
- D. Connect electrical wiring according to Section 16120 "Conductors and Cables."
- E. Ground equipment according to Section 16060 "Grounding and Bonding."

### 3.4 TESTING

- A. Test the unit in accordance with manufacturer's instructions and Section 15950 .

### 3.5 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

**3.6 CLEANING**

- A. Vacuum clean coils and inside of unit cabinet.
- B. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

**3.7 DEMONSTRATION**

- A. Demonstrate unit operation, adjusting and maintenance.
- B. Furnish services of manufacturer's technical representative for 8 hours to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days' notice to Engineer of training date.

**3.8 PROTECTION OF FINISHED WORK**

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

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## SECTION 15750

## HUMIDITY CONTROL EQUIPMENT

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Dehumidifiers, DX.
  - 2. Dehumidifiers, DX small.
  - 3. Dehumidifiers, Desiccant.
  - 4. Humidifiers
- B. Related Requirements:
  - 1. Section 15184 – Refrigerant Piping
  - 2. Division 16 - Electrical

## 1.2 SUBMITTALS

- A. Product Data: For each dehumidification unit indicated.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 3. Provide discharge air temperatures, operating temperature ranges and capacity charts.
- B. Shop Drawings: For each dehumidification unit indicated.
  - 1. Include plans, elevations, sections, details, and attachments details.
  - 2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Indicate service clearances and rough in requirements,
  - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Product Test Reports:
  - 1. Startup service reports.
- E. Installation, Operations and Maintenance manuals.

## 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
- B. Installer Qualifications: minimum 5-year experience installing similar products.
- C. Unit shall be certified in accordance with ANSI B-149-1.
- D. Unit shall be constructed in accordance with U.S. standards and be C.S.A. certified.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Applicable requirements in ASHRAE 62.1, Section 5, "Systems and Equipment" and Section 7, "Construction and Startup."
- G. Applicable requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."
- H. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."
- I. ASHRAE 84 (2020; Errata 2021) Method of Testing Air-to-Air Heat/Energy Exchangers.

#### 1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of dehumidification units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Manufacturer's standard, but not less than two years from date of Substantial Completion.

#### 1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: Two spare sets of each type of filter specified.
  - 2. Fan Belts: One set for each belt-drive fan.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Dehumidifiers, DX
  - 1. Desert Aire
  - 2. Condair
  - 3. EBAC
  - 4. Or equal
- B. Dehumidifiers, DX small

1. Quest
  2. Dayton
  3. EBAC
  4. Therrma-Stor Hi-E-Dry
  5. Or equal
- C. Dehumidifiers, Desiccant
1. Ebac
  2. Innovative Air
  3. Stulz
  4. Or equal

## 2.2 DEHUMIDIFIERS, DX

### A. UNIT CONSTRUCTION

1. The base rails and supports shall be 12 gauge galvanized steel channels;
2. Corner posts and side posts shall be formed of 18 gauge galvanized steel;
3. Top panels and removable side panels shall be 18 gauge galvanized steel. Removable panels with insert nut screw sites shall be provided to allow easy access to all internal parts and components.
4. The electrical control box and switch panel shall be enclosed in a separate compartment and shall include a hinged door that requires a tool to open.
5. Access: Removable panels with neoprene gaskets.
6. Drain Pan and Connection: Stainless steel; insulated.

### B. PAINT AND FINISH

1. Prior to painting, all metal parts shall be pretreated to remove oils and dirt and rinsed with an ionized solution.
2. Painting shall be by a powder coat technique to assure positive adherence with a high impact finish.
3. All sides of panels shall be painted after manufacturing.
4. The paint shall be High Yield Polyester.
5. Salt spray test: Minimum of 1,000-hour per ASTM B117
6. Direct impact resistance: Minimum of 160 in-lbs per ASTM D2794
7. Flexibility: Minimum of 1/4" Mandrel per ASTM D522, Method B
8. Humidity Resistance: Minimum 1,000-hour per ASTM D2247.

9. Color: Manufacturers standard unless noted otherwise in the equipment schedule on the Drawings.

#### C. INSULATION

1. The thermal and sound insulation shall be engineered polymer closed-cell foam insulation. Indoor units shall have 3/8" thick insulation with an R value of 1.5 and outdoor units shall have 3/4" thick insulation with an R value of 3.
2. Closed Cell Flexible Insulation performance must be able to operate in a temperature between -40° and 150°.

#### D. FANS

1. The supply fan shall be wired to run continuously except when in defrost mode of operation.
2. Fan shall be direct or belt drive, based on the model specified in the equipment schedules in the Drawings.
3. Supply fan shall be a double inlet forward curve fan. The fan housing shall be made of galvanized steel. The impeller is manufactured in galvanized steel with tab locked blades.
4. All bearings are selected for a minimum of a L50 Lifetime of 100,000 hours.
5. All fans shall be dynamically and statically balanced
6. Blower Discharge: The unit's air discharge will be as shown on the drawing.
7. Blower Pulley Assembly: The driver pulley and the blower pulley will be made of cast iron. The motor sheave will be a variable pitch type to allow for field adjustment of CFM and external static.

#### E. RETURN AIR FILTERS

1. Pleated: MERV 8 disposable, 4" deep.

#### F. REFRIGERATION SYSTEM

1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IES 90.1.
2. Refrigerant Coils: Copper tubes with mechanically bonded aluminum fins; factory fabricated and tested to comply with ASHRAE 33 and AHRI 410; with multiple refrigerant circuits, seamless-copper headers with brazed connections, and galvanized-steel frame. Coil and fins shall have a polyester coating. Coils shall have a minimum 300-psig working-pressure rating and be factory tested to 450 psig and to 300 psig while underwater.
3. Compressors: The compressors shall be a heavy-duty scroll-type. The compressor shall be equipped with high- and low-pressure safety switches, with internal protection from overheating. The compressor shall be externally vibration isolated

4. Receiver: The unit shall include a refrigerant receiver. The receiver shall assist the unit in operating at the highest efficiency over a wide range of load conditions.
5. The unit shall include an automatic evaporator coil defrost cycle activated by time and suction temperature and terminated by time or suction temperature for low temperature operation
6. The refrigeration system shall include a "pump down" cycle to prevent liquid refrigerant build-up in the low side of the system during the off cycle
  - a. Fins: Fins shall be die-formed, aluminum and shall be damage resistant. Self-spacing fin collars provide maximum heat transfer. Fin spacing shall be 8 FPI (fins per inch) maximum. The coil shall be designed to avoid water carryover to the reheat coil and re-evaporation into the air stream.
  - b. Tubes: Coils shall be fabricated from seamless drawn copper. The inner tubing shall be designed to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be mechanically expanded to form-and interference-fit with the fin collars for maximum heat transfer and stability.
  - c. Testing: Coils shall be leak tested at the factory.
7. Internal Air-Cooled Condenser (Reheat Coil)
  - a. The reheat coil shall be positioned with a minimum of 5" clearance from the DX coil to prevent water re-evaporation.
  - b. The reheat coil shall be sized to reject the total heat of rejection developed by the refrigeration system in the dehumidification mode with an operating range between 32°F and 80°Fdb.
  - c. Fins: Fins shall be die-formed aluminum and shall be damage resistant. Fins spacing shall be 12 FPI (fins per inch) maximum.
  - d. Tubes: Coils shall be fabricated from seamless drawn copper. The tubes shall be mechanically expanded to form and interference fit with the fin collars for maximum heat transfer and stability.
  - e. Testing: Coils shall be leak tested at the factory
  - f. All air-side refrigeration heat exchangers shall be coated with ElectroFin® E-Coat through electro-deposition immersion process for enhanced corrosion resistance. Dry film thickness shall be 0.6-1.2 mils (15-25 µm). Heat transfer coefficient loss shall be less than 1% after coating. Minimum salt spray resistance per ASTM B117-97 / DIN 53167 after coating shall be 6,000 hours. Phenolic coatings or fin surface only coatings are not acceptable. Manual dip processes or spray application processes will not meet specification.

#### G. CONTROL PANEL

1. Units shall include factory supplied, mounted, wired, and tested stand-alone microprocessor controls and a control interface for remote mounting if shown on drawings or schedules.
2. Microprocessor controller shall include local liquid crystal display (LCD) for user interface. Microprocessor controller remote LCD shall be mounted in an enclosure suitable for the electrical space rating and accessible without exposing the operator to high voltage wiring or having to turn off or circumvent the main disconnect. Refer to HVAC or electrical drawings for reference of space rating.



3. The electrical control panel shall be of adequate size to house all electrical controls and devices. The control panel shall be provided loose with the unit for remote mounting.
4. The unit shall be provided with single point power connection to service controls, fans and compressors, factory wired to the power connection lug set. The electrical controls will include low-voltage transformers to supply 24 VAC control power, clearly labeled high- and low-voltage, terminal strips, high- and low-pressure control (with manual reset of the high-pressure cutout and automatic reset of low-pressure cutout), and an anti-short cycling timer to protect against compressor cycling.
5. Short Circuit Current Rating (SCCR): The complete unit shall be rated in compliance with NEC<sup>®</sup> 110.10 and UL 1995 at nameplate voltage maximum, when protected by Class J, Class T or Class RK1 fusing. Electrical markings on the unit shall include, but not limited to the MCA (Minimum Circuit Ampacity), the MOPD (Maximum Over-Current Protection Device) and the SCCR

#### H. CONTROL SYSTEM

1. A digital controller system shall be used to control the dehumidification system and the space environment. The controller shall include an open operator level and a minimum of one (1) password protected level.
2. The controller shall provide system control and easy-to-read display, indicating measured values, set points and alarms. The remote controller shall be remote mountable up to 1,640 feet from the unit.
3. Temperature Sensor: The unit shall include a temperature sensor to be field-installed.
4. Relative Humidity Sensor: The unit shall include a relative humidity sensor to be field-installed.
5. The supply fan shall run only when the unit has a demand for cooling, dehumidification or heating

#### I. SEQUENCE OF OPERATION

1. The unit mounted dehumidifier controller shall operate the dehumidifier and associated dampers.
2. The outside air damper will be field supplied with a 24V damper actuator.
3. A digital input signal from the main HVAC control panel shall switch the operation between occupied and unoccupied mode.
4. The unit controller shall monitor the space relative humidity and temperature to calculate the space dew point temperature, and shall determine when to perform dehumidification and operate the compressor accordingly.

### 2.3 DEHUMIDIFIERS, DX SMALL

- A. Unit shall be of the low temperature frost-free type suitable for running in enclosed areas with temperatures as low as 38°F.
- B. Unit shall contain integral condensate pump. Drain shall be hard piped from unit with PVC pipe to discharge location as shown on drawings.
- C. Unit shall be supplied with power cord and grounded plug suitable for use on 120-volt power supply receptacle.
- D. Unit shall be controlled by a cold coil low-temperature thermostat integrally mounted within the dehumidifier cabinet.
- E. Unit shall be provided with an adjustable dial-controlled humidistat. Humidistat shall be provided with a setting for continuous running.
- F. Unit shall contain a MERV 11 pleated filter.
- G. Cabinet shall be thermoplastic.
- H. Unit shall have a digital display that shows the percentage of humidity at the ambient temperature and the set point.
- I. Defrost cycle shall occur at a room temperature no greater than 42 degrees F.
- J. Dehumidifier shall be factory built, tested and shipped for installation in the field.
- K. Dehumidifier shall be ceiling suspended.

#### 2.4 DEHUMIDIFIERS, DESICCANT

##### A. General

1. Dehumidifier shall be dry desiccant on a rotor with hot air regeneration type. The dehumidifier shall be capable of automatic continuous outdoor operation. The desiccant wheel shall be rotary vertical desiccant wheel, sorption atmospheric type capable of constant moisture output with a constant moisture inlet. All access panels shall be weather tight and insulated as to not allow temperature or moisture infiltration into the system. The dehumidifier shall be a complete factory assembled, tested unit that includes: Electric heaters for reactivation heat, TEFC motors on both process and reactivation fans, replaceable high capacity pleated filters, direct drive fans, desiccant wheel chain drive system, high capacity desiccant wheel, NEC rated electrical panel, access panels for all components, internal safeties and automatic controls. Dehumidifier shall remove moisture from the air based on inlet conditions shown on equipment schedules on the drawings.
2. Construction Description: The unit casing shall be double wall and constructed using a 2.4" insulation thermal break unitized, internal aluminum framing, covered, riveted and welded for torsional rigidity. External skin shall be provided with 16 gauge Galvaneal steel, primed and painted with industrial marine grade enamel for long term corrosion protection. Access panels shall be double wall construction and shall use heavy-duty hinges with ½ turn compression latches fully capable of being fully tightened against gasket surfaces. Panels without gaskets shall not be acceptable. Access panels shall be large enough to access all internal components to facilitate easy replacement or maintenance. Hinges shall be installed by locating hinges no more than 36

inches on center from hinge to hinge. All major components such as coils, filters, blowers, etc., within the air handling structure shall be easily removable through access panels without dismantling plenums. Equipment that requires disassembly of components rather than access through removable or hinged panels shall not be acceptable. All open air ducts shall have rainhoods and rodent screens to prevent any water penetrations or unnecessary debris from entering unit. Electrical enclosures to be NEMA 4 construction.

- a. Unit construction and finish shall be suitable for booth indoor and outdoor rooftop installation.

## B. Dehumidifier

### 1. Wheel Media

- a. The dehumidification desiccant wheel or "rotor" shall be uniform in nature, comprised of corrugated fiberglass with an "in situ" formed silica gel desiccant, titanium silicate, or zeolite. Media shall be nominally 12 lb per cubic foot with "dry" (reactivated) desiccant concentration of not less than 80% of the total media mass. Not more than 4% of the media, including face coat, shall be of an organic material. Rotor media is rated for continuous service between -100 °F Dry Bulb and + 320 °F Dry Bulb. Media must withstand temperatures to 2000 °F Dry Bulb without mechanical failure. Rotor media shall be independently tested in accordance with ASHRAE guidelines for performance and independently tested in accordance with ASTM E-84 for flame resistance and smoke production. ASTM E-84 result must be 0/0 for both flame and smoke rounded indexes. Independent test results must be furnished by the manufacturer upon request.

### 2. Rotor Frame

- a. Rotor Frame shall be comprised of carbon steel tubing or stainless steel, with welded 10 gage spokes and welded internal 10 gage media retention strips (stainless steel alternate). Outer rim shall be manufactured from not less than 14 gage 304 stainless steel. Flanges shall be additionally sealed to the outer rim using 400 °F Dry Bulb rated silicone sealant. Rotor Frame shall include non-maintenance sealed bearings rated for 200,000 hours continuous duty.
- b. Rotor Perimeter shall be equipped with a carbon steel continuous perimeter sprocket (stainless steel alternate), rated for 87,600 hours of continuous use, and compatible with the specified drive system.

### 3. Cassette Frame

- a. Framing shall be manufactured from welded 304 stainless steel tubing. All welds shall be reasonably ground and dressed for appearance. Structural welds shall be continuous and non-structural welds shall be on 4" centers. Cassette face panels shall be 304 stainless steel and welded in place. Cassette motor drive base plate shall be of 304 stainless steel and shall be attached to the cassette via a bolted 1/2" shaft. Rotor shaft shall be manufactured from 4140 Cold Rolled steel (stainless steel alternate)

and shall be bolted to the cassette via oversized Allen head socket type shoulder screws. Rotor movement on the drive shaft shall be prevented by the use of two (2) machined anti rotation plates, which shall additionally prevent the rotor shaft from turning.

4. Rotor Seals
  - a. Shall be of "twin contact" design and manufactured from Viton material. Seals shall be rated for 87,600 hours of continuous use. Seals shall not require adjustment during their operable lifetime, or rotor removal for replacement.
5. Rotor Drive
  - a. Shall include a parallel shaft gear reducer with hardened steel gears and drive motor suitable for 60 hz operation. Motor to be TEFC type rated IP 54 minimum. Cast aluminum motor gear case shall be permanently lubricated. Gear Reducer drive shall be equipped with a #40 chain hardened carbon steel ANSI drive sprocket or stainless steel, nickel plated corrosion resistant drive chain and spring type automatic chain tensioning device. Automatic tensioner shall have manual backup. Drive Base Plate shall be stainless steel.

C. Electric Reactivation Heat

1. General Description
  - a. The reactivation shall consist of electric finned heaters. The total heat shall consist of two stages, one stage that operates when the react fan energizes, and one stage that operates via reactivation temperature controller. Electric heaters shall not be of the open Nichrome type.
2. Control Type
  - a. The reactivation heaters shall be controlled from the dehumidifier's on board temperature controller device.
3. Control Type
  - a. The reactivation heaters shall be controlled from the dehumidifier's on board temperature controller device.

D. Reactivation and Process Filters

1. The unit shall include removable filters at the inlet of both process and reactivation air streams. These filters shall be mounted on sliding racks and accessible through access panels. All supply air is filtered through MERV 8 filters as rated by ASHRAE Test Standard 52-76. Filters are disposable 2" deep, pleated disposable type with non-woven media held in place by a welded wire grid. Air velocity of 500 FPM shall be under maximum ASHRAE Standards. Filters are held in channels top and bottom with spacers and back-up plates to minimize bypass. Filter channels are welded and sealed in place to eliminate air bypass. Media shall be 100% synthetic media that does not support microbial growth. Filters shall have 100% recycled post consumer recycled expanded metal support grid bonded to the air exiting side of the filter to maintain pleat

uniformity and prevent fluttering. Metal grid shall be recyclable. Filters shall be rated to withstand a continuous operating temperature of up to 150F.

E. Reactivation Fan

1. General

- a. The fan shall be capable of operating over the entire range in accordance with the equipment schedule and as defined in AMCA Standard 99-2408. Process fan wheels shall utilize non overloading airfoil blades in all models. Flat, single thickness blades are not acceptable.

2. Performance

- a. Fan ratings shall be based on tests made in accordance with AMCA Standard 210, and licensed to bear the AMCA Certified Ratings Seal for Air Performance. Fans shall have a sharply rising pressure characteristic extending throughout the operating range to assure quiet and stable operation from wide open to closed off.

3. Sound

- a. Fan manufacturers shall provide sound power level ratings for fans tested and rated in accordance with AMCA Standards 300 and 301. Tests shall be performed in an accredited AMCA laboratory. Sound power ratings shall be in decibels (reference 10-12 watts) in eight octave bands. Sound power levels will be corrected for installation by the specifying engineer, > 90 dBA levels are not acceptable.

4. Construction

- a. Fan housings are to be heavy gauge, welded construction. Housings with lock seams are not acceptable. Slip outlet is included as standard. Housing inlet cones shall be aerodynamically designed and spun providing a minimum separation of air flow.

5. Balance and Run Test

- a. All fan wheels shall be dynamically balanced on precision balancers. Prior to shipment, completed fans shall receive a final test balance at the specified operating speed.

F. Process Fan

1. General

- a. The fan shall be capable of operating over the entire range in accordance with the equipment schedule and as defined in AMCA Standard 99-2408. Process Fan wheels shall utilize non overloading airfoil blades in all models. Flat, single thickness blades are not acceptable.

2. Performance

- a. Fan ratings shall be based on tests made in accordance with AMCA Standard 210, and licensed to bear the AMCA Certified Ratings Seal for Air Performance. Only AMCA certified fans will be accepted. Fans

shall have a sharply rising pressure characteristic extending throughout the operating range to assure quiet and stable operation from wide open to closed off.

3. Sound
  - a. Fan manufacturers shall provide sound power level ratings for fans tested and rated in accordance with AMCA Standards 300 and 301. Tests shall be performed in an accredited AMCA laboratory. Sound power ratings shall be in decibels (reference 10-12 watts) in eight octave bands. Sound power levels will be corrected for installation by the specifying engineer, >90 dBA levels are not acceptable.
4. Construction
  - a. Fan housings are to be heavy gauge, welded construction. Housings with lock seams are not acceptable. Slip outlet is included as standard. Housing inlet cones shall be aerodynamically designed and spun providing a minimum separation of air flow.
5. Balance and Run Test
  - a. All fan wheels shall be dynamically balanced on precision balancers. Prior to shipment, completed fans shall receive a final test balance at the specified operating speed.
- G. Unit shall have a digital display that shows the percentage of humidity at the ambient temperature and the set point.
- H. Dehumidifier shall be factory built, tested and shipped for installation in the field.
- I. Control Panel
  1. Units shall include factory supplied, mounted, wired, and tested stand-alone microprocessor controls and a control interface for remote mounting if shown on drawings or schedules.
  2. Microprocessor controller shall include local liquid crystal display (LCD) for user interface. Microprocessor controller remote LCD shall be mounted in an enclosure suitable for the electrical space rating and accessible without exposing the operator to high voltage wiring or having to turn off or circumvent the main disconnect. Refer to HVAC or electrical drawings for reference of space rating.
  3. The electrical control panel shall be of adequate size to house all electrical controls and devices. The control panel shall be provided loose with the unit for remote mounting.
  4. The unit shall be provided with single point power connection to service controls, fans and compressors, factory wired to the power connection lug set. The electrical controls will include low-voltage transformers to supply 24 VAC control power, clearly labeled high- and low-voltage, terminal strips, high- and low-pressure control (with manual reset of the high-pressure cutout and automatic reset of low-pressure cutout), and an anti-short cycling timer to protect against compressor cycling.

5. Short Circuit Current Rating (SCCR): The complete unit shall be rated in compliance with NEC® 110.10 and UL 1995 at nameplate voltage maximum, when protected by Class J, Class T or Class RK1 fusing. Electrical markings on the unit shall include, but not limited to the MCA (Minimum Circuit Ampacity), the MOPD (Maximum Over-Current Protection Device) and the SCCR

#### J. CONTROL SYSTEM

1. A digital controller system shall be used to control the dehumidification system and the space environment. The controller shall include an open operator level and a minimum of one (1) password protected level.
2. The controller shall provide system control and easy-to-read display, indicating measured values, set points and alarms. The remote controller shall be remote mountable up to 1,640 feet from the unit.

#### K. SEQUENCE OF OPERATION

1. The unit mounted dehumidifier controller shall operate the dehumidifier and associated dampers.
2. The outside air damper will be field supplied with a 24V damper actuator.
3. Move the selector switch on the control panel to either the ON or AUTO position to start the unit. If the selector switch is in the AUTO position, the unit will not start until the (external) auto run contact is closed, or the run command is issued through BACnet.
4. The process fan will start and will run at the speed set on the HMI screen or the speed from the Analog input. Once the process fan is running, the reactivation fan will start, and the desiccant wheel will begin rotating.
5. When air flow is sensed by the process air pressure switch, the following functions will be enabled:
  - a. When the reactivation pressure switch senses reactivation airflow and no other relevant alarms exist in the system, the reactivation heat will be modulated to maintain the reactivation temperature setpoint, which is automatically calculated based on the conditioned space dewpoint setpoint. To shut down the system, move the selector switch on the control panel to the off position, or remove the automatic run signal (from both Modbus address and external contact). The process fan will immediately shut down, along with the post heater. The reactivation fan and wheel will continue to run until the reactivation temperature falls below 120 degrees F.
6. Dehumidification setpoint determination:
  - a. The dehumidifier shall control space to both a maximum of 60% RH and space dewpoint to prevent condensation on the process piping.
  - b. A surface mounted pipe temperature sensor shall be used to calculate the pipe dew point and shall override and reset the humidity control set point. The dew point setpoint 3°F (adjustable) below the pipe temperature.

7. The unit controller shall monitor the space relative humidity and temperature to calculate the space dew point temperature, and shall determine when to perform dehumidification and operate the dehumidifier accordingly.
8. Dewpoint Control
  - a. The system will automatically adjust the face and bypass damper position to allow air to bypass the wheel and mix with the dry air from the wheel to maintain the output/space dewpoint.
  - b. If the dewpoint control output drives the bypass damper to the 100% open position for a period of time and the dewpoint is below the setpoint, the unit will enter economizer mode (react heat/fan and desiccant wheel turn off), and will stay there until the output of the bypass damper drops below 100% open.
9. Alarms
  - a. The controller monitors the system for alarm conditions, and reports any alarm detected by displaying a red warning bar at the bottom of the screen.

2.5 A HISTORY OF PREVIOUS ALARMS IS AVAILABLE FROM THE TECHNICAL SUPPORT SCREEN BY TOUCHING THE ALARM HISTORY BUTTON.ELECTRICAL REQUIREMENTS

- A. All unit power wiring shall enter unit cabinet at a single location.
- B. Provide a single point power connection to power all components, except a convenience outlet as described below.
- C. NEMA 3R Non-Fused Disconnect Switch: Factory mount on equipment.
- D. Duplex GFCI Outlet: Mounted on casing exterior, requiring a field power connection independent from the air handler's main power block and/or disconnect. Outlet shall be wired in field by the Electrical Contractor.
- E. Equipment Ampere Interrupting Capacity (Short Circuit Current Rating): HVAC equipment Ampere Interrupting Capacity (AIC) rating or Short Circuit Current Rating (SCCR) shall meet minimum requirements specified in 15700.
- F. Motors
  1. Compressor motors shall be of the refrigerant cooled type with line break thermal and current overload protection.
  2. Fan motors shall have permanently lubricated bearings, and inherent automatic reset thermal overload protection.
  3. Outdoor (condenser) fan motor shall be totally enclosed.
    - a.

PART 3 EXECUTION

3.1 FIELD ADJUSTMENT, INSPECTION, AND TEST



- A. Field adjust, test and operate the dehumidifier

### 3.2 COORDINATION

- a. Coordinate sizes and locations supports.
- b. Coordinate installation of equipment supports with other trades.

### 3.3 INSTALLATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls, floors, and roofs for suitable conditions where dehumidification units will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Install humidifiers and dehumidifiers in accordance with the manufacturer's recommendations.
- E. Install with required clearances for service and maintenance.
- F. Install dehumidifier per description below or as indicated on drawings.
- G. Provide support railing for ceiling suspension to elevate dehumidifier above floor to allow for condensate drainage.
- H. Provide insulated outside air filter box of same material as ductwork with Merv 11 filters in outside air intake duct. Install at location convenient for filter replacement.
- I. Provide PVC piping from dehumidifier to condensate disposal location. Run flexible condensate hose supplied with dehumidifier inside of PVC pipe to termination point. Secure PVC piping to wall and/or floor.
- J. CONNECTIONS
  - 1. Where piping or duct is installed adjacent to dehumidification units, allow space for service and maintenance of dehumidification units.

### 3.4 FIELD QUALITY CONTROL OF CONDENSING DEHUMIDIFIERS, DX

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Perform the following Tests and Inspections:
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Include ducted dehumidifier in Testing and Balancing Procedures. Refer to specification section 15950 for air system and equipment testing details.
  - C. Dehumidification unit will be considered defective if it does not pass tests and inspections.
  - D. Prepare test and inspection reports.
- 3.5 FIELD ADJUSTMENT, INSPECTION, AND TEST DEHUMIDIFIERS, DX SMALL
- A. Field adjust, test and operate the dehumidifier
- 3.6 STARTUP SERVICE OF DEHUMIDIFIERS
- A. Engage a factory-authorized service representative to perform startup service for units, including complete testing and adjusting of controls and operation.
    1. Complete installation and startup checks according to manufacturer's written instructions.
  - B. Perform the following final checks before startup:
    1. Verify that shipping, blocking, and bracing are removed.
    2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
    3. Perform cleaning and adjusting specified in this Section.
    4. Coordinate fan operation and adjusting with testing, adjusting and balancing contractor.
    5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
    6. Check lubrication of bearings, pulleys, belts, and other moving parts.
    7. Install clean filters.
    8. Verify that manual and automatic volume control in connected duct systems are in fully open position.
    9. Starting procedures for dehumidification units include the following:
      - a. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace malfunctioning motors, bearings, and fan wheels.
      - b. Measure and record motor's electrical values for voltage and amperage.
      - c. Manually operate dampers from fully closed to fully open position and record fan performance.
      - d. Startup Report: Report findings during startup. Identify startup steps, corrective measures taken, and final results.

**C. ADJUSTING**

1. Adjust initial temperature and humidity set points of all dehumidifiers.

**D. CLEANING**

1. Clean dehumidification units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering-air face.
2. After completing system installation, testing, and startup service of dehumidification units, clean filter housings and install new filters of all dehumidifiers.

**E. DEMONSTRATION**

1. Engage a factory-authorized service representative for units  $\geq 500$ lb/day, to train Owner's maintenance personnel on adjustments, operation, and maintenance.

**END OF SECTION**

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## SECTION 15810

## DUCTS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Metal Ductwork
  - 2. Sealants and Gaskets
  - 3. Hangers and Supports
- B. Related Sections
  - 1. Section 15080 - Mechanical Insulation

## 1.2 REFERENCES

- A. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) for the Hot-Dip Process
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM A666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. SMACNA – Thermoset FRP Duct Construction Standards.

## 1.3 SUBMITTALS

- A. Product data and installation instructions for materials and products.
- B. Scaled layout drawings of ductwork and fittings including but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how these modifications ensure that free area, materials and rigidity are not reduced. Provide a legend defining all abbreviations used.
- C. Maintenance data and parts lists for ductwork materials and products.
- D. Duct Leakage Test Areas: Submit ductwork shop drawing showing locations of duct system as installed. Identify locations of duct leakage testing areas. Refer to Part 3 of this Section for quantity and test location requirements.
- E. Duct leakage test and cleanliness inspection reports.

## 1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of metal products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.
- B. Installer's Qualifications - Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.
- C. Codes and Standards
  - 1. SMACNA Standards - Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
  - 2. SMACNA Standards - Comply with SMACNA's Thermoset FRP Duct Construction Standards.
  - 3. ASHRAE Standards - Comply with ASHRAE Handbook, HVAC Systems and Equipment, Chapter 16 "Duct Construction", for fabrication and installation of ductwork.
  - 4. NFPA Compliance - Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".
- D. Field Reference Manual - Have available for reference at project field office, copy of the following references:
  - 1. SMACNA "HVAC Duct Construction Standards, Metal and Flexible."
  - 2. SMACNA "Thermoset FRP Duct Construction Manual."

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

## PART 2 PRODUCTS

### 2.1 METAL DUCTWORK

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Aluminum Ducts: Comply with ASTM B209.
  - 1. Aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

2. Finish: Mill finish for concealed ducts and standard, one-side bright finish for surfaces exposed to view.
- C. Stainless Steel Ducts: Comply with ASTM A 480/A 480M.
1. Type 304 or 316 as indicated in the "Ductwork Schedule"
    - a. Cold rolled, annealed sheet.
    - b. Finish: No. 2B finish for concealed ducts and No. 3 finish for exposed ducts.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 METAL DUCTWORK MATERIALS

- A. General - Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Fittings - Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.
- C. Flexible Ducts - Either spiral-wound spring steel with flame-proof vinyl sheathing, or corrugated aluminum; complying with UL 181.
1. Where installed in unconditioned spaces other than return air plenums, provide 2 inch thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

## 2.3 METAL DUCT FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards). Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide [airfoil]

turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, or mastic plus embedded fabric systems.
  - 1. Sealants and Mastics: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
  - 2. Tape is not acceptable.
- H. Sealing products shall bear UL approval markings.

#### 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Solvent-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Base: Synthetic rubber resin.
  - 3. Solvent: Toluene and heptane.
  - 4. Solids Content: Minimum 60 percent.
  - 5. Shore A Hardness: Minimum 60.

6. Water resistant.
  7. Mold and mildew resistant
  8. Maximum Static-Pressure Class: 10-inch wg positive or negative.
  9. Service: Indoor or outdoor.
  10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
- 1) Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  - 2) EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  2. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.
- G. Tape type sealants are not acceptable.

## 2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Hot-dipped galvanized G60 steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with cold galvanizing compound after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Hot-dipped galvanized steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.



- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 2. Supports for Aluminum Ducts: Aluminum or galvanized steel painted with cold galvanizing compound.
- I. Beam clamps: hot-dipped galvanized steel with set screw and lock nut. Use jam nut with threaded rod. Spring steel snap-on or hammer-on type are not acceptable.

### PART 3 EXECUTION

#### 3.1 INSPECTION

- A. General - Examine areas and conditions under which ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

#### 3.2 DUCTWORK SCHEDULE:

- A. Duct material: All ductwork shall be Aluminum unless noted otherwise on Drawings or as follows,
  - 1. Desiccant Dehumidifier, reactivation air exhaust Ducts: 316 or 304 stainless steel
- B. Static Pressure Class: Unless noted otherwise, construct ducts according to the following:
  - 1. Ducts connected to constant-volume air handling units:
    - a. Supply Ducts (Positive Pressure): 2" w.g.
    - b. Return Ducts (Negative Pressure): 2" w.g.
    - c. Outdoor-air Ducts: (Negative Pressure): 2" w.g.
  - 2. Exhaust Ducts (Negative Pressure):
    - a. Ducts exhausting ASHRAE 62.1 Class 1 and 2 air: 2" w.g.
    - b. Reactivation Air intake and exhaust Ducts: 2" w.g.

#### 3.3 INSTALLATION OF DUCTWORK

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts according to SMACNA's "Thermoset FRP Duct Construction Manual"

- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3 inches w.c. and under) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connection, within 1/2 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.
- F. Inserts - Install concrete inserts for support of ductwork in coordination with formwork.
- G. Support design and installation shall be in accordance with applicable Building Codes.
- H. Field Fabrication - Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- I. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system
- J. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations, or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment.
- K. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- L. Install ducts close to walls, overhead construction, and other structural and permanent enclose elements of building.
- M. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- N. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- O. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- P. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 15820 "Ductwork Accessories" for fire and smoke dampers.
- Q. For penetrations in fire rated walls and ceilings, provide fire dampers and fire stops to maintain the fire rating of the wall or ceiling. For penetrations in non-fire rated ceilings, provide fire blocking around the ducts.

- R. Coordination - Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- S. Ductwork Insulation – Insulate ductwork in accordance with Section 15080.

### 3.4 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.5 EQUIPMENT CONNECTIONS

- A. General - Connect ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated, or as required to provide access for cleaning ducts.

### 3.6 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. All ducts shall be "Seal Class A".

### 3.7 HANGERS AND SUPPORTS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Comply with SMACNA's "Thermoset FRP Duct Construction Standards," Chapter 8, "Hangers and Supports."
- C. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- D. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- E. Hangers Exposed to View: Threaded rod and angle or channel supports.
- F. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- G. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used

### 3.8 FIELD QUALITY CONTROL

- A. Visually inspect duct system to ensure that no visible contaminants are present
- B. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- C. Provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris at ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation.
- D. Seal any leaks in ductwork that become apparent in balancing process.
- E. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
1. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- F. Duct system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.9 LEAKAGE TESTING

- A. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
- B. Test the following systems:

1. Desiccant system air ducts with a Pressure Class Higher Than 2-Inch wg: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
3. Test for leaks before applying external insulation.
4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
5. Give seven days' advance notice to Owner and Engineer for testing.

### 3.10 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.
  2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.
  7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  6. Provide drainage and cleanup for wash-down procedures.
  7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris

END OF SECTION

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## SECTION 15820

## DUCTWORK ACCESSORIES

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Volume dampers
  - 2. Automatic Control Dampers - Metal
  - 3. Turning vanes
  - 4. Duct hardware
  - 5. Duct access doors
  - 6. Flexible connections

## 1.2 QUALITY ASSURANCE

- A. Manufacturers' Qualifications - Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Code and Standards:
  - 1. SMACNA Compliance - Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible"
  - 2. Industry Standards - Comply with ASHRAE recommendations pertaining to construction of ductwork, accessories, except as otherwise indicated.
  - 3. UL Compliance - Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
  - 4. NFPA Compliance - Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

## 1.3 SUBMITTALS

- A. Technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- C. Manufacturer's maintenance data including parts lists for each type of duct accessory.
- D. As specified in Section 01330, submit certifications regarding all iron or steel products that all manufacturing processes occurred in the US.

**PART 2 PRODUCTS****2.1 VOLUME DAMPERS**

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Splitter Dampers:
  - 1. Material: Same material and gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.
  - 2. Blade: Fabricate of single or double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  - 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
  - 4. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.
- D. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.
- E. Quadrants:
  - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
  - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
  - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
- F. Manufacturer - Subject to compliance with requirements, provide dampers of one of the following:
  - 1. Air Balance, Inc.
  - 2. Airguide Corp.
  - 3. Louvers & Dampers, Inc.
  - 4. McGill Airflow Corp.
  - 5. Nailor Industries
  - 6. Penn Ventilator Co.
  - 7. Ruskin Mfg. Co.
  - 8. Or equal

**2.2 AUTOMATIC CONTROL DAMPERS - METAL**



- A. General: Automatic control dampers may also be referred to as motorized dampers in the Contract Documents.
- B. Manufacturers:
  - 1. Greenheck
  - 2. McGill Airflow Corporation
  - 3. Nailor Industries
  - 4. Ruskin Company
  - 5. Tamco
  - 6. Or equal
- C. Performance: Test in accordance with AMCA 500.
- D. Dampers used for modulating service shall be opposed blade type and arranged for normally open or normally closed operation as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
- E. Dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
- F. Frames: Galvanized steel, extruded aluminum or stainless steel to match duct material, welded or riveted with corner reinforcement, minimum 16 gauge (0.06”).
- G. Blades: Galvanized steel, extruded aluminum or stainless steel to match duct construction, secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade, maximum blade length of 48 inches, minimum 22 gauge (0.03”), attached to minimum 1/2 inch shafts with set screws.
- H. Damper linkage hardware shall be constructed of aluminum or corrosion-resistant zinc and nickel-plated steel:
  - 1. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Install bearing support bracket and drive blade pin extension. Provide permanent visible indication of blade position.
  - 2. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts shall be milled with at least one side flat to avoid slippage.
  - 3. Damper manufacturer shall supply alignment plates for multi-section dampers.
- I. Provide stiffening rods or bracing for frame sections over 48” high.
- J. In Class 1 areas, dampers shall be constructed per AMCA Spark A or B standards.
- K. Blade Seals: Close cell neoprene mechanically attached, field replaceable.
- L. Jamb Seals: Stainless steel spring.

- M. Outside Air, Exhaust Air, Stairway, and Shaft Vent Damper Leakage: Class 1 motorized, maximum leakage rate of 4.0 cfm per square foot at 1.0 inches wg pressure differential when tested in accordance with AMCA 500D.
- N. Other Damper Leakage: Less than one percent based on approach velocity of 2000 fpm and 4 inches wg.
- O. For low-leakage applications, use parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4 inches wg. when the damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.
- P. Maximum Pressure Differential: 6 inches wg.
- Q. Temperature Limits: - 40 to 200 degrees F.
- R. Dampers shall be full size of duct or wall opening damper is serving.

### 2.3 TURNING VANES

- A. Manufactured Turning Vanes - Provide turning vanes constructed in accordance with SMACNA requirements.
- B. Turning vanes shall be an engineered, true airfoil design with smoothly-rounded entry nose and extended trailing edge for high efficiency performance.
- C. Fabricate assemblies with side rail support system. Install vanes 2.4” on center across the full diagonal dimension of the elbow. Secure each vane with ring shank screws, two on each end for no-rattle assembly. Tabbed or slotted dimple fasteners are not acceptable.
- D. Vanes and rails shall be fabricated from hot-dipped galvanized G60 steel.
- E. Manufacturer - Subject to compliance with requirements, provide turning vanes by one of the following:
  - 1. Aero-Dyne Sound Control Co.
  - 2. General Insulation Company, Inc.
  - 3. Ductmate Industries, Inc.

### 2.4 DUCT HARDWARE

- A. General - Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
  - 1. Test Holes - Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
  - 2. Quadrant Locks - Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 inches. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
- B. Manufacturer - Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.
3. United Sheet Metal
4. Or equal

## 2.5 DUCT ACCESS DOORS

- A. General - Provide where indicated or required, duct access doors of size indicated.
- B. Construction - Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle-type latch for doors 12 inches high and smaller, 2 handle-type latches for larger doors. Material of construction shall match ductwork.
- C. Manufacturer - Subject to compliance with requirements, provide duct access doors of one of the following:
  1. Air Balance, Inc.
  2. Duro Dyne Corp.
  3. Register & Grille Mfg. Co., Inc.
  4. Ruskin Mfg. Co.
  5. Ventfabrics, Inc.
  6. Zurn Industries, Inc.; Air Systems Div.
  7. Or equal

## 2.6 FLEXIBLE CONNECTORS

- A. General - Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: provide flexible connectors with a factory fabricated fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  1. Minimum Weight: 26 oz./sq. yd.
  2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg F.

- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd.
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.
- F. Manufacturer - Subject to compliance with requirements, provide flexible connections of one of the following:
  - 1. American/Elgen Co., Energy Div.
  - 2. Duro Dyne Corp.
  - 3. Flexaust (The) Co.
  - 4. Ventfabrics, Inc.
  - 5. Or equal

### PART 3 EXECUTION

#### 3.1 INSPECTION

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

#### 3.2 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.
- C. Access Doors
  - 1. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter. Install at the following locations,
    - a. Spaced every 50 feet of straight duct.
    - b. Upstream of each elbow.
    - c. Before and after each automatic control damper.
  - 2. Access Door Sizes:
    - a. Square Ducts: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

- b. Round Ducts: Install minimum 8 inches in diameter for hand access, 18 inch for head and shoulder access, 24 inches for body access, and as indicated on Drawings.
- D. Provide volume dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- E. Sheet metal contractor shall install all motorized control dampers.
- F. Provide test holes at fan inlets and outlets and elsewhere as required for testing and balancing purposes.
- G. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

### 3.3 FIELD QUALITY CONTROL

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

### 3.4 ADJUSTING AND CLEANING

- A. Adjusting - Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
  - 1. Label access doors in accordance with Division 15 section "Mechanical Identification".
  - 2. Final positioning of manual dampers is specified in Division 15 section "Testing, Adjusting, and Balancing".
- B. Cleaning - Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

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## SECTION 15850

## AIR OUTLETS AND INLETS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Duct registers and grilles
  - 2. Wall Registers.
  - 3. Rain Resistant Stationary Louvers

## 1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards
  - 1. ARI Compliance - Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
  - 2. ASHRAE Compliance - Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
  - 3. ADC Compliance - Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
  - 4. ADC Seal - Provide air outlets and inlets bearing ADC Certified Rating Seal.
  - 5. AMCA Compliance - Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
  - 6. AMCA Seal - Provide louvers bearing AMCA Certified Rating Seal.
  - 7. NDPA Compliance - Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

## 1.3 SUBMITTALS

- A. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
- B. Data sheets for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, mounting details and warranty.
- C. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

- D. Manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- E. Maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

#### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Diffusers, Registers, & Grilles
  - 1. Price Industries
  - 2. Krueger
  - 3. Titus Products Div; Phillips Industries, Inc.
  - 4. Metal-Aire
  - 5. Or equal
- B. Louvers
  - 1. Construction Specialties, Inc.
  - 2. Greenheck
  - 3. Louvers & Dampers, Inc.
  - 4. Ruskin Company
  - 5. Or equal

#### 2.2 DUCT REGISTERS AND GRILLES

- A. General - Provide manufacturer's standard duct registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as required.
- B. Performance - Provide duct registers and grilles sized to provide the cfm indicated and to fit in the duct where shown.
- C. Fabrication: extruded aluminum or stainless steel with baked enamel finish. Refer to Diffuser Schedule for material. Color shall be selected by Architect or Owner.
- D. Duct compatibility - Provide registers and grilles of materials and components, and finish compatible with the duct.

### 2.3 WALL REGISTERS

- A. General - Except as otherwise indicated, provide manufacturer's standard wall registers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated.
- B. Performance - Provide wall registers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- C. Wall Compatibility - Provide registers with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to Drawings for types of wall construction which will contain each type of wall register.
- D. Types - Provide wall registers of type, capacity, and with accessories and finishes as listed on register schedule. The following requirements shall apply to nomenclature indicated on schedule:
  - 1. Register Materials
    - a. Aluminum Construction - Manufacturer's standard extruded aluminum frame and adjustable blades.
  - 2. Register Faces
    - a. Horizontal Straight Blades - Horizontal blades, individually adjustable, at manufacturer's standard spacing.
    - b. Vertically Straight Blades - Vertical Blades, individually adjustable, at manufacturer's standard spacing.
  - 3. Register Patterns
    - a. Double Deflection - 2 sets of blades in face, rear set at 90 degrees to face set.
  - 4. Register Dampers
    - a. Opposed Blade - Adjustable opposed blade damper assembly, key operated from face of register.
  - 5. Register Accessories
    - a. Extractor - Curved blades mounted on adjustable frame to produce air scooping action in duct at register take-off.
    - b. Operating Keys - Tools designed to fit through register face and operate volume control device and/or pattern adjustable.
  - 6. Register Finishes
    - a. Aluminum Anodize - Aluminum etched and anodized, covered with clear lacquer finish.

### 2.4 RAIN RESISTANT STATIONARY LOUVERS



- A. General – Except as otherwise indicated, provide manufacturer’s standard rain resistant stationary louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated.
- B. Performance – Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer’s current data, complying with louver schedule
- C. Substrate Compatibility – Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to Drawings for types of substrate which will contain each type of louver.
- D. Louvers shall possess stationary vertical blades designed to prevent the penetration of wind driven rain. Louver blades shall be contained within a 7-inch frame. Extended sill shall be provided to capture and drain water to exterior of building. Louver components (heads, jambs, sill and blades) shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 5 ft. and shall withstand a wind load of 20 lbs. per sq. ft. (equivalent of a 90 mph wind).
- E. Louvers shall be extruded 6063T5 aluminum alloy construction as follows:
  - 1. Frame: 0.125-inch wall thickness, caulking surfaces provided.
  - 2. Blades: 0.091-inch wall thickness, installed vertically on approximately 1-inch centers.
  - 3. Extended Sill: 0.081-inch wall thickness, with upturned side panels to prevent water leakage.
  - 4. Screen: 1/2-inch by 0.063-inch square mesh aluminum bird screen in removable frame.
  - 5. Color: Match color of building exterior. Verify final color selection with owner.

**PART 3 EXECUTION**

**3.1 INSPECTION**

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. General - Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

**END OF SECTION**

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## SECTION 15910

## DIRECT-DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section includes control equipment and software.
- B. Related Sections:
- C. Related Sections:
  - 1. Section 15935 - HVAC Control Systems.
  - 2. Section 15951 – HVAC Variable Frequency Drives
  - 3. Section 16060 - Grounding and Bonding
  - 4. Section 16075 - Electrical Identification
  - 5. Section 16120 – Conductors and Cable
  - 6. Section 16131 - Conduits
  - 7. Section 16136 - Boxes
  - 8. Section 16220 - AC Motors
- D. Commissioning
  - 1. This project will be commissioned. Refer to the Commissioning specification(s) for information and responsibilities of the Testing and Balancing Contractor.

## 1.2 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI MC85.1 - Terminology for Automatic Control.

## 1.3 SYSTEM DESCRIPTION

- A. Automatic temperature controls shall be a field monitoring and control system using field programmable microprocessor-based units with communications to Building Automation and Control System.
- B. The system shall be based on a distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Provide control systems equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified in the Contract Documents.
- E. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Indicate the following:
  - 1. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
  - 2. Connected data points, including connected control unit and input device.
  - 3. System graphics showing monitored systems, data (connected and calculated) point addresses, and operator notations.
  - 4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
  - 5. Description and sequence of operation for operating, user, and application software.
  - 6. Use terminology in submittals conforming to ASME MC85.1.
- B. Product Data: Submit data for each system component and software module.
- C. Manufacturer's Installation Instructions: Submit installation instruction for each control system component.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Submit a statement that the submitted products are the most current model. not obsolete, and not currently published to be phased-out.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Section 01770 – Closeout Procedures: Requirements for submittals.
- B. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
  - 1. Revise shop drawings to reflect actual installation and operating sequences.
  - 2. Submit data specified in "Submittals" in final "Record Documents" form.
- C. Operation and Maintenance Data:
  - 1. Submit administrative username and password to the Owner. Username and password shall not be changed by the installing contractor after project closeout.
  - 2. Submit interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
  - 3. Submit keyboard illustrations and step-by-step procedures indexed for each operator function.
  - 4. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of Project.

- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience, approved by manufacturer.

#### 1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.8 WARRANTY

- A. Section 01770 – Closeout Procedures: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for direct digital controls.

#### 1.9 MAINTENANCE SERVICE

- A. Section 01770 - Closeout Procedures: Requirements for maintenance service.
- B. Furnish service and maintenance of control systems for one year from Date of Substantial Completion.
- C. Furnish complete service of controls systems, including callbacks. Make minimum of one complete normal inspection in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.
- D. Furnish two complete inspections per year under warranty, one in each season, to inspect, calibrate, and adjust controls. Submit written report after each inspection. Schedule inspections with Owner.
- E. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- F. Perform work without removing units from service during building normal occupied hours.
- G. Provide emergency call back service during working hours for this maintenance period.
- H. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- I. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.
- J. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

### PART 2 PRODUCTS

#### 2.1 GENERAL

- A. Products that are obsolete or are in the process of being phased out by the manufacturer are not acceptable. Confirm prior to submittal that all products submitted on are the most current product available and are not scheduled to be phased out. If at any time, through the end of the warranty period it is discovered that the products provided were listed on a publication at the time of the submittal indicating that the products were obsolete or in the process of being phased out, the installing Contractor shall replace them at no additional cost. Other system modifications

required to integrate the replaced equipment shall also be provided at no additional cost. The warranty period for all replaced equipment shall start when the new equipment is fully installed and operational.

**B. System Architecture**

1. The top level LAN shall be BACnet over IP.
2. The second level LAN shall be BACnet over MS/TP for applications requiring low bandwidth, otherwise provide BACnet over Ethernet.

C. Turn over administrative username and password to Owner. Owner shall have full access to system without assistance from manufacturer or installing Contractor.

**2.2 DIRECT DIGITAL CONTROLS**

**A. Manufacturers:**

1. Alerton Inc.
2. Automated Logic Corp., WebCTRL
3. Johnson Controls, Inc., Facility Explorer
4. Siemens Building Technologies Inc., Talon
5. Automated Logic Corporation, WebCTRL
6. Johnson Controls, Inc., Metasys
7. Siemens Building Technologies Inc., APOGEE
8. Or equal

**2.3 CONTROL UNITS**

A. Units: Modular and expandable in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.

**B. Control Units Functions:**

1. Monitor or control each input/output point.
2. Completely independent with hardware clock/calendar and software to maintain control independently.
3. Acquire, process, and transfer information to operator station or other control units on network.
4. Accept, process, and execute commands from other control unit's or devices or operator stations.
5. Access both data base and control functions simultaneously.
6. Record, evaluate, and report changes of state or value occurring among associated points. Continue to perform associated control functions regardless of status of network.
7. Perform in stand-alone mode:
  - a. Start/stop.

- b. Duty cycling.
  - c. Automatic Temperature Control.
  - d. Event initiated control.
  - e. Calculated point.
  - f. Scanning and alarm processing.
  - g. Full direct digital control.
  - h. Trend logging.
  - i. Global communications.
  - j. Maintenance scheduling.
- C. Global Communications:
- 1. Broadcast point data onto network, making information available to other system controls units.
  - 2. Transmit input/output points onto network for use by other control units and use data from other control units.
- D. Input/output Capability:
- 1. Discrete/digital input (contact status).
  - 2. Discrete/digital output.
  - 3. Analog input.
  - 4. Analog output.
  - 5. Pulse input (5 pulses/second).
  - 6. Pulse output (0-655 seconds in duration with 0.01-second resolution).
- E. Monitor, control, or address data points. Include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs. Furnish control units with minimum 30 percent spare capacity.
- F. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
- G. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard-wired LAN or 60 seconds over voice grade phone lines.
- H. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
- 1. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from workstation.
  - 2. Control output points but change only database state or value; leave external field hardware unchanged.

3. Enable control-actions on output points but change only data base state or value.
- I. Local display and adjustment panel: Provide with each control-unit, a door mounted digital display, with touchscreen. Display and adjust:
    1. Input/output point information and status.
    2. Controller set points.
    3. Controller tuning constants.
    4. Program execution times.
    5. High and low limit values.
    6. Limit differential.
    7. Set/display date and time.
    8. Control outputs connected to the network.
    9. Automatic control outputs.
    10. Perform control unit diagnostic testing.
  - J. Points in "Test" mode.
  - K. Web accessible display and adjustment panel. Display and adjust:
    1. Input/output point information and status.
    2. Controller set points.
    3. Controller tuning constants.
    4. Program execution times.
    5. High and low limit values.
    6. Limit differential.
    7. Set/display date and time.
    8. Control outputs connected to the network.
    9. Automatic control outputs.
    10. Perform control unit diagnostic testing.
- 2.4 LOCAL AREA NETWORKS (LAN):
- A. Contact Owner to determine existing bandwidth at site. Coordinate with Owner if existing backbone is to be used or a separate LAN backbone should be provided.
  - B. Furnish communication between control units over local area network (LAN).
  - C. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
  - D. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.



- E. Network Support: Time for global point to be received by any station, less than 3 seconds. Furnish automatic reconfiguration when station is added or lost. In event transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

## 2.5 OPERATING SYSTEM SOFTWARE

### A. Input/output Capability From Operator Station:

1. Request display of current values or status in tabular or graphic format.
2. Command selected equipment to specified state.
3. Initiate logs and reports.
4. Change analog limits.
5. Add, delete, or change points within each control unit or application routine.
6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
7. Add new control units to system.
8. Modify and set up maintenance scheduling parameters.
9. Develop, modify, delete or display full range of color graphic displays.
10. Automatically archive select data even when running third party software.
11. Capability to sort and extract data from archived files and to generate custom reports.
12. Support two printer operations.
13. Alarm printer: Print alarms, operator acknowledgments, action messages, system alarms, operator sign-on and sign-off.
14. Data printer: Print reports, page prints, and data base prints.
15. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
16. Print selected control unit database.

### B. Operator System Access: Via software password with minimum 10 access levels at work station and minimum 3 access levels at each control unit.

### C. Data Base Creation and Support: Use standard procedures for changes. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:

1. Add and delete points.
2. Modify point parameters.
3. Change, add, or delete English language descriptors.
4. Add, modify, or delete alarm limits.
5. Add, modify, or delete points in start/stop programs, trend logs, and other items.
6. Create custom relationship between points.

7. Create or modify DDC loops and parameters.
8. Create or modify override parameters.
9. Add, modify, and delete applications programs.
10. Add, delete, develop, or modify dynamic color graphic displays.

D. Dynamic Color Graphic Displays:

1. Utilizes custom symbols or system supported library of symbols.
2. Sixteen (16) colors.
3. Sixty (60) outputs of real-time live dynamic data for each graphic.
4. Dynamic graphic data.
5. 1,000 separate graphic pages.
6. Modify graphic screen refresh rate between 1 and 60 seconds.

E. Operator Station:

1. Accept data from LAN as needed without scanning entire network for updated point data.
2. Interrogate LAN for updated point data when requested.
3. Allow operator command of devices.
4. Allow operator to place specific control units in or out of service.
5. Allow parameter editing of control units.
6. Store duplicate data base for every control unit and allow down loading while system is on line.
7. Control or modify specific programs.
8. Develop, store and modify dynamic color graphics.
9. Data archiving of assigned points and support overlay graphing of this data using up to four (4) variables.

F. Alarm Processing:

1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.
2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
3. Print on line changeable message, up to 255 characters in length, for each alarm point specified.
4. Display alarm reports on video. Display multiple alarms in order of occurrence.
5. Define time delay for equipment start-up or shutdown.
6. Allow unique routing of specific alarms.

7. Operator specifies when alarm requires acknowledgment.
  8. Continue to indicate unacknowledged alarms after return to normal.
  9. Alarm notification:
  10. Print automatically.
  11. Display indicating alarm condition.
  12. Selectable audible alarm indication.
  13. Built in notification for text and email alarm.
- G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.
- H. Automatic Restart: Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.
- I. Messages:
1. Automatically display or print user-defined message subsequent to occurrence of selected events.
  2. Compose, change, or delete message.
  3. Display or log message at any time.
  4. Assign any message to event.
- J. Reports:
1. Manually requested with time and date.
  2. Long term data archiving to hard disk.
  3. Automatic directives to download to transportable media including floppy diskettes for storage.
  4. Data selection methods to include data base search and manipulation.
  5. Data extraction with mathematical manipulation.
  6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
  7. Generating reports either normally at operator direction, or automatically under workstation direction.
  8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.
  9. Include capability for statistical data manipulation and extraction.
  10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

- K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
- L. Data Collection:
  - 1. Automatically collect and store in disk files.
  - 2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2-year period.
  - 3. Daily consumption for up to 30 meters over a 2 year period.
  - 4. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
  - 5. Archiving of stored data for use with system supplied custom reports.
  - 6. Points forced report.
- M. Graphic Display: Support graphic development on work station with software features:
  - 1. Page linking.
  - 2. Generate, store, and retrieve library symbols.
  - 3. Single or double height characters.
  - 4. Sixty (60) dynamic points of data for each graphic page.
  - 5. Pixel level resolution.
  - 6. Animated graphics for discrete points.
  - 7. Analog bar graphs.
  - 8. Display real time value of each input or output line diagram fashion.
- N. Maintenance Management:
  - 1. Run time monitoring, for each point.
  - 2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
  - 3. Equipment safety targets.
  - 4. Display of maintenance material and estimated labor.
  - 5. Target point reset, for each point.
- O. Advisories:
  - 1. Summary containing status of points in locked out condition.
  - 2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
  - 3. Report of power failure detection, time and date.
  - 4. Report of communication failure with operator device, field interface unit, point and programmable control unit.

## 2.6 LOAD CONTROL PROGRAMS

- A. General: Support inch-pounds and S.I. metric units of measurement.
- B. Automatic Time Scheduling:
  - 1. Self-contained programs for automatic start/stop/scheduling of building loads.
  - 2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
  - 3. Special day's schedule supporting up to 30 unique date/duration combinations.
  - 4. Number of loads assigned to time program; with each load having individual time program.
  - 5. Each load assigned at least 16 control actions for each day with 1 minute resolution.
  - 6. Furnish the following time schedule operations:
    - a. Start.
    - b. Optimized Start.
    - c. Stop.
    - d. Optimized Stop.
    - e. Cycle.
    - f. Optimized Cycle.
  - 7. Capable of specifying minimum of 30 holiday periods up to 100 days in length for the year.
  - 8. Create temporary schedules.
  - 9. Broadcast temporary "special day" date and duration.
  - 10. Group scheduling.
- C. Start/Stop Time Optimization:
  - 1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
  - 2. Adaptive and self-tuning, adjusting to changing conditions unattended.
  - 3. For each point under control, establish and modify:
    - a. Occupancy period.
    - b. Desired temperature at beginning of occupancy period.
    - c. Desired temperature at end of occupancy period.
- D. Night Setback/Setup Program: Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
- E. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.
  - 1. Employ arithmetic, algebraic, Boolean, and special function operations.
  - 2. Treat calculated values like any other analog value; use for any function where a "hard wired point" might be used.

- F. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.
  - 1. Define time interval between each control action between 0 to 3600 seconds.
  - 2. Output may be analog value.
  - 3. Provide for "skip" logic.
  - 4. Verify completion of one action before proceeding to next action. When not verified, program capable of skipping to next action.
  
- G. Direct Digital Control: Furnish with each control unit Direct Digital Control software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.
  - 1. Control loops: Defined using "modules" are analogous to standard control devices.
  - 2. Output: Paired or individual digital outputs for pulse width modulation, and analog outputs.
  - 3. Firmware:
    - a. PID with analog or pulse-width modulation output.
    - b. Floating control with pulse-width modulated outputs.
    - c. Two-position control.
    - d. Primary and secondary reset schedule selector.
    - e. Hi/Low signal selector.
    - f. Single pole double-throw relay.
    - g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
  - 4. Direct Digital Control loop: Downloaded upon creation or on operator request. On sensor failure, program executes user defined failsafe output.
  - 5. Display: Value or state of each of lines interconnecting DDC modules.
  
- H. Fine Tuning Direct Digital Control PID or floating loops:
  - 1. Display information:
    - a. Control loop being tuned.
    - b. Input (process) variable.
    - c. Output (control) variable.
    - d. Set-point of loop.
    - e. Proportional band.
    - f. Integral (reset) Interval.
    - g. Derivative (rate) Interval.

2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" versus "variable".

I. Trend logging:

1. Each control unit capable of storing samples of control unit's data points.
2. Update file continuously at operator assigned intervals.
3. Automatically initiate upload requests and then stores data on hard disk.
4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
5. Co-ordinate sampling with specified on/off point- state.
6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

## 2.7 HVAC CONTROL PROGRAMS

A. General:

1. Support Inch-pounds and S.I. metric units of measurement.
2. Identify each HVAC Control system.

B. Optimal Run Time:

1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
4. Use outside air temperature to determine early shut down with ventilation override.
5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
6. Operator commands:
  - a. Define term schedule.
  - b. Add/delete fan status point.
  - c. Add/delete outside air temperature point.
  - d. Add/delete mass temperature point.
  - e. Define heating/cooling parameters.
  - f. Define mass sensor heating/cooling parameters.
  - g. Lock/unlock program.
  - h. Request optimal run-time control summary.
  - i. Request optimal run-time mass temperature summary.

- j. Request HVAC point summary.
- k. Request HVAC saving profile summary.
- 7. Control Summary:
  - a. HVAC Control system begin/end status.
  - b. Optimal run time lock/unlock control status.
  - c. Heating/cooling mode status.
  - d. Optimal run time schedule.
  - e. Start/Stop times.
  - f. Selected mass temperature point ID.
  - g. Optimal run-time system normal start-times.
  - h. Occupancy and vacancy times.
  - i. Optimal run time system heating/cooling mode parameters.
- 8. Mass temperature summary:
  - a. Mass temperature point type and ID.
  - b. Desired and current mass temperature values.
  - c. Calculated warm-up/cool-down time for each mass temperature.
  - d. Heating/cooling season limits.
  - e. Break point temperature for cooling mode analysis.
- 9. HVAC point summary:
  - a. Control system identifier and status.
  - b. Point ID and status.
  - c. Outside air temperature point ID and status.
  - d. Mass temperature point ID and status.
  - e. Calculated optimal start and stop times.
  - f. Period start.
- C. Supply Air Reset:
  - 1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
  - 2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
    - a. Raising cooling temperatures to highest possible value.
    - b. Reducing heating temperatures to lowest possible level.



3. Operator commands:
  - a. Add/delete fan status point.
  - b. Lock/unlock program.
  - c. Request HVAC point summary.
  - d. Add/Delete discharge controller point.
  - e. Define discharge controller parameters.
  - f. Add/delete air flow rate.
  - g. Define space load and load parameters.
  - h. Request space load summary.
4. Control summary:
  - a. HVAC control system status (begin/end).
  - b. Supply air reset system status.
  - c. Optimal run time system status.
  - d. Heating and cooling loop.
  - e. High/low limits.
  - f. Deadband.
  - g. Response timer.
  - h. Reset times.
5. Space load summary:
  - a. HVAC system status.
  - b. Optimal run time status.
  - c. Heating/cooling loop status.
  - d. Space load point ID.
  - e. Current space load point value.
  - f. Control heat/cool limited.
  - g. Gain factor.
  - h. Calculated reset values.
  - i. Fan status point ID and status.
  - j. Control discharge temperature point ID and status.
  - k. Space load point ID and status.
  - l. Airflow rate point ID and status.

**D. Enthalpy Switchover:**

1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
2. Operator commands:
  - a. Add/delete fan status point.
  - b. Add/delete outside air temperature point.
  - c. Add/delete discharge controller point.
  - d. Define discharge controller parameters.
  - e. Add/delete return air temperature point.
  - f. Add/delete outside air dewpoint/humidity point.
  - g. Add/delete return air dewpoint/humidity point.
  - h. Add/delete damper switch.
  - i. Add/delete minimum outside air.
  - j. Add/delete atmospheric pressure.
  - k. Add/delete heating override switch.
  - l. Add/delete evaporative cooling switch.
  - m. Add/delete air flow rate.
  - n. Define enthalpy deadband.
  - o. Lock/unlock program.
  - p. Request control summary.
  - q. Request HVAC point summary.
3. Control summary:
  - a. HVAC control system begin/end status.
  - b. Enthalpy switchover optimal system status.
  - c. Optimal return time system status.
  - d. Current outside air enthalpy.
  - e. Calculated mixed air enthalpy.
  - f. Calculated cooling coil enthalpy using outside air.
  - g. Calculated cooling coil enthalpy using mixed air.
  - h. Calculated enthalpy difference.
  - i. Enthalpy switchover deadband.
  - j. Status of damper mode switch.

## 2.8 PROGRAMMING APPLICATION FEATURES

### A. Trend Point:

1. Output trend logs as line-graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern or color, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

### B. Alarm Messages:

1. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totaled point's warning limit, hardware elements advisories.
2. Output assigned alarm with "message requiring acknowledgment".
3. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

### C. Weekly Scheduling:

1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.
2. Program times for each day of week, for each point, with one minute resolution.
3. Automatically generate alarm output for points not responding to command.
4. Allow for holidays.
5. Operator commands:
  - a. System logs and summaries.
  - b. Start of stop point.
  - c. Lock or unlock control or alarm input.
  - d. Add, delete, or modify analog limits and differentials.
  - e. Adjust point operation position.
  - f. Change point operational mode.
  - g. Open or close point.
  - h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
  - i. Begin or end point totals.
  - j. Modify total values and limits.
  - k. Access or secure point.
    - l. Begin or end HVAC or load control system.
  - m. Modify load parameter.
  - n. Modify demand limiting and duty cycle targets.

6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:

1. Permit events to occur, based on changing condition of one or more associated master points.
2. Binary contact, high/low limit of analog point or computed point capable of being used as master. Master capable of monitoring or commanding multiple slaves.
3. Operator commands:
  - a. Define single master/multiple master interlock process.
  - b. Define logic interlock process.
  - c. Lock/unlock program.
  - d. Enable/disable interlock process.
  - e. Execute terminate interlock process.
  - f. Request interlock type summary.

## 2.9 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with,

1. Section 16120 - Conductors and Cable
2. Section 16131 - Conduit
3. Section 16136 - Boxes
4. Section 16075 - Electrical Identification
5. Section 16060 - Grounding and Bonding
6. Motors shall conform to the requirements of Section 16220 - AC Motors.

B. Disconnect Switches: Factory-mounted on each control panel/device.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify conditioned power supply is available to control units and to operator workstation.
- B. Verify field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

### 3.2 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 15940.

- C. Install with 120 volts alternating current, 15 amp dedicated emergency power circuit to each programmable control unit.
- D. Install conduit and electrical wiring in accordance with Section 16120 and 16131.
- E. Install electrical material and installation in accordance with appropriate requirements of Division 16.

### 3.3 MANUFACTURER'S FIELD SERVICES

- A. Section 01450 - Quality Control: Manufacturers' field services.
- B. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.
- C. Furnish service technician employed by system installer to instruct Owner's representative(s) in operation of systems plant and equipment for a 3 day period.

### 3.4 DEMONSTRATION AND TRAINING

- A. Section 01770 - Closeout Procedures: Requirements for demonstration and training.
- B. Furnish basic operator training for person(s) on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of [40] hours instructor time. Furnish training on site.
- C. Demonstrate complete and operating system to Owner.

END OF SECTION

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## SECTION 15935

## INSTRUMENTATION AND CONTROL FOR HVAC

## PART 1 GENERAL

## 1.1 SUMMARY

## A. General Requirements

1. Provide all materials, engineering, and labor for the proper installation of a complete and operational control system.
2. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified in the Contract Documents.
3. Provide 120 volt power for all HVAC control panels and devices requiring 120 volts from electrical power panels. Spare circuit breakers will be provided in electrical power panels as part of the Division 16 Work. Coordinate with the Division 16 Contractor and Electrical Engineer to determine the location of the 120 volt power source(s).
4. Step down the 120 volt power and provide 24 volts or less for all control devices, unless control devices require 120 volt power per the Contract Documents.
5. Install and wire all loose control devices provided with HVAC equipment, i.e. fan EC motor controllers, wall mounted speed switches, etc.
6. Provide all electrical components in accordance with Division 16 requirements, including but not limited to conductors, cables, conduit, hangers and supports, identification, boxes, and enclosures.

## B. Section Includes

1. Control Valves
2. Damper and Valve Actuators
3. Low Temperature Detection
4. Thermostats
5. Sensors and Transmitters
6. Switches
7. Duct Mounted Smoke Detectors
8. Timers and Clocks
9. Control Panels
10. Control wiring between field-installed controls, indicating devices, and unit control panels

11. Interlock wiring specified as factory-installed
- C. Related Sections
  1. Section 15735 - Packaged Rooftop Air Conditioning Units
  2. Section 15750 - Humidity Control Equipment
  3. Section 15910 - Direct Digital Controls
  4. Section 15951 - HVAC Variable Frequency Drives
  5. Division 16 - Electrical
- D. Commissioning
  1. This project will be commissioned. Refer to the Commissioning specification(s) for information and responsibilities of the Testing and Balancing Contractor.

## 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. National Fire Protection Association:
  1. NFPA 72 - National Fire Alarm Code.
  2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- C. Underwriters Laboratories, Inc.:
  1. Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories, Inc.

## 1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications -
  1. Firms regularly engaged in manufacture of electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
  2. Location of manufacturer's approved service facilities, located within 50 miles of the project.
- B. The Control Systems Contractor Qualifications - Firms specializing and experienced in electrical control system installations for not less than 5 years.

## 1.4 SUBMITTALS

- A. Manufacturer's technical product data for each control device, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.
- B. Shop drawings for each electric control system, containing the following information.

1. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and control devices.
  2. Label each control device with setting or adjustable range of control.
  3. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  4. Provide details of faces of control panels, including controls instruments, and labeling.
  5. Include description of sequence of operation.
- C. Provide point schedule for each controller. Include point description, system served, location of device being controlled, device product information.
- D. Submit a list of all spaces requiring temperature sensors and thermostats and identify the model of sensor and/or thermostat provided for each room.
- E. Product Data: Submit description and engineering data for each control system component, including sensitivity ranges, means of adjustment and calibration, its function and application. Include sizing as required.
- F. Maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.
- G. Submit circuit coordination information for review by Engineer and Contractor, indicating electrical circuit requirements, loads, etc for control system. Provide copy of final electrical circuit requirements to Division 16 Contractor for use in preparing electrical panels serving controls system.
- H. Submit software manual to Owner. Manual shall include:
1. Overview of system and a description of each feature.
  2. Operational instructions including verifying status and errors, changing passwords, and initiating or disabling control programs/sequences.
  3. Description of programming language including commands, algorithms, system printouts and logs.
  4. Documentation necessary for Owner to interpret program and make desired changes.
  5. Instructions for user programming any portion of the control system including algorithms, variables, setpoints, time periods, equations and other user adjustable settings.

## 1.5 COORDINATION

- A. Coordinate location of thermostats, switches, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment from other divisions including to achieve compatibility with equipment that interfaces with those systems.

## 1.6 DELIVERY, STORAGE AND HANDLING



- A. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside, protected from weather.
- B. Upon completion of project, submit for review electronic control shop drawings corrected for as-built conditions. Include final pressure settings, spring ranges, temperature ranges, throttling ranges and temperature control settings. Three copies of accepted "record" shop drawings shall be provided to Owner.

#### 1.7 WARRANTY

- A. Provide one year manufacturer warranty for materials and labor.
- B. Provide necessary service to adjust and check the control system, at no additional cost to the Owner, during the one year warranty.
  - 1. This shall include service required to correct space temperature alarms and equipment control problems which are the result of malfunction of control equipment.
- C. This shall include full system checkout and calibration.

### PART 2 PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer - Subject to compliance with requirements, provide electric control systems of one of the following:
  - 1. Control Devices:
    - a. Honeywell, Inc.
    - b. Johnson Controls
    - c. Siemens Building Technologies, Inc.
    - d. Or equal
  - 2. BMS System and Controllers:
    - a. Automated Logic Corp.
    - b. Honeywell, Inc.
    - c. Johnson Controls
    - d. Johnson Controls, Metasys
    - e. Siemens Building Technologies, Inc.
    - f. Siemens Talon
    - g. Or equal

#### 2.2 GENERAL

- A. Provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide control systems with following functional and construction features as indicated.
- B. Contract Drawings do not show every control device. Specifications shall be the primary source of control requirements and unless specifically stated, every piece of heating and cooling equipment shown on Contract Drawings requires control through the BMS system.
- C. Control system shall be complete, to provide a fully functional system, including, but not limited to:
  - 1. Room, insert and immersion thermostats and sensors.
  - 2. Transmitters and relays.
  - 3. Control Dampers.
  - 4. Control Panels.
  - 5. Digital controllers.
  - 6. Transmission power supply.
  - 7. Control wiring and conduit.
  - 8. Auxiliary devices and accessories.
  - 9. Interface with fire alarm system.
  - 10. Building communication network interface and associated software.
- D. Provide 120 V power wiring to ATC control panels, 24 volt control wiring to control devices, and conduit, junction boxes, relays, transformers, fittings and other electrical appurtenances that are required for complete and operational control and monitoring systems. Conform to electrical standards, codes and requirements specified under Division 16 . This work shall include, but not be limited to:
  - 1. Power wiring of ATC temperature control panels carrying voltages up to and including 120 V.
  - 2. Wiring of 24 V from temperature control CPUs to digital controllers, switches, sensors, thermostats, and other control system equipment and devices.
  - 3. Wiring required for interfacing with building fire alarm panels, security panels and power generator systems; including wiring between ATC panels and said panels.
  - 4. Wiring of devices controlled as part of the work of this Division.
  - 5. Wiring of devices providing control inputs. Examples include smoke detector contact; fire alarm relay contact; pressure, temperature, limit level and motion switches.
  - 6. Wiring from temperature control panel to terminal strips.
  - 7. Wiring between panel terminal strips and field mounted devices.

8. Wiring of communication cables:
  - a. Provide network devices and wiring between DDC controllers, BMS head end, BMS LAN, and building network. Coordinate with Owner for the exact location of the data jack, and network configuration.
- E. Electrical Conduit and Tubing:
  1. Refer to specification 16131 for all conduit, tubing, and fitting material and application requirements.
  2. Exposed wiring is not permitted.
  3. Refer to specification 16131 and 16070 for all conduit supports requirements. Refer to specification 16136 for all electrical box requirements.
- F. Power wiring installed and terminated as part of the DIVISION 16, shall include,
  1. Wiring of devices and circuits carrying voltages 120 volts or greater, unless otherwise indicated.
  2. Wiring of power feeds to disconnects, starters, VFDs and electric motors.
- G. Transmission Network
  1. System shall have mulitdrop digital transmission network that provides a communication link between operator's terminal and all DDC panels.
  2. System shall have error checking feature to ensure signal reliability and shall identify signal transmission network failures. System shall ensure signal quality and strength and support mulit-drop trunks.
  3. Wiring shall NOT be run in same conduit with fire alarm, security, lighting, building power or other dedicated systems.
- H. Refer to the Electrical drawings and specifications for room classifications (i.e. "wet", "damp", "wet/corrosive", "Class 1", etc.) and required materials and equipment NEMA ratings. Room classifications noted on the Electrical drawings supersede noted classifications on the HVAC drawings.

### 2.3 DAMPER ACTUATORS

- A. Manufacturers:
  1. Belimo (Basis of Design)
  2. Honeywell
  3. Siemens
  4. or equal
- B. Quality Assurance for Actuators:
  1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.

2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting. Provide explosion proof enclosure for actuators located in Class 1 spaces as identified on HVAC or Electrical Drawings.
  3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
- C. Execution Details for Actuators:
1. Provide a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
  2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DDC as an analog input for true actuator position status.
  3. Primary valve control shall be analog (2 - 10VDC, 4 - 20mA).
- D. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).
1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
- E. Electronic Damper and Valve Actuators: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve.
1. Coupling: V-bolt and V-shaped, toothed cradle.
  2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
  4. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.
  5. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.
  6. A pushbutton gearbox release shall be provided for non-spring actuators.
  7. Actuators shall have the ability to be tandem mounted.

8. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
9. Power Requirements
  - a. Two-Position Spring Return: 24V ac or dc, Maximum 10VA.
  - b. Modulating: 24V ac or dc, Maximum 15 VA.
10. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
11. Temperature Rating: -22°F to 140°F.
12. Run Time: 200 seconds open, 40 seconds closed.
13. All actuators shall have a 5-year warranty.
14. Dampers:
  - a. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.
  - b. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
  - c. Failsafe:
    - 1) Outside air and exhaust air damper actuators shall be mechanical spring return and fail closed unless otherwise specified.
  - d. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
  - e. Electric damper actuators shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
  - f. One electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
  - g. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft-mounted per damper section
  - h. Size for running torque calculated as follows:
    - 1) Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.

- 2) Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
- 3) Dampers with 2 to 3 Inches wg. of Pressure Drop or Face Velocities of 1000 to 2500 FPM Multiply the minimum full-stroke cycles above by 1.5.
  - i. Spring Return Manual Override actuators shall have a factory set 5 Degree Damper Preload.

#### 2.4 LOW TEMPERATURE DETECTION

- A. Provide low temperature protection thermostats in air systems as shown on drawings. Thermostats shall be two position snap-acting, and either manual or automatic reset as indicated.
- B. Thermostat capillary shall have a length long enough to adequately cover the device and shall be installed in serpentine fashion downstream from coil it is protecting per the manufacturer's recommendations.
  1. Each square foot of coil shall be protected by a section of thermostat capillary.
  2. Where large coil size or multiple coil construction exceeds the limit of coverage of one unit, provide additional units placed in series so that coil area coverage is maintained.
- C. Upon detecting a coil leaving temperature below its setpoint, thermostat shall stop fan, close outside air damper.
- D. An alarm shall be sent to the BMS indicating a freezestat trip.

#### 2.5 THERMOSTATS

- A. Low Voltage Room Thermostats:
  1. Power: 24 Vac with battery backup.
  2. Service: Cooling only, heating only, or cooling and heating.
  3. Covers: Locking with set point adjustment.
  4. Display: Large, clear display with backlight and real-time clock.
  5. Operating ambient temperatures: 0° F to 120° F.
  6. Humidity Rating: 5% to 90% RH.
  7. Setpoint Range:
    - a. Cooling: 50° F to 99° F.
    - b. Heating: 40° F to 90° F.
  8. Changeover: Auto or manual, selectable. Set to auto.
  9. Programmable:
    - a. Seven day with holidays.

- b. Two occupied and two unoccupied daily settings.
- B. Room Thermostat Accessories:
  - 1. Thermostat Covers: Brushed aluminum.
  - 2. Insulating Bases: For thermostats located on exterior walls.
  - 3. Thermostat Guards: Metal mounted on separate base.
  - 4. Adjusting Key: Matching device.
  - 5. Aspirating Boxes: for thermostats requiring flush installation.
- C. Corrosion Resistant Thermostats – Provide a NEMA 4X rated thermostat in corrosive, unrated spaces. Refer to Contract Documents to identify spaces considered corrosive.

## 2.6 ROOM SENSORS

- A. Simple Wall Sensors (Process Areas):
  - 1. Digital with LCD display, day-night override button, and set point slide adjustment override options. Set point slide adjustment capable of being software limited by automation system to limit amount of room adjustment. Measure and display temperature and relative humidity. Sensing elements shall meet the requirements of the “intelligent room sensors” section below.
- B. Intelligent, room temperature and humidity sensor with touchscreen:
  - 1. Hardware
    - a. Room sensor shall include:
      - 1) Backlit touchscreen LCD digital display
      - 2) Temperature sensor
      - 3) Humidity sensor
      - 4) Programmable Status Light indicator
      - 5) BACnet MS/TP communication up to 115.2kbps
    - b. Temperature sensor shall be a Uni-Curve Type II thermistor with an accuracy of +/- 0.36 °F at calibration point over the range of 32 to 158 °F or better.
    - c. Humidity sensor shall have an accuracy of +/-3% from 10 to 90% relative humidity (RH) or better, non-condensing.
    - d. The intelligent room sensor’s Status Light indicator shall have a minimum of four (4) colors (blue, red, amber and green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. Or if not available with inboard LED, a separate wall devise shall be provided to indicated four (4) colors (blue, red, amber and green) that will illuminate adjacent to sensor. The color and on/off state of the Status Light indicator shall be fully programmable. Color coding as follows

- 1) Blue: Cooling mode
  - 2) Amber: Heating Mode
  - 3) Green: Unoccupied
  - 4) Red: Alarm
- e. The user shall interact with the smart sensor using a touchscreen, with no buttons allowed.
- f. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.
- g. The touchscreen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
- h. Controller shall function as room control unit, and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.
2. Display Content
- a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.
- b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temperature to customize the view for the customer.
- c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Celsius.
- d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
- e. Information about the version of firmware shall be displayable on the LCD screen.
- f. A cleaning mode will be provided to allow for the touchscreen to be cleaned without inadvertently making changes to system parameters.
- g. After Hours Override shall:
- 1) Override time may be set and viewed in 30-minute increments.
  - 2) Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor.
  - 3) Time remaining shall be displayed.
  - 4) Display shall show the word “OFF” in unoccupied mode unless a function button is pressed.
3. Other Modes



- a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed-protected with a configurable PIN number.
  - b. Field Service Mode shall allow access to common parameters as dictated by the application's sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
  - c. If the intelligent room sensor is connected to VAV controller, Balance Mode shall allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
4. Intelligent Room Sensor shall be in compliance of the following:
- a. UL Standard for Safety 916
  - b. FCC Part 15.107 & 109, Class B, CFR47-15
  - c. EMC Directive 89/336/EEC (European CE Mark)
- C. Temperature Sensor, wall mount:
1. Thermoplastic ventilated enclosure, brushed aluminum face plate and mounting plate.
  2. Solid state RTD, platinum, 1k ohm.

## 2.7 SENSORS AND TRANSMITTERS

- A. Temperature Sensors:
1. General:
    - a. All temperature sensors shall be solid-stated, electric, interchangeable with housing appropriate for the application.
    - b. Display accuracy and resolution: minimum of plus or minus 1 degree F.
    - c. Built-in communications port.
  2. Outside Air Temperature Sensors:
    - a. Type: Thermistor, watertight inlet fitting with shield from direct sunlight.
    - b. Range: -30 – 140 degree F.
    - c. Accuracy: +/- 0.36 degrees F, at calibration point.
  3. Duct Averaging Temperature Sensors:
    - a. Type: Rigid probe or copper element, thermistor or RTD and temperature transmitter, well-insertion.

- b. Range: -30 – 140 degree F, with a factory calibration point of 77 degrees F.
  - c. Accuracy: +/- 0.36 degrees F, at calibration point.
  - d. Duct Cross Sections Greater Than 10 square feet: Serpentine averaging element to sense stratified air temperatures.
  - e. Install so the sensing element is in the middle of the main air stream within 10' of the unit discharge and before any branch duct take-offs.
- B. Relative Humidity Duct Mounted Sensor:
- 1. Sensing Range: 20 to 80 percent.
  - 2. Accuracy of plus or minus 5 percent relative humidity.
  - 3. Field selectable output of 0-10 Vdc, 0-5 Vdc, or 4-20 mA.
- C. Outdoor Air Humidity Sensors:
- 1. Sensing Range: 20 to 95 percent relative humidity.
  - 2. Suitable for ambient conditions of minus 40 to 170 degrees F.
  - 3. Accuracy: Plus or minus 2 percent relative humidity at 77 degrees.
  - 4. Field selectable output of 0-10 Vdc, 0-5 Vdc, or 4-20 mA.
  - 5. Element guard.
  - 6. Mounting plate.
- D. Differential Pressure Switches:
- 1. Sensor shall have field selectable outputs of 0-5 VDC, 0-10 VDC, and 4-20 mA
  - 2. Where specified, sensor shall have and LCD display that displays measured value.
  - 3. Sensor accuracy shall be plus or minus 1% FS selected range.
  - 4. Scale range and differential suitable for intended application.
  - 5. Fully adjustable differential pressure settings.
  - 6. UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum).
  - 7. NEMA 250 Type 1 enclosure.
- E. Current Sensors
- 1. Scale sensors so that average operating current is between 20-80% full scale.
  - 2. Accuracy plus or minus 1.0% (5-100% full scale)
  - 3. Operating frequency 50-600 Hz.
  - 4. Operating Temperature 5-104 deg. F ( -15 – 40 deg. C), Operating Humidity 0-95% non-condensing

5. Approvals CE, UL.
- F. SPDT Relay with Enclosure
1. General Requirements:
    - a. Operating Temp. Range: -29 to 131 °F (-34 to 55 °C)
    - b. Operating Humidity Range: 10 to 90% RH non-condensing
    - c. Relay status: LED ON=energized
    - d. Insulation Class: 600 Vac RMS
    - e. Agency Approvals: UL 508
  2. Coil Performance
    - a. 24V: 75 mA, 32 mA
    - b. 120V: 42 mA
    - c. 208V: 36 mA
    - d. 277V: 49ma
  3. Contactor Rating:
    - a. 20A @ 277 VAC, 28 VDC
  4. Wire Specifications:
    - a. Lead Length: 14" (356 mm).
    - b. Gauge: UL1015; Coil: 18 AWG; Contacts: 12 AWG
- G. Aqua-stat Pipe Mounted
1. Description: SPDT temperature control that uses a liquid-filled sensing element and capillary.
  2. Setpoint Adjust: Screwdriver slot or knob
  3. Sensor: Liquid-filled bulb and capillary
  4. Approval: UL Listed File #E6688, CSA
- H. Water Detector Sensor
1. Supply Voltage: 11-27 VAC at 1.7 VA; 11-27 VDC at 30 mA
  2. Relay Type: SPDT
  3. Relay Rating: 1 A at 24 VAC/VDC, 1/2 A at 120 VAC
  4. Display: Green LED = Power; Red LED = Alarm
  5. Probe: Gold plated, 1.5" adjustable Operating
  6. Temperature range: 32° to 158°F (0° to 70°C)

7. Enclosure Rating: NEMA 4, Cast aluminum, weather resistant with adjustable legs
  8. Dimensions 4.3"H X 3.75"W X 4.5"L (10.7 X 9.5 X 11.4 cm) Weight 0.98 lb (6.44 Kg)
  9. Approvals CE
- I. Air Pressure Sensing Switch (for fan shutdown - over-pressurized ducts)
1. UL approved
  2. Adjustable Range: 0.40 +/- 0.06" w.c. to 12" w.c.
  3. Maximum pressure: 0.5 PSI
  4. Electrical rating: ½ A @ 125 VDC
  5. Manual reset
  6. Sample tube connection: ¼" OD for rigid and semi rigid tubing
    - a. Provide adaptor for ¼" ID flexible tubing.
  7. Provide tubing size based on total length, per manufacturer's recommendations.

## 2.8 DUCT MOUNTED SMOKE DETECTORS

- A. For buildings with a fire alarm system:
1. As part of Division 16: Furnish duct mounted smoke detectors.
  2. Install duct smoke detectors as indicated on the Contract Drawings. Install remote test station in a location where occupants can access without the use of a ladder and can clearly see the device without the removal of access panels, ceiling tiles, etc. Coordinate location of test station in field.
- B. Provide wiring from smoke detectors to air handling system so that, when a duct mounted smoke detector senses smoke, the system shall:
1. Indicate alarm to DDC system.
  2. Stop associated system's supply and return fan. Return fans functioning as a smoke-control system shall not stop the respective fan.
  3. When the supply and the return fans are proven off:
    - a. Close associated system's outside air intake and exhaust dampers.
    - b. Report damper status to DDC system.

## 2.9 CONTROL PANELS

- A. Provide for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face. All lights shall be LED.s
- B. Construction: Refer to Division 16.

- C. Covers: Continuous hinge, held closed by flush latch operable by screwdriver or key (common key for all panels).
- D. Enclosure Finish: Manufacturer's standard enamel.
- E. Master control panel shall have multi-color graphic displays, schematically showing system being controlled.
- F. Provide spare dry form C alarm contacts.

## 2.10 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Conform to electrical requirements in Division 16 specifications.
- B. Disconnect Switch: Factory mount disconnect switch on control panels.

## PART 3 EXECUTION

### 3.1 INSPECTION

- A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

### 3.2 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

- A. General - Install systems and materials in accordance with manufacturer's instructions and roughed-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division 16 sections of these specifications. Mount controllers at convenient locations and heights.
- B. Control Wiring - The term "control wiring" is defined to include providing wire as per Section 16120, conduit as per Section 16131 and miscellaneous materials as required for mounting and connecting electric control devices.
- C. Wiring System - Install complete control wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along a common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.
- D. Number-code and color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.
- E. Reset Limit Controls - Install manual-reset limit controls to be independent of power controllers; automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.
- F. Unit-Mounted Equipment - Where control devices are indicated to be unit-mounted, ship electric relays, electric switches, valves, dampers, and damper motors to unit manufacture for mounting and wiring at factory.
- G. Room thermostats and wall mounted sensors:

1. Install in locations as indicated on the drawings and to meet the intent of the sequence of operations.
  2. Mount 48" above finished floor.
- H. Duct sensors – Install sensing element in the main air stream, a minimum of 24" of straight duct prior to sensor in the direction of flow.
- I. Immersion sensors – Install in wells provided by control contractor. Fill wells with thermal compound before installation of immersion sensor.
- J. Outside air temperature sensors – Install a minimum 10' away from exhaust and relief vents. Do not install in an outside air duct or in a location that is in the shade most of the day.

### 3.3 ADJUSTING AND CLEANING

- A. Start-Up - Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Cleaning - Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment - After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this Section.

### 3.4 CLOSEOUT PROCEDURES

- A. Owner's Instructions - Provide services of manufacturer's technical representative for one 8-hour day to instruct Owner's personnel in operation and maintenance of electric control systems.
1. Schedule instruction with Owner, provide at least 7-day notice to Contractor and Engineer of training date.
  2. Record a video of the training and provide a video recording of the training to the owner within 10 days of the training.
  3. Duct Smoke Detector Training:
    - a. Train Owner how to test operation of duct smoke detectors. Inform Owner they must be tested annually.

END OF SECTION

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## SECTION 15940

## HVAC SEQUENCE OF OPERATION

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section includes sequences for HVAC systems and equipment. All control devices, components, wiring, etc. shall be provided to execute the sequence of operations listed in the Contract Documents.
- B. Operating equipment, devices, and system components required for control systems are specified in other Division 15 sections of these Specifications.
- C. HVAC control system shall be a DDC system with Bacnet protocol. All setpoints shall be adjustable through the DDC system.
- D. Coordinate with Section 15950 - Testing, Adjusting, and Balancing to test and balance equipment at each setpoint specified for each sequence of operation.
- E. Section Includes
  - 1. Operating sequence for HVAC equipment and systems
  - 2. Operating equipment, devices, and system components required for control systems are specified in other Division 15 sections of these Specifications.
- F. Related Sections
  - 1. Section 15910 – Direct Digital Controls
  - 2. Section 15935 – HVAC Control Systems
  - 3. Section 15950 – Testing, Adjusting and Balancing
  - 4. Section 15951 – HVAC Variable Frequency Drives
  - 5. Division 16 – Electrical
- G. Commissioning
  - 1. This project will be commissioned. Refer to the Commissioning specification(s) for information and responsibilities of the Testing and Balancing Contractor.

## 1.2 SUBMITTALS

- A. Shop Drawings - Submit shop drawings for each system automatically controlled, containing the following information:
  - 1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
  - 2. Submit flow diagrams for each control system, graphically depicting control logic.

3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
  4. Indicate conduit, factory and field wiring.
  5. Indicate each control panel required, with internal and external conduit and wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling.
- B. Closeout Submittals
1. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

## PART 2 PRODUCTS

### 2.1 BMS NETWORK

- A. All digital controllers shall be connected to a universal network controller located in the Mechanical Room or as shown on the drawings. The main controller shall have graphics for the building.
- B. Dynamic color graphics shall be provided. Graphics shall include real point display and direct software communication for setpoint and program override.
- C. Network shall be web accessible. IP drop shall be furnished in the Mechanical Room by Division 16. Division 15 shall connect HVAC Control Panel to IP drop. All setpoints shall be user adjustable via the web.
- D. All space sensors located in supervised areas shall have user setpoint adjustment (+/- 3°F) and pushbutton override to enable occupied mode. Time of day scheduling and space temperature adjustment for each supervised area shall be adjustable through the BMS.
- E. Space sensors/thermostats in unsupervised areas shall have full temperature adjustment.

### 2.2 COMPONENTS

- A. Provide all control components necessary to operate the equipment as specified herein. All controls shall be electric or self-contained. Refer to entire specification for additional components and sequences. Control components to include dampers, control valves, thermostats/temperature sensors, actuators, sensors, switches, wiring and conduit.
- B. Provide control panels containing the switches, lights for monitored points, alarm lights, etc. for all equipment.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Electrical equipment, wiring, conduit and controls shall conform to the requirements of the Division 16 specifications.



- B. Provide controls, including wiring for the HVAC equipment in accordance with the following sequences of operation.
1. Sequences of operation in this Section are written in performance-based plain language, and do not specify all required control loops, delays, dead bands, and other parameters and settings necessary for smooth and reliable operation. Provide all necessary programming and controls tuning for smooth and reliable operation, and to maximize occupant comfort.
  2. All setpoints, delays, and similar parameters shall be adjustable.
  3. Monitor speed and current draw of all fans. If current is too low or high, or if speed does not match command, provide an alarm to the BMS.
  4. Monitor discharge pressure of all AHU fans to serve as a proxy for airflow. If airflow is too low or high, provide an alarm to the BMS.
  5. All motorized dampers shall be proven open before the associated fan is permitted to operate. If the damper fails to open, provide an alarm to the BMS and do not permit the fan to operate. If position does not match the command, provide an alarm to the BMS.
  6. If any heating or cooling coil fails to meet the temperature setpoint, provide an alarm to the BMS.
  7. Monitor differential pressure at each filter bank for each AHU above 2,000 cfm. If pressure is too high, provide an alarm to the BMS.
  8. Provide trending for all data points, with 15 minute frequency or better for 30 days, and 1 hour frequency for 1 year. Use change in value thresholds where possible to reduce storage requirements.
- C. Provide up to 8 hours of labor to make revisions to the sequence of operations as directed by the Engineer to adjust the control of system components to satisfy owner requirements after equipment installation.

### 3.2 SEQUENCE OF OPERATION – DUCT SMOKE DETECTOR

1. Upon a detection of smoke from the duct mounted smoke detector,
  - a. Indicate alarm to BMS.
  - b. Stop the associated supply fan.
  - c. Close outside air intake damper.
2. Provide a manual switch to reset smoke detector, open outside air intake damper, and to turn the unit back on.

END OF SECTION

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## SECTION 15950

## TESTING, ADJUSTING, AND BALANCING FOR HVAC

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes, but not limited to:
  - 1. Balancing Air Systems.
  - 2. Testing, Adjusting, and Balancing Equipment:
    - a. Fans
    - b. Motors.
  - 3. Duct leakage tests.
  - 4. Measuring electrical performance of HVAC equipment.
  - 5. Verifying control system sequence of operations and coordination with the ATC contractor.
- B. Related Sections:
  - 1. Section 15940 – HVAC Sequence of Operations

## 1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

## 1.3 SUBMITTALS

- A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- C. Deficiency reports.
- D. Certified TAB reports.
- E. Floor plans with all test locations circled in bold red marker. Note duct and piping sizes on the floor plans if they differ from the design drawings.

- F. Floor plans noting where balancing devices (dampers, valves, etc.) are not installed per the contract documents. Refer to HVAC details for balancing device locations.
- G. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

#### 1.4 QUALITY ASSURANCE

- A. Installing contractor may not test and balance their own work. An independent TAB Contractor is required.
- B. TAB Specialists Qualifications: Certified by AABC, NEBB or TABB.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TAB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

#### 1.5 FIELD CONDITIONS

- A. Full or Partial Owner Occupancy: Owner may occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

#### PART 2 PRODUCTS (NOT APPLICABLE)

#### PART 3 EXECUTION

##### 3.1 GENERAL

- A. Test and balance all sequences of operation and operating conditions specified in the sequences of operation for all equipment. Coordinate with the HVAC system controls contractor for this effort.

##### 3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems to observe if the installed systems may create adverse effects on airflow or water flow performance. Submit observation Deficiency Report to Engineer and Owner. Do not begin testing, adjusting, and balancing of any systems until deficiencies have been remedied.

- C. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible. If there are inadequate devices or are not easily accessible, notify project Engineer in writing.
- D. Examine the approved submittals to obtain flow rates and balancing values for HVAC systems and equipment.
- E. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, statements of philosophies and assumptions about HVAC system and equipment controls, and sequences of operations.
- F. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required. If any deficiencies exist, notify project Engineer in writing.
- G. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
    - a. Document locations in systems where system effects may cause undesired conditions. Submit locations to project Engineer.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- H. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- I. Examine test reports specified in individual system and equipment Sections.
- J. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- K. Examine motorized dampers to ensure installed damper type matches the control requirement. Report any deviations.
  - 1. Opposed blade dampers shall be used for modulating flow.
  - 2. Parallel blade dampers shall be used for open/close flow.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures to project Engineer. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values. Report if no deficiencies are discovered.

### 3.3 PREPARATION

- A. Prepare a complete TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. All sequences to be tested.
  - 3. Strategies and step-by-step procedures for balancing the systems.
    - a. Note minimum and maximum duct traverse test points and test point distance spacing for varying duct sizes.
  - 4. Instrumentation to be used.
  - 5. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Windows and doors are installed. All windows shall be shut and locked. All exterior doors shall be shut, with only normal traffic in and out. All interior doors in rooms served by systems being tested shall be closed and remain closed for the duration of the test.
    - i. Suitable access to balancing devices and equipment is provided.

### 3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance"
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch and seal probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. Install, join, and seal new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 15080 "Mechanical Insulation".

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in the "Ducts" specification.
- L. Adjust VFDs to properly balance the system.

### 3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. The procedures in this article apply to constant volume supply, return, and exhaust air systems.
- B. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and exhaust-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

- e. Set and measure other outside-air, return air, and exhaust air dampers for proper position that simulates other outdoor air conditions as specified in the sequence of operations.
2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Measure outlet static pressure as far downstream from the fan as practicable, at least three-quarters of the way down the system.
    - e. Report artificial loading of filters at the time static pressures are measured.
  3. Obtain approval from Engineer or Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- D. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- E. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Re-adjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

### 3.7 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Phase and hertz.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter size and thermal-protection-element rating.
  8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.8 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  1. Verify temperature control system is operating within the design limitations.
  2. Confirm that the sequences of operation are in compliance with Contract Documents.
  3. Verify that controllers are calibrated and function as intended.
  4. Verify that controller set points are as indicated.
  5. Verify the operation of lockout or interlock systems.
  6. Verify the operation of valve and damper actuators.
  7. Verify that controlled devices are properly installed and connected to correct controller.
  8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.



- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions. Report airflows for all sequences.

### 3.9 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Air Systems:
    - a. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to +10 percent.
    - b. Air Outlets and Inlets: +/- 10 percent.
      - 1) Laboratories: Maintain airflow rate differential within +/-10 percent
  - 2. Hydronic Systems: +/- 10 percent
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.10 FINAL REPORT

- A. General: Prepare a certified computer written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.

6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Design versus final performance. Design values shall be recorded from the approved equipment submittals.
    - b. Notable characteristics of systems, including suspect duct, piping, and equipment installations causing high system pressure drop.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.

6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit, Makeup air unit, and DOAS unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  3. Test Data (Designed and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Filter static-pressure differential in inches wg.
    - f. Preheat-coil static-pressure differential in inches wg.

- g. Cooling-coil static-pressure differential in inches wg.
  - h. Heating-coil static-pressure differential in inches wg.
  - i. Outdoor airflow in cfm.
  - j. Return airflow in cfm.
  - k. Outdoor-air damper position.
  - l. Return-air damper position.
  - m. Vortex damper position.
4. Identify critical zone used to set AHU static pressure setpoint.
- F. Apparatus-Coil Test Reports:
- 1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.
    - g. Face area in sq. ft.
    - h. Tube size in NPS.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  - 2. Test Data (Designed and Actual Values):
    - a. Airflow rate in cfm.
    - b. Average face velocity in fpm.
    - c. Air pressure drop in inches wg.
    - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    - e. Return-air, wet- and dry-bulb temperatures in deg F.
    - f. Entering-air, wet- and dry-bulb temperatures in deg F.
    - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    - h. Water flow rate in gpm.
    - i. Water pressure differential in feet of head or psig.
    - j. Entering-water temperature in deg F.

- k. Leaving-water temperature in deg F.
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig.
  - n. Refrigerant suction temperature in deg F.
  - o. Inlet steam pressure in psig.
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btu/h.
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Airflow rate in cfm.
    - i. Face area in sq. ft.
    - j. Minimum face velocity in fpm.
  - 2. Test Data (Designed and Actual Values):
    - a. Heat output in Btu/h.
    - b. Airflow rate in cfm.
    - c. Air velocity in fpm.
    - d. Entering-air temperature in deg F.
    - e. Leaving-air temperature in deg F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.

- e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
- a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Designed and Actual Values):
- a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone. Note location on floor plans.
    - c. Traverse air temperature in deg F.
    - d. Quantity of traverse reading points for each test location.
    - e. Duct static pressure in inches wg.
    - f. Duct size in inches.
    - g. Duct area in sq. ft.
    - h. Indicated airflow rate in cfm.
    - i. Indicated velocity in fpm.

- j. Actual airflow rate in cfm.
  - k. Actual average velocity in fpm.
  - l. Barometric pressure in psig.
- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  - 2. Test Data (Designed and Actual Values):
    - a. Airflow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.
- K. Instrument Calibration Reports:
- 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.11 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner, Architect, Engineer, Construction Manager, or commissioning authority.
- B. Owner, Architect, Engineer, Construction Manager, or Commissioning authority will randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, Owner, Engineer, or Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

### 3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

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## SECTION 15951

## HVAC VARIABLE FREQUENCY DRIVES (VFDs)

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Variable frequency drives (VFDs) for HVAC equipment.

## B. Related Sections

1. Section 15700 – Basic Heating, Ventilation and Air Conditioning Requirements
2. Section 15910 – Direct Digital Controls
3. Section 15935 - HVAC Control Systems
4. Division 16 – Electrical

## 1.2 REFERENCES

- A. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Variable Speed Drive Systems.
- B. NFPA 70 – National Electrical Code (NEC)
- C. IEEE 519 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

## 1.3 SUBMITTALS

- A. Shop drawings, product data, wiring diagrams and reports
- B. Equipment ratings, include voltage & current
- C. Operation and Maintenance Data
  1. Submit instruction manuals with recommended maintenance procedures and intervals, installation, operation and programming information.

## 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store drive in a heated, dry, non-corrosive location in original shipping carton to prevent damage.

## PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. ABB
- B. Eaton
- C. Square D
- D. Allen-Bradley

- E. Siemens
- F. or equal

## 2.2 AC VARIABLE FREQUENCY DRIVE

- A. VFDs for HVAC shall be furnished and installed under this Section. Power circuiting for VFDs shall be by Division 16; control wiring and conduit shall be by Division 15 (in accordance with Division 16 requirements).
- B. The variable frequency AC drive shall convert 3 phase, 60 hertz input power to an variable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The converter shall use a diode bridge rectifier to convert incoming AC power to a constant DC voltage bus. The inverter section shall be a voltage source design with a sine-weighted pulse-width modulated output. The output voltage is to vary proportionally with the output frequency to maintain a constant volts/hertz value up to 60 hz.
- C. The VFD shall be UL or ETL listed.
- D. Include in the controller, power conversion components, power control logic devices and regulator circuitry. Provide full digital control of frequency and voltage.
- E. Provide VFDs large enough to handle the nameplate full load current of the installed motor; do not select VFDs based solely on motor HP. Verify the nameplate full load current of the installed motor and provide the appropriately sized VFD for the installed motor.
- F. The VFD shall be rated for 100% continuous current, 110% current for one minute.
- G. The drive shall also include as functional components: capacitors for DC bus, single control logic board, terminal blocks for connection of incoming power, motor terminations, operator controls and transient suppressor.
- H. Include motor current overload protection.
- I. Provide keypad for display and control.
- J. Provide 3% line reactor (pre-wired/integral).
- K. Each VFD enclosure shall be suitable for use in the specific environment in which it is being installed. Location environment ratings shall be as shown on the Electrical Drawings. If no environment rating is listed on the Electrical Drawings, then the enclosure shall be NEMA 12.
- L. Provide integral disconnect switch.
- M. Provide communication card to interface VFD with HVAC control system. Coordinate with Controls Contractor to determine proper card required.
- N. Equipment Ampere Interrupting Capacity (Short Circuit Current Rating): VFD Ampere Interrupting Capacity (AIC) or Short Circuit Current Rating (SCCR) rating shall meet or exceed the minimum requirements specified in 15700.

## 2.3 ADJUSTABLE DRIVE FUNCTIONS

- A. Frequency Accuracy  $\pm 0.5\%$ .

- B. Operating Frequency Range Output: 0-60 Hz.
- C. Variable Acceleration and Deceleration Times: 0.1-1600 seconds.
- D. Lower Limit Frequency Adjustment: 0-60 Hz.
- E. Upper Limit Frequency Adjustment: 0-60 Hz.

#### 2.4 VARIABLE DRIVE CONTROLS

- A. Speed control, start/stop control, local/remote control on keypad.
- B. Remote speed adjustment from 4-20 mA or 0-10VDC (as required) control signal.
- C. Remote start/stop.
- D. Drive run and stop indicating lights.
- E. Contact closures for external indication of drive running and overload/fail.
- F. Any/all other controls and devices required to meet Division 15 specifications.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. VFD equipment shall be either an integral part of the HVAC equipment, and/or wall mounted in view of the HVAC equipment and/or in the nearest room (coordinate location with the General/Electrical Contractor), unless otherwise shown on the drawings.
- B. Install VFDs with NEC-required clearances and with no equipment below the VFD.
- C. Power wiring shall be installed in separate raceways, separated from control wiring, and shall not be installed in a common enclosure (other than in the VFD enclosure).
- D. Provide services of a factory trained technician for startup and training, a minimum of one day per type of drive installed, per location.

END OF SECTION

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**DIVISION 16 - ELECTRICAL**

## SECTION 16050

## BASIC ELECTRICAL REQUIREMENTS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Basic Electrical Requirements specifically applicable to Division 16 Sections
  - 2. As-Built Documentation
- B. Related Sections
  - 1. Section 01140 – Work Restrictions
  - 2. Section 01770 - Closeout Procedures
  - 3. Section 16080 - Electrical Testing
- C. ASCE 7-10 – Minimum Design Loads for Buildings and Other Structures
- D. International Building Code – IBC 2015
- E. NFPA 70 - National Electrical Code
- F. NFPA 79 – Electrical Standard for Industrial Machinery
- G. ANSI/ISA-S5.4 – Instrument Loop Diagrams

## 1.2 SUBMITTALS

- A. Submit shop drawings, product data, and reports.
- B. Submit as-built documentation in accordance with Section 01770. I&C documentation shall conform to the latest versions of NFPA 79 and ANSI/ISA-S5.4.
- C. Submit a written warranty.
- D. Seismic restraint details including stamped certification from a professional engineer.
- E. Provide a schedule of all Electrical system related Owner training, within one month of the Notice to Proceed. Prior to training, resubmit schedule if training is rescheduled and resubmit upon completion of all training. At a minimum, for each piece of equipment or system to be demonstrated, the schedule should include the following:
  - 1. Equipment or system to be demonstrated
  - 2. Related specification section
  - 3. Anticipated date of training
  - 4. Anticipated duration of training session
  - 5. Name and company of instructor providing the training

6. Date completed
  7. Actual duration of training session
- F. Submit a Sequence of Construction for the demolition and installation of equipment with restrictions listed in this document and 01140. Sequence of Construction shall be updated during construction (if changes are required) and resubmitted for comment.

### 1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Code.
- B. Conform to applicable Local Building Codes.
- C. Obtain and pay for all applicable permits.
- D. Schedule and pay for all inspections necessary for the electrical installation including but not necessarily limited to the general electrical inspection and fire department inspections.

### 1.4 PROJECT CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Engineer before proceeding.
- C. Location of electrical equipment, devices, and similar items, as indicated, are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is different from those indicated (greater than 5 feet away from location shown on Drawings), the Engineer must give approval to the change.
- D. Verify in field, existing conditions and final locations of equipment installed under other Sections that require electrical work.
- E. Where it is necessary to core a hole through an existing concrete slab or wall, the Contractor shall conduct a survey with a pachometer or by similar means to identify the location of steel reinforcing bars. The new hole shall be located so as to avoid cutting reinforcing bars. Where reinforcing steel is close enough together that it is not possible to core the required hole without cutting reinforcing bars, contact the Engineer for further direction before cutting a hole. Where reinforcing bars are cut without the consent of the Engineer, the slab or wall will be repaired at the expense of the Contractor.
- F. Equipment wiring
  1. Equipment power and control wiring is based on specific manufacturers and models. Actual wiring required may be different.
  2. Before pulling any power or control wire or installing conduit, obtain equipment electrical and control installation instructions and wiring diagrams. Any discrepancies from what is shown on the electrical drawings shall be brought to

the attention of the Engineer. The Engineer will provide instructions for any changes that may be necessary.

3. Installation of conduit or wire prior to obtaining the above specified information shall be at the Contractor's risk. The Owner will not be responsible for any extra costs related to removal or replacement of conduit or wire resulting from the failure to coordinate equipment conduit and wire requirements. In the event that additional conductors or larger conductors than shown on the Drawings are required, the Owner will not be responsible for any labor costs related to the installation of these materials unless it can be demonstrated by the Contractor to the satisfaction of the Engineer that these conductors could not have been installed at the same time as the conductors shown on the Drawings.
4. Provide wiring shown on the Drawings unless specifically excluded.

G. Drawings and Specifications

1. Drawings and Specifications are typical of work done and of arrangement desired. Provide accessories and appurtenances necessary for complete installation (e.g., home runs, conduit and wire for instrumentation and control wiring) that are required to provide a complete electrical system.
- H. As-Built Drawings: Maintain a master set of as-built drawings showing the changes and deviations from the Drawings or the approved shop drawings. Make markups as the changes are made.
- I. Where underground electric facilities are installed, measure, record, and submit as built dimensions.

1.5 SEQUENCING AND SCHEDULING

- A. Shutdown quantity and durations shall be minimized and limited to restrictions specified in 01140 Work Restrictions and as described below.
- B. Provide temporary power source(s), motor controller(s), distribution equipment, wiring (power and signal) and conduit as required to keep all equipment operational at all times (except during switchovers), to meet requirements of 01140 011400 Work Restrictions, and to meet requirements described below.
- C. Coordinate shutdown schedule and durations with the Owner.
- D. Install all conduit/wire to the extent feasible prior to shutdowns to minimize outage durations.

1.6 WARRANTY

- A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts and adjustments required due to failure in materials or workmanship within one year from final acceptance of the Work.
- B. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty is in addition to all other warranties existing under either the Contract Documents or required by Law.

## 1.7 SEISMIC REQUIREMENTS

- A. Components, systems and their supports shall be designed by the contractor in accordance with ASCE 7-10, Section 13.6 Mechanical and Electrical Component Design, the 2018 Connecticut State Supplement to the 2015 edition of the International Building Code (IBC 2015).
- B. Submit details showing the seismic restraints.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Products shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA if a listing for that product is available. NRTL shall be Underwriter's Laboratory (UL), Electrical Testing Laboratory (ETL), Factory Mutual (FM) or equal.
- B. Equipment Ampere Interrupting Capacity (AIC) and/or Short Circuit Current Rating (SCCR): Electrical equipment shall be labeled in accordance with NFPA 70 and have an Ampere Interrupting Capacity rating or Short Circuit Current Rating of equal to or greater than the following:
  - 1. 480 volt equipment: 35,000 amps
  - 2. 208 or 240 volt equipment: 10,000 amps where fed from a transformer rated 45KVA or less, otherwise 35,000 amps

### 2.2 FINAL SYSTEM DOCUMENTATION

- A. Prior to final acceptance of the system, provide operating and maintenance manuals (O&M's) covering instruction and maintenance on each type of equipment in accordance with Section 01770.
- B. The requirements for final documentation shall be as specified in Section 01770.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Perform all work in accordance with OSHA (Occupational Safety and Health Administration) requirements.
- B. Perform all work in accordance with NFPA 70E, Handbook for Electrical Safety in the Workplace.
- C. Install all equipment in accordance with manufacturer's instructions and recommendations.
- D. Test all electrical components in accordance with Section 16080 and as indicated in individual electrical equipment specification sections.
- E. Perform all electrical equipment installation, checkout, and test in a safe manner. Provide the following special safety precautions, as appropriate:
  - 1. Locking and tagging procedures



2. Barricades
  3. De-energization and/or isolation of equipment prior to testing
  4. Review of procedures with the Engineer and the Owner
  5. Erection of warning signs
  6. Stationing of guards and watchmen
  7. Maintenance of voice communications
  8. Personnel orientation
- F. Do not install electrical equipment in its permanent location until structures are weather-tight or equipment is properly protected from the weather.
- G. Before energizing any machine, visually inspect for serviceability. Verify that equipment and machines have been properly lubricated and aligned. Verify nameplate for electrical power requirements.

END OF SECTION

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## SECTION 16060

## GROUNDING AND BONDING

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Power system grounding
  - 2. Electrical equipment and raceway grounding and bonding
  - 3. Grounding of piping, tanks, handrails and other conductive equipment
  - 4. Communication system grounding
  - 5. Grounding electrode system three-point test (to be performed by a third-party NETA-certified testing company)
- B. Related Sections
  - 1. Section 16080– Electrical Testing

## 1.2 REFERENCES

- A. NFPA 70 – National Electrical Code
- B. UL 467 - Grounding and Bonding Equipment
- C. UL 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors
- D. UL 1059 – Terminal Blocks
- E. IEEE/ANSI 142 – Latest Edition Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- F. IEEE 837 – Standards for Qualifying Permanent Connections Used in Substation Grounding
- G. ASTM B3 - Solid Conductors
- H. ASTM B8 – Assembly of Stranded Conductors
- I. ASTM B33 – Tinned Conductors
- J. NEMA GR1 – Ground Rods and Ground Rod Couplings

## 1.3 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral and ground bus at the utility service entrance equipment to grounding electrodes. Grounding electrode system shall include a minimum of three driven ground rods, the underground water service pipe, sprinkler service pipe and the metal frame of the building (if effectively grounded). For new construction, the grounding electrode system shall include the rebar in accordance with NEC 250.52(A)(3). Run exposed grounding electrode conductors in conduit.

- B. Ground each separately derived system neutral to the nearest effectively grounded building structural steel member or, if such is not available, to the nearest grounding electrode other than a water pipe.
- C. Provide communications systems grounding conductor at point of service entrance and connect to nearest effectively grounded building structural steel member or, if such is not available, to the nearest grounding electrode other than a water pipe.
- D. Bond together exposed non-current carrying metal parts of electrical equipment, handrails, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, metallic tanks and all metallic piping.
- E. Install grounding in accordance with NEC Article 250.

#### 1.4 SUBMITTALS

- A. Submit shop drawings, product data, and reports.
- B. Indicate layout of ground rods, location of system grounding electrode connections, and routing of grounding electrode conductor.
- C. Submit ground resistance testing reports in accordance with Section 16080.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Grounding Electrode Conductors
  - 1. Type: Medium-hard drawn bare copper
  - 2. Manufacturer
    - a. Okonite Co.
    - b. Rome Cable Corp.
    - c. American Insulated Wire Corp.
    - d. Southwire
    - e. or equal
- B. Grounding Conductors - insulated copper, minimum size #12 AWG and in accordance with NEC Tables 250.66, 250.102(C)(1) and 250.122, or larger if so indicated on the Drawings
- C. Ground Rods: Copper-clad steel,  $\frac{3}{4}$  inch diameter, minimum length 10 feet
- D. Connectors - Mechanical
  - 1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of silicon bronze and supplied as part of the connector body and shall be two bolted pressure types.
3. The connectors shall meet or exceed UL467 and be clearly marked with the catalog number, conductor size and manufacturer.
  - a. Manufacturer
    - 1) ABB Blackburn Installation Products
    - 2) Burndy
    - 3) Ilsco
    - 4) Or equal

E. Connectors - Compression

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.
2. Irreversible compression connectors that meet or exceed the performance requirements of IEEE837, UL467 latest revisions. Compression connectors shall be listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and specific types, sizes and combinations of conductors and other items connected.
3. The irreversible compression connectors shall be manufactured of from pure wrought copper.
  - a. The installation of the connectors shall be made with a hydraulic compression tool and die system clearly showing embossed die stamp on each crimp as recommended by the manufacturer of the connectors
  - b. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size
  - c. Each connector shall be factory filled with an oxide - inhibiting compound where applicable.
4. Manufacturer
  - a. ABB Blackburn Installation Products
  - b. Burndy
  - c. Ilsco
  - d. Or equal

F. Connectors - Welded

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. Exothermic welded connections for copper to copper and copper to steel connections to ground rods, ground buses, ground wires, steel beams etc.
3. Conductors spliced with exothermic welded connections shall be considered as a continuous conductor, as stated in the noted accompanying NEC Article 250.50, 250.64 and IEEE Standard 80 latest edition.
  - a. Procedures outlined in the manufacturer's installation instructions shall be followed. Molds shall not be modified during installation in field applications
  - b. Weld metals shall be a mixture of copper oxide and aluminum. Only one weld metal mixture shall be required for each grounding connection.
  - c. Grounding connections shall be tested and certified in accordance with IEEE837, UL487A and UL 467.
  - d. Manufacturer
    - 1) ABB Furseweld Installation Products
    - 2) Burndy Thermoweld
    - 3) Erico Cadweld
    - 4) Or equal

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Provide a separate, insulated equipment grounding conductor with each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- B. Run all exposed grounding electrode conductors and equipment grounding conductors in conduit.
- C. Use a minimum of #8 AWG copper wire to ground all piping, tanks, handrails and other conductive equipment or structures including ductwork and floor gratings.
- D. Use grounding bushings on all conduits stubbed up below equipment, panelboards, switchboards and motor control centers. Bond all conduits to ground bus. Use grounding bushings to ground electrical equipment and exposed non-current carrying metal parts.
- E. Use the following types of ground connections for the grounding electrode system:
  1. Cable to cable & cable to ground rod: Use compression type
  2. Cable to building structural and reinforcing steel: Use compression type
  3. Cable to piping: Use mechanical type
- F. Supplementary Grounding Electrode: Use effectively grounded metal frame and rebar of the building and ground rods spaced a minimum of 10 feet apart in sufficient quantity to have a measured resistance to ground of not more than 5 ohms.

- G. Use minimum #6 AWG copper conductor for communications service grounding conductor. Leave 10' slack conductor at terminal board.
- H. Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only to service grounding electrode.
- I. Drive ground rods one foot below finished grade.
- J. Ground the water pipe as required by NEC Article 250. Provide a grounding jumper over the water meter as required. Provide a grounding jumper over all meters installed on incoming metallic piping for utility equipment.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation and compliance with NEC Article 250.

### 3.3 TESTING

- A. Perform ground tests using a low resistance, Null balance type, ground testing ohmmeter, with test lead resistance compensated for. Use the type of test instrument which compensates for potential and current rod resistances.
- B. Test the grounding electrode system using a fall of potential three-point test and measure ground resistance. This test shall be performed by a third-party NETA-certified testing company. Submit tabulation of results to the Engineer. Include identification of electrodes, date of reading and ground resistance value in the test reports. If the resistance is not 5 ohms or less, contact the Engineer. The Engineer will initiate design changes, if necessary, to obtain acceptable values of ground resistance.
- C. Ground resistance of conduits, equipment cases, and supporting frames, shall not vary from that of system as a whole and shall not exceed 0.5 ohms to ground. Measure resistance to ground of representative items, as directed by the Engineer. Submit all readings to the Engineer.

END OF SECTION

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## SECTION 16070

## ELECTRICAL HANGERS AND SUPPORTS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Support channel
  - 2. Fastening hardware
  - 3. Anchor bolts
  - 4. Polymer Housekeeping Pads

## 1.2 REFERENCES

- A. ASTM A-780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dipped Galvanized Coatings

## 1.3 SUBMITTALS

- A. Submit shop drawings, product data, and reports.

## 1.4 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

## PART 2 PRODUCTS

## 2.1 SUPPORT CHANNEL

- A. Support channel shall be stainless steel in chemical feed and storage areas. Support channel shall be aluminum where aluminum conduit is used, and hot dipped galvanized steel elsewhere unless noted otherwise.
- B. Support channel assembly hardware shall be aluminum where aluminum conduit is used, and stainless steel elsewhere.
- C. In wet locations, support channel components in contact with the floor shall be stainless steel.
- D. Manufacturer:
  - 1. Unistrut
  - 2. B-Line
  - 3. ABB Super Strut Installation Products
  - 4. Or equal

## 2.2 FASTENING HARDWARE

- A. All fastening hardware shall be aluminum where aluminum conduit is used, fiberglass where fiberglass support channel is used, and 304-stainless steel elsewhere unless noted otherwise.

### 2.3 ANCHOR BOLTS

- A. Anchor bolts shall be suitable for cracked or uncracked concrete and CMU construction.
- B. Anchor bolts, nuts, washers, bolt sleeves, and assembly hardware shall be Type 316 stainless steel.
- C. Use expansion anchors in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces.
- D. Manufacturer:
  - 1. Hilti, Kwik-Bolt TZ SS 316
  - 2. Powers Fasteners, Power-Stud+ SD6
  - 3. Simpson Strong-Tie, Strong-Bolt 2
  - 4. Or Equal

### 2.4 PIPE CLAMPS AND STANDOFFS

- A. Pipe clamps and standoffs shall be rigid one hole, galvanized malleable iron type or aluminum where aluminum conduit is used. They shall be of the same manufacturer and shall be designed to be used together.
- B. Strut pipe clamps shall be 2-piece type, stainless steel in chemical feed and storage areas, aluminum where aluminum conduit is used, and galvanized steel elsewhere.
- C. The finish shall be suitable for the piping system being supported. If PVC coated conduit is being supported, PVC coated clamps and standoffs shall be used. For PVC conduit, stainless steel or PVC coated clamps and standoffs shall be used.

### 2.5 THREADED RODS

- A. Threaded hanging rods shall be 304 stainless steel and be one piece. The size shall be suitable for the loads being supported.

### 2.6 SCREWS

- A. Use Sheet Metal Screws in sheet metal studs.
- B. Use Wood Screws in wood construction.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, preset inserts or beam clamps. Do not use spring steel clips and clamps.
- B. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.



- C. Do not use powder-actuated anchors.
- D. Hanger rods shall be subjected to tension only. Lateral and axial movements shall be accommodated by proper linkage in the rod assembly.
- E. Fabricate supports from support channel rigidly welded or bolted to present a neat appearance. Galvanized structural steel may be used where galvanized support channel is allowed. Use stainless steel hexagon head bolts with spring lock washers under all nuts. Coat ends of galvanized steel channel that has been cut with zinc-rich paint in accordance with ASTM A-780.
- F. Install freestanding electrical equipment on 4 inch concrete housekeeping pads.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide channel supports to stand cabinet 1 inch off wall.
- H. Bridge studs top and bottom with galvanized steel channels to support flush-mounted cabinets and panelboards in stud walls.
- I. Use standoffs for all surface mounted conduit to maintain ¼ inch space between conduits and walls.

END OF SECTION

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## SECTION 16075

## ELECTRICAL IDENTIFICATION

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Nameplates
  - 2. Wire and cable markers

## 1.2 REFERENCES

- A. NEMA WC5 - Thermoplastics - Insulated Wire and Cable for Transmission and Distribution of Electrical Energy
- B. ANSI C57

## 1.3 SUBMITTALS

- A. Provide schedule for nameplates.

## PART 2 PRODUCTS

## 2.1 NAMEPLATES

- A. Engraved two-layer plastic, white letters on a black background
- B. Nameplate Wording:
  - 1. Wording of the nameplates shall be in conformance with Drawings and acceptable to the Owner.
  - 2. Wording of the nameplates for each piece of equipment shall be based on the common name and tag number (when applicable) of the equipment.

## 2.2 WIRE AND CABLE MARKERS

- A. Wires up to AWG10: Split sleeve or tubing type waterproof markers (Thomas & Betts, Panduit, Burndy or equal).
- B. Wires AWG8 and larger: Plastic impregnated cloth markers, resistant to abrasion, moisture, dirt and oil (Ideal, Panduit, Brady or equal).

## PART 3 EXECUTION

## 3.1 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using ASA Type U drive screws, and water-resistant adhesive. Secure nameplate to face of panelboard doors one third of the way down from the top of the door. Embossed tape will not be permitted for any application.

### 3.2 WIRE IDENTIFICATION

- A. Provide wire markers on each end of each conductor in panelboard gutters, pull boxes, outlet and junction boxes, switchgear, switchboards, motor control centers, control panels, at each load connection and at each terminal board connection. Identify wiring as following:
1. Power and lighting circuit wires: Wire markers shall identify (a) power source/panelboard name and circuit ID number (e.g. "LP-1,2,3"), and (b) load/equipment name (e.g. "VFD 1").
  2. Control & signal wiring: The identification on wire markers shall match the ID tag number of the wire/terminal shown on the associated equipment shop drawings.
- B. Circuits passing through junction boxes shall be individually grouped and bound with Ty-raps.
- C. Include the following color coding of all conductors used for power or lighting circuits.
1. 120/240 volt, single phase 3 wire
    - a. Black - Phase A
    - b. Red - Phase B
    - c. White - Neutral
    - d. Green - Equipment ground
  2. 120/208 volt, three phase 4 wire
    - a. Black - Phase A
    - b. Red - Phase B
    - c. Blue - Phase C
    - d. White - Neutral
    - e. Green - Equipment ground
  3. 277/480 volt 3 phase 4 wire
    - a. Brown - Phase A
    - b. Orange - Phase B
    - c. Yellow - Phase C
    - d. Gray - Neutral
    - e. Green - Equipment ground
- D. Color coding of multiconductor control cables shall be in accordance with NEMA Standard WC5.

### 3.3 NAMEPLATE ENGRAVING SCHEDULE

- A. Provide nameplates of minimum letter height as scheduled below.
- B. Panelboards, Switchboards, Switchgear, and Motor Control Centers - ¼ inch to identify equipment designation, 1/8 inch to identify voltage rating and source.
- C. Switches in Panelboards, Switchboards, Switchgear, and Motor Control Centers - ¼ inch to identify circuit and load served, including location.
- D. Motor Starters and VFDs - ¼ inch to identify circuit and load served, including location.
- E. Individual Circuit Breakers, Enclosed Switches, Remote Operator Stations, Time Clocks, Control Devices, and Motor Starters - 1/8 inch to identify load served.
- F. Transformers - ¼ inch to identify equipment designation, 1/8 inch to identify primary and secondary voltages, primary source, and secondary load and location. Power transformer nameplates shall be in accordance with ANSI C57.
- G. Pumps, fans, and other electrical equipment - ¼ inch to identify circuit and equipment designation.
- H. Equipment with More Than One Power Source, Including Motors with Heaters - ¼ inch to identify power sources. Mount nameplate on motor disconnect switch, equipment enclosure, or other prominent location.
- I. Provide a red nameplate/marker stating “Fire Alarm” tag at the circuit breaker feeding fire alarm system equipment, ELOCK-FA circuit lockout kit by Space Age Electronics or equal.

END OF SECTION

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## SECTION 16080

## ELECTRICAL TESTING

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Testing of Electrical Systems - General
  - 2. Electrical Test Equipment
  - 3. Electrical Test Procedures
  - 4. Specific Electrical Tests
  - 5. System Function Tests
- B. Related Sections
  - 1. Section 16060 – Grounding and Bonding
  - 2. Section 16075 – Electrical Identification

## 1.2 REFERENCES

- A. NFPA 79 – Electrical Standard for Industrial Machinery
- B. ANSI/ISA-S5.4 – Instrument Loop Diagrams
- C. ANSI C37

## 1.3 SUBMITTALS

- A. General: Testing shall be performed, with satisfactory results, prior to connecting and energizing equipment. Problems discovered as a result of testing shall be corrected and retesting performed prior to connecting and energizing equipment.
- B. The following test reports shall be submitted
  - 1. Motor test results
  - 2. Megger test results
  - 3. Wire and cable continuity test results
  - 4. Grounding system test results
  - 5. System functional test reports

## PART 2 PRODUCTS – NOT USED

**PART 3 EXECUTION****3.1 TESTING OF ELECTRICAL SYSTEMS - GENERAL**

- A. Provide supervision, labor, materials, tools, test instruments and other equipment or services and expenses required to test, adjust, set, calibrate, and operationally check work and components of the various electrical and control systems and circuitry throughout the contract.
- B. Pay for all tests specified in Division 16 including expenses incident to re-tests occasioned by defects and failures of equipment to meet specifications. Unless otherwise specified, the Owner will supply the electric current necessary for tests.
- C. After completion of testing replace wiring and equipment found defective (defined as failing to meet specified requirements).
- D. Do not void equipment warranties or guarantees by testing and checkout work. Checks and tests shall be supplemental to and compatible with the manufacturer's installation instructions. Where deviations are apparent, obtain the manufacturer's approved review of procedure prior to testing. Where any repairs, modifications, adjustments, tests or checks are to be made, contact the Engineer to determine if the work should be performed by or with the manufacturer's representative. All checks and tests specified for proper operating and safety of equipment and personnel are to be performed concurrent with progression of the work, prior to final acceptance by the Owner.
- E. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, or faulty, is to be reported to the Engineer. Corrective action requires Engineer's approval prior to re-testing, and inspection.
- F. Prior to testing and start-up, equipment and wiring shall be properly and permanently identified with nameplates, and other identification as specified in Section 16075. Check and tighten terminals and connection points, remove shipping blocks and thoroughly clean equipment, repair damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions for delivery to the Engineer. Make routine checks and tests as the job progresses to ensure that wiring and equipment is properly installed.
- G. Testing and checkout work is to be performed with fully qualified personnel skilled in the particular tests being conducted. Personnel are to have at least 5 years of experience with tests of same type and size as specified.
- H. Conduct tests in presence of the Engineer. Notification is required 7 calendar days or more in advance when any test is to be performed, and do not start tests without approval.
- I. Make openings in circuits for test instruments and place and connect instruments, equipment, and devices, required for the tests. Upon completion of tests, remove instruments and instrument connections and restore circuits to permanent conditions.
- J. Identify test being performed, conductor or equipment the test is being performed on, date the test was performed, value of test results, person performing the test, the witness to the test, and the serial and model number and description of test instrument. Arrange information in tabular form and submit to the Engineer for approval.

- K. When the electrical tests and inspections specified or required within Division 16 are complete and results reported, reviewed, and approved, that portion of the electrical equipment system or installation may be considered electrically complete. Affix appropriate, approved, and dated completion or calibration labels to the tested equipment and notify the Engineer of electrical completion. If the Engineer finds completed work unacceptable, he will notify the Contractor in writing of unfinished or deficient work, with the reason for his rejection, to be corrected by the Contractor. The Contractor will notify the Engineer in writing when exceptions have been corrected. The Contractor will prepare a "notification of Substantial Electrical Completion" for approval by the Engineer following the Engineer's acceptance of electrical completion. If later in-service operation or further testing identifies problems attributable to the Contractor, these will be corrected.

### 3.2 ELECTRICAL TEST EQUIPMENT

- A. Test equipment used is to be inspected and calibrated.
- B. Perform calibration and setting checks with calibrated test instruments of at least twice that of the accuracy of the equipment, device, relay or meter under test. Dated calibration labels shall be visible on test equipment. Calibrations over 6 months old are not acceptable on field test instruments. Inspect test instruments for proper operation prior to proceeding with the tests.
- C. Perform ground tests using a low resistance, Null balance type, ground testing ohmmeter, with test lead resistance compensated for. Use the type of test instrument which compensates for potential and current rod resistances.

### 3.3 TEST PROCEDURES

- A. Prepare procedures and schedules for the work specified herein. This work is to be coordinated and compatible with both the work and schedule of the other crafts. Sequence the tests and checks so that the equipment can be energized immediately after the completion of the application tests.
- B. The test procedures shall provide specific instructions for the checking and testing of each electrical component of each system. Schedule tests and inspections as the job progresses.
- C. Testing and checkout work shall be conducted in a safe manner. Provide the following special safety precautions, as appropriate:
  - 1. Locking and tagging procedures
  - 2. Barricades
  - 3. Deenergization and/or isolation of equipment prior to testing
  - 4. Review of procedures with the Engineer and Resident Project Representative
  - 5. Erection of warning signs
  - 6. Stationing of guards and watchmen
  - 7. Maintenance of voice communications
  - 8. Personnel orientation

- D. Before energizing any machine, visually inspect for serviceability. Check manufacturer's instruction manual for correct lubrication and ventilation. Align motor with driven equipment. Check nameplate for electrical power requirements.
- E. Insulation resistance measurements for motor feeders shall be performed with motors disconnected, measure insulation resistance from load side of contactors or circuit breakers.
- F. Perform insulation tests at the following times and conditions:
  - 1. Prior to energization and/or placing into service.
  - 2. When damage to the insulation is suspected or known to exist.
  - 3. After repairs or modifications to the equipment affecting the insulation.
  - 4. Where lightning or other surge conditions are known to have existed on the circuit.
- G. Where ground test results identify the need for additional grounding conductors or rods that are not indicated or specified, design changes will be initiated to obtain the acceptable values.

#### 3.4 SPECIFIC ELECTRICAL TESTS

- A. Motors
  - 1. Perform insulation tests on motor windings and record results.
  - 2. Test run motors 1 HP and above uncoupled or unloaded, before placing into operation. Check the motor for rotation, speed, current and temperature rise under normal load and record the results.
- B. Wire and Cable
  - 1. For all 480 volt circuits, megger test the insulation of every external circuit wire to each other and to ground. Tests shall be conducted at voltages of 1,000 V DC and record results.
  - 2. Continuity test each control and/or low voltage (below 480 volts) wire and cable to verify the field applied tag per conductor and record results.
- C. Perform insulation tests on electrical equipment, apparatus, generators, transformers, power circuit breakers and switches, switchgear, motor control centers, bus duct, and similar electrical equipment.
- D. Relay Panels, Operator and Instrument Control Panels, Programmable Controllers, Micro-Processors, Battery Systems and Other Miscellaneous Equipment
  - 1. Upon completion of equipment installation, visually and functionally test equipment and their control devices for tightness of connections and for proper operation. In the case of battery systems, static inverters and similar equipment, follow manufacturer's recommended test and installation manuals upon review and approval by the Engineer. In the case of operator, instrument, and relay panels and cabinets or devices used solely for control, functionally test each circuit for proper operation and compliance with the Drawings and



Specifications. Where functional testing is deemed undesirable by the Engineer from a safety or plant operational standpoint, then continuity and terminal connection verification checks will be acceptable.

E. Grounding Systems

1. Test in accordance with Section 16060.

### 3.5 SYSTEM FUNCTION TESTS

- A. It is the purpose of system function tests to prove the correct operation of systems/equipment and correct interaction of all sensing, processing, and action devices.
- B. Perform system function tests upon completion of the maintenance tests defined, as system conditions allow. Document results and submit a detailed report for all functional tests.
1. Develop test parameters and perform tests for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
  2. Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
  3. Verify the correct operation of all sensing devices, alarms, and indicating devices.
  4. Verify communication assisted protection schemes via end-to-end testing.
  5. Measure latency of communication lines for pilot wire, line differential and transfer trip protection schemes.
  6. Function test bus restoration and/or transfer switches.
  7. Verify correct metering on protective relays and meters.
  8. Verify control circuits and current transfer circuits are restored to normal operation.
  9. Verify communication lines are operational for local and remote devices.
  10. Verify control annunciation systems are left with no alarms and any alarms present shall be investigated.
- C. Verify systems are left in normal operating mode or position, transfer and restoration schemes are enabled, and monitoring and protection devices are operational.

END OF SECTION

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## SECTION 16091

## MINOR ELECTRICAL DEMOLITION

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Electrical demolition

## PART 2 PRODUCTS

## 2.1 MATERIALS AND EQUIPMENT

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

## PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on field observation and existing record documents. Report discrepancies to the Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

## 3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary power source(s), wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- C. Existing Electrical System: Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Verify permission to disable with the Owner immediately before the work.
- D. Existing Fire Alarm System: Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

## 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.

- D. Remove exposed abandoned conduit, boxes, supports and fasteners, including above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Voids created by the removal of conduit in floors or walls above or below ceilings shall be patched and sealed with materials matching the existing construction.
- F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Repair adjacent construction and finishes damaged during demolition and extension work with materials matching the existing construction.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

#### 3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangements.

#### 3.5 INSTALLATION

- A. Install relocated materials and equipment as indicated.

END OF SECTION

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## SECTION 16120

## CONDUCTORS AND CABLES

## PART 1 GENERAL

## 1.1 SUMMARY

## A. Section Includes

1. Building wire and cable
2. Shielded signal cable
3. Coaxial cable
4. Data highway cable
5. Device Net cable
6. Ethernet cable
7. Genius Bus cable
8. RS-485 cable
9. Wire connectors

## B. Related Sections

1. Section 16075 - Electrical Identification

## 1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code

## 1.3 SUBMITTALS

- A. Submit shop drawings, product data and reports.

## 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

## 1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Determine required separation between cable and other work.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required. Determine cable routing to avoid interference with other work.

**PART 2 PRODUCTS****2.1 BUILDING WIRE AND CABLE**

- A. Description: Stranded conductor insulated wire, multi-conductor control cable and tray cable.
- B. Conductor: copper
- C. Insulation Voltage Rating: 600 volts
- D. Insulation: ANSI/NFPA 70; all power and control wiring shall be XHHW-2 unless otherwise indicated in this specification.
- E. Manufacturer
  - 1. Okonite Co.
  - 2. Rome Cable Corp.
  - 3. American Insulated Wire Corp.
  - 4. Southwire
  - 5. or equal

**2.2 SHIELDED SIGNAL CABLE**

- A. Description: twisted pair shielded instrumentation wire, NEC type TC listed, wet location, approved for Class 1 circuits as permitted in NEC Article 725.
- B. Conductor: tinned copper 18 AWG
- C. Insulation Material: PVC with a nylon overcoat
- D. Insulation Temperature Rating: 75°C wet, 90°C dry
- E. Shield: 100% coverage, with drain wire
- F. Jacket: 90°C PVC
- G. Insulation voltage rating: 600 volts
- H. Manufacturer
  - 1. Belden No. 9341
  - 2. Approved equal by Alpha
  - 3. Approved equal by Clifford
  - 4. or equal
- I. Description: Two twisted pairs, pairs individually foil shielded, with one drain wire per pair, Class 2.
- J. Conductors: 18 AWG
- K. Conductor Color:
  - 1. Pair 1: Red/Black

2. Pair 2: White/Green

- L. Insulation Voltage Rating: 300 volts
- M. Jacket: Grey PVC
- N. OD: Approx. 0.2 inches
- O. Manufacturer: Smartwire

2.3 SHIELDED 3-CONDUCTOR CABLE

- A. Description: Three-conductor shielded instrumentation cable, NEC type TC listed, wet location, approved for Class 1 circuits as permitted in NEC Article 725.
- B. Conductor: Tinned copper 18 AWG
- C. Insulation Material: PVC with nylon overcoat
- D. Insulation Temperature Rating: 75°C wet, 90°C dry
- E. Insulation Voltage Rating: 600 volts
- F. Shield: 100% shield coverage, with drain wire
- G. Jacket: 90°C PVC
- H. Manufacturer
  - 1. Belden No. 1121A
  - 2. Approved equal by Alpha
  - 3. Approved equal by Clifford
  - 4. or equal

2.4 COAXIAL CABLE

- A. Description: RG59/U Coaxial cable
- B. Provide coaxial cable in accordance with industry standards and manufacturer's requirements and recommendations.

2.5 DATA HIGHWAY CABLE

- A. Manufacturer: Allen Bradley
- B. Type: Data Highway + Cable

2.6 SHIELDED DEVICENET SIGNAL CABLE

- A. Description: Twisted pair shielded instrumentation wire, NEC type TC listed, approved for Class 1 circuits as permitted in NEC Article 725
- B. Power Conductor: tinned copper, 16 AWG
- C. Power Conductor Insulation Material: PVC with a nylon overcoat
- D. Power conductors colored Red/Black

- E. Data Conductor: tinned copper 18 AWG
- F. Data Conductor Insulation Material: F-R Polypropylene
- G. Data conductors colored Blue/White
- H. Insulation Temperature Rating: 75°C
- I. Shield: 100% coverage, with 18 AWG stranded drain wire
- J. Insulation voltage rating: 600 volts
- K. Manufacturer
  - 1. Belden No. 7896A
  - 2. Approved equal by Alpha
  - 3. Approved equal by Clifford

## 2.7 ETHERNET CABLE

- A. Description: NEC CMR cable, Category 6 unbonded-pair cable
- B. Construction: 23 AWG solid bare copper, 4 twisted pairs, overall shield, drain wire, RJ-45 compatible, non-plenum, polyolefin (PO) or PO+FEP insulation, PVC jacket.
- C. Manufacturer
  - 1. Belden 2412F
  - 2. Approved equal by Alpha
  - 3. Approved equal by Quabbin

## 2.8 ETHERNET CABLE (WITHIN MCC, 600V)

- A. Ethernet cable within motor control centers (either in part or whole) shall be 600V-insulated with 4 twisted pair and overall shield. Conductors shall be stranded or solid, and 22-24 AWG. Performance rating shall be Cat5E.
- B. Manufacturer
  - 1. Belden
  - 2. Quabbin
  - 3. Lutze
  - 4. Or Equal

## 2.9 GENIUS BUS CABLE

- A. Description: Twisted pair, NEC listing CM CL2, shielded
- B. Temperature Rating: 80°C
- C. Conductor: 20 AWG stranded
- D. Voltage Rating: 300 volts

- E. Impedance: 100 ohms
- F. Manufacturer
  - 1. Belden 9207
  - 2. Alpha 9818C
  - 3. Approved equal

#### 2.10 RS-485 CABLE

- A. Description: Twisted 4-pair, NEC CL2, shielded, low capacitance cable.
- B. Temperature Rating: 80°C
- C. Voltage Rating: 30 volts
- D. Conductor: 28 AWG stranded, tinned copper
- E. Shielding: 100% coverage with 28 AWG tinned copper drain wire
- F. Insulation: Datalene
- G. Jacket: Chrome PVC
- H. Manufacturer
  - 1. Belden 8134FO
  - 2. Approved equal

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

#### 3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

#### 3.3 INSTALLATION

- A. Minimum size for power wiring shall be AWG #12.
- B. Minimum size for control wiring shall be AWG #14.
- C. All wiring shall be run in conduit, unless otherwise noted.
- D. Install products in accordance with manufacturer's instructions.
- E. Use stranded conductors for all wire sizes.
- F. In raceways, mechanically complete the installation in all details. Pull all conductors into raceway at same time.
- G. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- H. Protect exposed cable from damage.



- I. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.
- J. Use suitable cable fittings and connectors.
- K. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- L. Clean conductor surfaces before installing lugs and connectors.
- M. Instrumentation, control and signal wiring shall be continuous with no splices from source to destination, unless otherwise shown on drawings.
- N. Splices
  - 1. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
  - 2. Properly connect and insulate shields at all splice points.
  - 3. Underground Splices or Splices called out to be Submersible
    - a. Provide Polaris Submersible Splice Connectors or equal one-piece system by Burndy, Blackburn or equal.
    - b. Underground splices shall be made in a handhole or manhole provided by the contractor and sized per the NEC.
  - 4. Above grade splices
    - a. 8 AWG and Larger: Use split bolt connectors for copper conductor splices and taps. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
    - b. 10 AWG and smaller: Use insulated spring wire connectors with plastic caps for copper conductor splices and taps.
  - 5. Above ground splices wire reducer
    - a. When wire size has been increased to account for derating and/or voltage drop, provide an In-Line Standard Barrel Reducer Splice Kit to reduce the wire down to the size necessary to terminate at the circuit breaker, disconnect, equipment, etc.
    - b. The reduced wire shall be sized by the contractor per NEC Table 310.15(B)(16) using the 60°C Column. The wire shall be sized according to the upstream over current protective device size.
    - c. The splice kit shall contain clear heat shrink tube to protect the butt splice.
    - d. Tape splice with electrical tape to 150 percent of insulation rating of conductor.
    - e. The Reducer splice kit shall be:
      - 1) Butt splice compression type with inspection window.
      - 2) Tin plated Copper

- 3) Provide Burndy Hyreducer or equal by Blackburn, Polaris or equal.
- O. Ground signal cable shields on receiving end only.
- P. Provide Kellems grips for all cord connected devices.
- Q. Provide separation of power wiring from control and signal wire in accordance with NEC Article 725.
- R. Install coaxial cables in accordance with industry standards and manufacturer's requirements and recommendations.
- S. Install Device Net cables in accordance with manufacturer's instructions and NEC Article 725 requirements for Class 1 wiring.
- T. Install Ethernet cables in accordance with manufacturer's instructions and industry standards for category 6 wiring.
- U. Install Genius Bus cables in accordance with manufacturer's instructions and industry standards.

#### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16075.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

#### 3.5 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- C. Verify continuity of each branch circuit conductor.

END OF SECTION

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## SECTION 16131

## CONDUIT

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Galvanized rigid steel conduit
  - 2. PVC coated metal conduit
  - 3. Electrical metallic tubing (EMT)
  - 4. Non-metallic (PVC) conduit
  - 5. Fittings and conduit bodies
  - 6. Conduit wall seals, new walls
  - 7. Conduit wall seals, existing walls
  - 8. Fire stop fittings
  - 9. Conduit expansion joint
  - 10. Conduit sealing bushing
  - 11. Cold galvanizing compound
  - 12. Explosion proof sealing fittings
- B. Related Sections
  - 1. Section 16060 - Grounding and Bonding
  - 2. Section 16070 - Electrical Hangers and Supports

## 1.2 REFERENCES

- A. ACI 318 – Building Code Requirements for Structural Concrete
- B. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
- C. ANSI/NFPA 70 - National Electric Code
- D. NEMA TC 2 - Electrical Plastic Tubing (EPT)
- E. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit
- F. ANSI C80.1 - Galvanized Rigid Steel Conduit, Zinc Coated
- G. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
- H. UL-6 – Standard for Rigid Metal Conduit

- I. ANSI C80.3 – Electrical Metallic Tubing, Zinc Coated
- J. ANSI C80.6 – Intermediate Metal Conduit, Zinc Coated

### 1.3 SUBMITTALS

- A. Shop drawings, product data and reports
- B. Riser Diagrams for the electrical installation

### 1.4 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept conduit on site. Inspect for damage.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

### 1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.
- D. Provide complete conduit systems between electrical equipment and devices as required.
- E. Where it is necessary to core a hole through an existing concrete slab or wall, the Contractor shall conduct a survey with a pachometer or by similar means to identify the location of steel reinforcing bars. The new hole shall be located so as to avoid cutting reinforcing bars or existing embedded conduits. Where reinforcing steel is close enough together that it is not possible to core the required hole without cutting reinforcing bars, contact the Engineer for further direction before cutting a hole. Where reinforcing bars are cut without the consent of the Engineer, the slab or wall will be repaired at the expense of the Contractor.

## PART 2 PRODUCTS

### 2.1 GENERAL CONDUIT REQUIREMENTS

- A. Minimum Size: 3/4 inch unless otherwise specified
- B. Outdoor locations:
  - 1. Exposed: Use galvanized rigid steel conduit
- C. Chemical Feed and Storage Rooms:
  - 1. Exposed: Use schedule 40 PVC conduit
  - 2. Stub out of floor with PVC coated rigid steel conduit

- D. Office Area
  - 1. Use EMT (electrical metallic tubing)
- E. Below floors and embedded in concrete floors and walls:
  - 1. Conduit shall not be installed below or embedded in concrete floors or walls unless otherwise shown on the drawings or in location(s) described below.
  - 2. Conduit shall not be embedded in walls or floors of water-retaining structures.
  - 3. In locations where below-floor or embedded conduits are allowed:
    - a. Use schedule 40 PVC conduit below floors or embedded in floors or walls.
    - b. Stub out of floors with PVC coated rigid steel conduit.
    - c. Stub out of walls with conduit type required for the location.
- F. Class 1 Division 1 and 2 Hazardous Locations
  - 1. Use galvanized rigid steel conduit.
  - 2. Provide sealing fittings at each entrance to enclosure housing an arcing device and/or in conduits 2 inch and larger per NEC. Locate seal fittings as close as possible, in no case more than 18 inches.
  - 3. Provide seal fittings for each conduit leaving hazardous (Class 1 Division 1 or 2) area and all other locations required by the NEC.
  - 4. Use conduit seal fittings appropriate for conduit orientation.
  - 5. Use conduit sealing compound with fiber dam in compliance with manufacturer's recommendations.
  - 6. Provide junction boxes rated for hazardous locations.
- G. Conduit for Fire Alarm Systems:
  - 1. In office areas, above lay-in tile ceilings, and hollow stud walls, EMT conduit shall be used.
  - 2. In all other locations, Rigid Metal Conduit shall be used.
  - 3. All fire alarm conduit shall be factory painted red on the exterior.
- H. All Other Locations:
  - 1. Concealed: Use galvanized rigid steel conduit
  - 2. Exposed: Use galvanized rigid steel conduit
- I. Connections to portable equipment from junction boxes and connections to all motors: use liquid tight flexible conduit, metallic where metallic conduit is used and nonmetallic where nonmetallic conduit is used.
  - 1. Minimum Length: 12 inches
  - 2. Maximum Length: 36 inches

**2.2 GALVANIZED RIGID STEEL CONDUIT**

- A. Rigid Steel Conduit: ANSI C80.1
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; all steel fittings
- C. Hot dipped galvanized inside and outside with additional passivation coating for extra protection.

**2.3 PVC COATED RIGID STEEL CONDUIT AND FITTINGS**

- A. Description: NEMA RN1; rigid steel conduit with external PVC coating, 40 mil thick with 2 mil. urethane interior coating
- B. Fittings and Conduit Bodies; ANSI/NEMA FB 1; steel fittings with external PVC and internal urethane coating to match conduit. Form 8 Type, NEMA 4X rated with stainless steel encapsulated screws.
- C. Provide a PVC coated sealing locknut where transitioning from PVC coated rigid steel conduit to non-metallic conduit.
- D. Manufacturer
  - 1. Robroy Industries
  - 2. ABB OCAL Installation Products
  - 3. Calbond

**2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS**

- A. Description: Interlocked steel construction with PVC jacket
- B. Liquidtight flexible metal conduit and fittings shall be appropriate outer jacket and metallic core for application requirements.
- C. For use where metallic conduit is used.
- D. Fittings: ANSI/NEMA FB 1. Fittings shall be gasketed. Material shall be zinc-coated in dry locations, galvanized in wet and damp locations, and stainless steel in corrosive locations.
- E. Manufacturer
  - 1. ABB Installation Products
  - 2. Carlon
  - 3. Anamet
  - 4. Electriflex
  - 5. Or equal

**2.5 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT AND FITTINGS**

- A. Description: Flexible PVC conduit with smooth inner surface and integral reinforcement within the conduit wall, designated as a Type LFNC-B.
- B. For use where nonmetallic conduit is used.

C. Fittings: UL 514B. Fittings shall be gasketed. Material shall be nylon or PVC.

D. Manufacturer

1. ABB Installation Products
2. Carlon
3. Anamet
4. Electriflex
5. Or equal

## 2.6 NONMETALLIC (PVC) CONDUIT

A. Description: NEMA TC 2; Schedule 40 PVC

B. Fittings: NEMA TC3

## 2.7 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel compression or set screw type

## 2.8 CONDUIT WALL SEALS, NEW WALLS

A. Type - sleeve and compression ring on both ends

B. Provide compression rings with hex head screws on sealing assembly.

C. Manufacturers

1. O-Z Gedney, Type WSK
2. Equal by Crouse-Hinds
3. Or equal

## 2.9 CONDUIT WALL SEALS, EXISTING WALLS

A. Type - Suitable for core drilled holes

B. Manufacturer

1. O-Z Gedney, Type CSM
2. Equal by Crouse-Hinds
3. Or equal

## 2.10 FIRE STOP FITTINGS

A. Type - Fittings with elastomeric rings to seal smoke and fumes

B. Fire rating of seal to be equal to or greater than rating of wall

C. Manufacturers

1. O-Z Gedney, Type CFS



2. Or equal

## 2.11 FITTINGS AND CONDUIT BODIES

### A. Fittings

1. Description - Threaded, malleable Iron or copper-free aluminum. Material and coating to correspond with type of conduit system being used, galvanized where galvanized steel conduit is used, PVC where PVC conduit is used, and PVC-coated where PVC-coated conduit is used.

### B. Conduit Bodies

1. Description - Threaded, malleable Iron or copper-free aluminum. Material and coating to correspond with type of conduit system being used, galvanized where galvanized steel conduit is used, PVC where PVC conduit is used, and PVC-coated where PVC-coated conduit is used.

2. Manufacturer

- a. Appleton-Type Mogul - malleable iron or copper-free aluminum
- b. Equal by ABB Installation Products
- c. Equal by O-Z Gedney
- d. Equal by Crouse-Hinds
- e. or equal

### C. Conduit Hubs

1. Material:

- a. Zinc plated steel or cast zinc in dry locations
- b. Cast zinc or galvanized steel in damp or wet locations
- c. Stainless steel in corrosive locations
- d. Copper-free aluminum where aluminum conduit is used
- e. PVC coated steel where PVC coated conduit is used

2. Manufacturer

- a. Crouse Hinds – Myers hub Type HUB
- b. Equal by O-Z Gedney
- c. Equal by RACO
- d. Equal by Appleton
- e. or equal

## 2.12 CONDUIT EXPANSION JOINT, RIGID METAL CONDUIT

- A. Weather tight, internal ground, expansion joint for galvanized rigid steel conduit, 4 inch maximum conduit movement

- B. Manufacturer
  - 1. ABB Type XJG Installation Products
  - 2. Crouse-Hinds Type XJG
  - 3. Appleton Type XJ
  - 4. O-Z Gedney Type AX
  - 5. or equal

#### 2.13 CONDUIT EXPANSION AND DEFLECTION FITTING, PVC

- A. Expansion fitting for PVC conduit shall compensate for length changes due to temperature variations in exposed conduit runs, 4-inch maximum conduit movement.
- B. Manufacturer
  - 1. ABB NM-XD Type Installation Products
  - 2. Equal by Carlon
  - 3. Or equal

#### 2.14 CONDUIT SEALING BUSHING

- A. Description: Bushing that provides a waterproof seal around wire and cables in a conduit
- B. Construction: Slotted PVC coated steel discs, neoprene sealing ring and stainless steel head cap screws and washers
- C. Manufacturer
  - 1. O-Z Gedney Type CSBI

#### 2.15 COLD GALVANIZING COMPOUND

- A. Cold galvanizing compound shall be applied to all field threads and shall be as manufactured by ZRC Products Company, a division of Norfolk Corp. or equal.

#### 2.16 EXPLOSION PROOF SEALING FITTINGS

- A. Description: Explosion proof and dust-ignition proof sealing fitting. Material and coating to correspond with type of conduit system being used.
- B. Ratings:
  - 1. Class I, Division 1 and 2, Groups A, B, C, D
  - 2. Class II, Division 1, Groups E, F, G
  - 3. Class II, Division 2, Groups F, G
  - 4. Class III
- C. Bodies: Feraloy iron alloy, ductile iron, or copper-free aluminum
- D. Plugs: Feraloy iron alloy, steel, or copper-free aluminum

- E. Removable Nipples: steel or copper-free aluminum
- F. Manufacturer:
  - 1. Crouse-Hinds type EYS or EYSX (copper-free aluminum)
  - 2. Approved equivalent
- G. Sealant:
  - 1. Crouse-Hinds Chico X fiber and Chico A sealing compound or Chico Speed Seal
  - 2. Sealant system of sealing fitting manufacturer selected

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Junction boxes shown on the Drawings shall be provided in locations indicated. Additional boxes shall be provided as needed to comply with NFPA 70 requirements.
- B. Install conduit in accordance with NECA "Standards of Installation."
- C. Install nonmetallic conduit in accordance with manufacturer's instructions.
- D. Arrange supports to prevent misalignment during wiring installation.
- E. Support rigid steel conduit using galvanized steel or galvanized malleable iron straps, pipe hangers, U-bolt clamps and beam clamps.
- F. Support EMT using zinc coated steel straps, pipe hangers, U-bolt clamps and beam clamps.
- G. Group related conduits; support using conduit rack. Construct rack using support channel; provide space on each for 25 percent additional conduits.
- H. Fasten conduit supports to building structure and surfaces under provisions of Section 16070.
- I. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- J. Do not attach conduit to ceiling support wires.
- K. Arrange conduit to maintain headroom and present neat appearance.
- L. Route exposed conduit parallel and perpendicular to walls.
- M. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- N. Route conduit in and under slab from point-to-point unless drawings indicate otherwise.
- O. Cross conduits in slab only with the Engineer's approval.
- P. Maintain adequate clearance between conduit and piping.
- Q. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104°F.

- R. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- S. Before installation of wires and cables, clean and dry inside of each conduit run.
- T. For galvanized conduit, apply cold galvanizing compound to all field threads.
- U. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fittings. Allow joint to cure for 20 minutes, minimum.
- V. Use conduit hubs to fasten conduit to boxes and enclosures in damp locations, wet locations, and locations below fluid piping. For wet and corrosive locations, use stainless steel or non metallic conduit hubs.
- W. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.
- X. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Y. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints per Manufacturer's best practice and recommendations.
- Z. Provide 100-lb. test nylon pull string in each conduit 2 inch or larger except sleeves and nipples.
- AA. Use suitable caps (cast metal or thermoplastic) to protect installed conduit against entrance of dirt and moisture.
- BB. Ground and bond conduit in accordance with Section 16060.
- CC. Do not install exposed conduit in rooms with glazed tile or similar interior finish.
- DD. Do not penetrate waterproofing membranes in the structural floor slab or foundation walls without approval by, and in a manner acceptable to the Engineer.
- EE. Install rigid metal conduit using only threaded fittings.
- FF. Use conduit hubs with sealing gaskets on all boxes and enclosures, except those with NEMA 1 rating.
- GG. Use two locknuts, one inside and one outside of each box and enclosure when enclosure rating is NEMA 1.
- HH. Install a chromium plated, spun or split type escutcheon on all exposed conduits passing through walls or ceilings.
- II. Extend pipe sleeves 3/4 inch above finished floors.
- JJ. Install a water and fire resistant caulking around all conduits passing through floors.
- KK. Provide a separate conduit run for each 480V power circuit, unless otherwise shown on drawings.
- LL. Provide a separate conduit run for the output power wiring of each VFD.

- MM. Provide separate conduit runs for 480 and 120/208/240 volts systems. Install motor feed and control wiring in the same conduit only when shown on the Drawings or as approved by the Engineer.
- NN. Install all empty conduits in floor so finished installation is flush with finished floor. Use suitable coupling and pipe plug.
- OO. Arrange for all duct bank systems to drain away from buildings. Install duct bank systems to drain toward manholes or handholes.
- PP. Provide thru wall seals on all conduits passing through foundation walls.
- QQ. Provide a 4 inch band of black asphaltic paint, 2 inches in the concrete and 2 inches above floor, at all galvanized rigid steel conduit floor penetrations in pump chambers, tunnels, cellars and other below grade high moisture areas.
- RR. Provide a 4 inch band of black asphaltic paint, 2 inches in the concrete and 2 inches in the soil, at all galvanized rigid steel penetrations through floors or walls into soil.
- SS. Use stainless steel or PVC coated steel hangers and straps to support PVC conduit.
- TT. Use PVC conduit fittings and bodies with PVC conduit.
- UU. Use PVC coated hangers and straps to support PVC coated steel conduit.
- VV. Use PVC coated conduit fittings and bodies with PVC coated steel conduit.
- WW. PVC coated conduit: Installer shall be Manufacturer-trained and certified for installation of the PVC coated conduit. If not certified, the Manufacturer shall provide an on-site installation training course by the company representative. Installer shall use proper installation tools that are intended for use with PVC coated rigid steel conduit.
- XX. Install underground warning tape 12 inches above all underground conduits.
- YY. Install underground conduit with minimum cover, in accordance with National Electric Code or utility requirements, but no less than 36 inches.
- ZZ. For penetrations in existing walls, patch with mortar and touch up paint. Match existing paint color.
- AAA. For penetrations in fire rated walls, use materials that maintain the fire rating of the wall.
- BBB. Conduit penetrations in the walls of wetwells, clearwells and other water or wastewater retaining structures shall be located above the maximum water elevation.
- CCC. For all structures or buildings located at an elevation low enough to potentially allow water to infiltrate the structure through one or more conduit(s):
  - 1. For conduits smaller than 1½", provide conduit sealing foam where the conduit(s) enter the structure/building. Prepare conduit and provide foam in accordance with the manufacturer's recommendations. Foam shall be Polywater FST-250 Expanding Foam or equal.
  - 2. For conduits 1½" or larger, provide conduit sealing bushing(s) where the conduit(s) enter the structure/building.

- DDD. Provide conduit sealing foam or conduit sealing bushings for conduits that enter a wet, corrosive location such as a wet well. Provide the foam/seal in both sides of the conduit (where the conduit enters the location and where the conduit enters the remote junction box/device).
- EEE. Provide conduit expansion joints for underground conduits that enter a building through an exterior wall or connect to an exterior mounted disconnect switch, meter, or other equipment.
- FFF. Provide explosion proof sealing fittings where indicated on the Drawings and where required by code.
- GGG. Conduit embedded in concrete slabs and walls:

END OF SECTION

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## SECTION 16136

## BOXES

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Wall and ceiling outlet/device boxes
  - 2. Pull and junction boxes
  - 3. Floor Boxes
  - 4. Covers
  - 5. Conduit Hubs

## 1.2 REFERENCES

- A. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies
- B. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- C. ANSI/NFPA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)
- E. UL514 A - Metallic Outlet Boxes
- F. UL514 C - Nonmetallic Outlet Boxes, Flush-Device Covers and Covers

## 1.3 SUBMITTALS

- A. Shop drawings, product data, and reports

## 1.4 PROJECT CONDITIONS

- A. Verify that the field measurements are as shown on the Drawings.
- B. Verify locations of outlets in offices and work areas prior to rough-in.
- C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. Include installation within 5 feet of location shown.

## 1.5 DESIGN REQUIREMENTS

- A. Unless otherwise specified or indicated on Drawings, NEMA rating for boxes shall correspond as follows to location classifications indicated on Drawings. Indoor locations for which a classification is not indicated are to be considered dry locations unless otherwise designated by Code. Outdoor locations are to be considered wet locations unless otherwise indicated.

1. Dry locations - NEMA 1 Metallic Boxes
2. Damp locations and Wet locations - NEMA 4 Metallic Boxes
3. Corrosive locations - NEMA 4X Metallic and Non-Metallic Boxes to match conduit
4. Wet & Corrosive locations - NEMA 4X Metallic and Non-Metallic Boxes to match conduit
5. Class 1 Division 1 or 2 Group D - NEMA 7, gasketed , cast aluminum Boxes
6. All boxes associated with the fire alarm system shall be field-painted red with a red cover.

## PART 2 PRODUCTS

### 2.1 WALL AND CEILING OUTLET/DEVICE BOXES

#### A. Sheet Metal (stamped steel) Outlet/Device Boxes

1. NEMA OS 1, galvanized steel.
2. Provide green grounding screw.
3. Stamped steel boxes shall be used only above accessible ceilings and within Gypsum wall board walls.
4. Acceptable Manufacturers
  - a. ABB Steel City Installation Products
  - b. Appleton
  - c. Raco
  - d. or equal

#### B. Cast Metal Outlet/Device Boxes

1. NEMA FB 1, Type FD, cast iron or copper-free aluminum with internal green grounding screw terminal.
2. Shall be suitable for use in wet locations when used with gasketed covers.
3. Cover shall be by box manufacturer, and shall have stainless steel cover screws and a neoprene gasket.
4. Boxes shall have external mounting feet cast into the box assembly, screw-in feet will not be acceptable.
5. Material and coating shall match that of the conduit system being used.
6. Provide threaded sealing conduit hubs on all conduit entries.
7. Acceptable Manufacturers
  - a. ABB Installation Products
  - b. Crouse-Hinds



- c. Appleton
- d. Hubbell
- e. or equal

C. Non-metallic Outlet/Device Boxes

- 1. NEMA OS 2.
- 2. Material shall be suitable for the chemicals in the area.
- 3. Cover shall be by box manufacturer, and shall have stainless steel cover screws and gasket.
- 4. Screws shall be stainless steel.
- 5. Acceptable Manufacturers
  - a. ABB Steel City Installation Products
  - b. Raco
  - c. or equal

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Pull and Junction Boxes

- 1. NEMA OS 1, Galvanized or Painted Steel.
- 2. Provide green grounding screw.
- 3. Boxes shall not contain knockouts, unless used with EMT or IMC conduit.
- 4. Acceptable Manufacturers
  - a. ABB Steel City Installation Products
  - b. Raco
  - c. Appleton
  - d. or equal

B. NEMA 4X Stainless Steel Pull and Junction Boxes

- 1. NEMA OS 1, Type 4X Stainless Steel (16 gauge minimum). Screws shall be stainless steel.
- 2. Provide green grounding screw.
- 3. Acceptable Manufacturers
  - a. Hoffman, Inc.
  - b. McKinstry
  - c. Wiegmann
  - d. or equal

- C. Cast Metal Pull and Junction boxes
  - 1. NEMA FB 1, type 4 cast iron or copper-free aluminum
  - 2. Shall be suitable for use in wet locations when used with gasketed covers.
  - 3. Cover shall be by box manufacturer and shall have stainless steel cover screws and a neoprene gasket.
  - 4. Material and coating shall match that of the conduit system being used.
  - 5. Boxes shall have external mounting feet cast into the box assembly, screw-in feet will not be acceptable.
  - 6. Provide threaded sealing conduit hubs on all conduit entries.
  - 7. Provide green grounding screw.
  - 8. Acceptable Manufacturers
    - a. Crouse-Hinds
    - b. Appleton
    - c. Hubbell, Inc.
    - d. or equal
- D. Non-Metallic Pull and Junction Boxes
  - 1. NEMA OS 2, NEMA 4X. Non-metallic boxes exceeding 18 inches in any direction shall be FRP type.
  - 2. If located outdoors, the material shall be ultraviolet stabilized for outdoor use.
  - 3. If located in a chemical area, the material shall be suitable for the chemicals in that area.
  - 4. Screws shall be stainless steel.
  - 5. Acceptable Manufacturers
    - a. Raco
    - b. ABB Carlon Installation Products
    - c. Stahlin
    - d. or equal
- E. Boxes exceeding 48 inches in any direction shall be provided with angle iron stiffeners.

### 2.3 NEMA 7 EXPLOSION-PROOF BOXES

- A. Boxes shall be rated for the hazardous classification of the area, Class I, Division 1, Division 2, etc.
- B. Boxes shall be NEMA 4X/7, gasketed, cast aluminum.

## 2.4 COVERS

- A. Provide covers for all boxes. Cover material and coating shall match the box, unless otherwise specified. Covers shall be screw fastened or hinged and comply with NEMA Standards OS 1, OS 2 or FB 1.

## 2.5 CONDUIT HUBS

- A. Conduit hubs shall be threaded and sealing type with neoprene gasket.
- B. Conduit hub material and coating shall match that of the conduit.
- C. Acceptable Manufacturers
  1. ABB Thomas & Betts - type "BULLET"
  2. Crouse Hinds - type "HUB"
  3. Equal by Appleton
  4. or equal

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. All junction boxes and pull boxes associated with the fire alarm system shall be field painted red with a red cover.
- B. Install electrical boxes as shown on Drawings. Provided additional boxes as required to comply with NFPA 70 requirements, for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Provide separate boxes for 480 and 120/208/240 volts systems. Install motor feed and control wiring in the same box only when shown as combined in a single raceway on the Drawings or as approved by the Engineer.
- D. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- E. Boxes shall not be mounted to the floor in damp, wet or corrosive locations.
- F. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
- G. Fasten boxes to walls, ceilings or strut supports; do not support boxes from equipment, panels, etc.
- H. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- I. Use gang box where more than one device is mounted together. Do not use sectional box.
- J. Provide permanent barriers in common boxes to limit voltage between adjacent switches to 300 volts or less.

- K. Common boxes used for gang installation with switches, receptacles, and low voltage devices shall include barriers between the devices and the switches or receptacles.
- L. The Contractor shall furnish and install outlet boxes for all wiring devices as shown on the drawings.
- M. Sheet Metal Outlet/Device Boxes
  - 1. Use only above accessible ceilings and within Gypsum wall board walls.
- N. Cast Metal Outlet/Device Boxes
  - 1. Use in locations exposed to the weather, wet locations, damp locations, surface mounted and pendant mounted locations and all locations where non-PVC coated rigid conduit is used. Use sealing conduit hubs on all conduit entries.
- O. Pull and Junction Boxes
  - 1. Use sealing conduit hubs on all conduit entries.
  - 2. Use stainless steel pull and junction boxes where PVC coated conduit is required and in locations rated as Wet and Corrosive, except where stainless steel is inadequate for corrosiveness of area. Use Non-Metallic in that case.
  - 3. Use Cast Metal pull and junction boxes in all locations where non-PVC coated rigid conduit is used and in locations rated as Wet Location.

### 3.2 ADJUSTING

- A. Install knockout closure in unused box opening.

END OF SECTION

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SECTION 16140  
WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
  - 1. Wall switches
  - 2. Occupancy Sensors
  - 3. Receptacles
  - 4. Cover plates
  - 5. Floor Boxes/Poke-Throughs
  - 6. Miscellaneous
- B. Related Sections
  - 1. Section 16136 - Boxes

1.2 SUBMITTALS

- A. Product Data: Provide catalog sheets for wiring devices.

PART 2 PRODUCTS

- A. GFCI Receptacle - 20 A, 120 V duplex
  - 1. Specification grade, nylon, brown, straight blade
    - a. Hubbell - Model GFR5362
    - b. Equal by Pass & Seymour
    - c. Equal by Bryant
    - d. or equal
- B. USB Charging Receptacle - 20 A, 120 V duplex with two USB Ports
  - 1. Specification grade, nylon, brown, straight blade
    - a. Hubbell - Model USB20X2
    - b. Equal by Pass & Seymour
    - c. Equal by Bryant
    - d. or equal
- C. Single 20A, 125V, 1 phase, 3 wire; twist lock type, corrosion resistant, grounding, yellow nylon
  - 1. Hubbell - Model 23CM10A

2. Equal by Pass & Seymour
3. Equal by Bryant
4. or equal

## 2.2 COVER PLATES

- A. Weatherproof Cover – Weatherproof while in use type for outdoor and wet locations.
  1. Sealing gasket and stainless steel mounting screws, for duplex GFCI receptacle, vertical orientation
  2. Cast metal base and cast metal cover where metallic conduit is used and nonmetallic PVC base and clear polycarbonate cover where nonmetallic conduit is used.
    - a. ABB Red Dot Installation Products
    - b. Equal by Hubbell, Inc.
    - c. Equal by Pass & Seymour
    - d. Equal by Bryant

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

### 3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install receptacles with grounding pole on bottom.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- E. Connect wiring devices by wrapping conductor around screw terminal.
- F. Install corrosion resistant, weatherproof cover plates on all devices located outside, in pump chambers, garages, chemical areas, areas subject to water spray or as indicated on drawings. Cover plate material and coating shall match the box unless otherwise specified.

- G. Install weatherproof while in use type covers for receptacles located outdoors and in damp or wet locations.
- H. Use jumbo size plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on metallic outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- J. Use stainless steel screws and hardware for mounting, device plates, fixtures, etc. in wet, damp, hazardous and corrosive areas.

#### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 16136 to obtain mounting heights specified and indicated on Drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor unless otherwise noted on plans.

#### 3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch .
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

#### 3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION

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## SECTION 16220

## AC MOTORS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Single Phase Capacitor Start Motors
  - 2. Three Phase Squirrel Cage Motors

## 1.2 REFERENCES

- A. ANSI/NEMA MG 1 - Motors and Generators.
- B. ANSI/NEMA MG 3 - Sound Level Prediction for Installed Rotating Electrical Machines
- C. ANSI/NFPA 70 - National Electrical Code.
- D. ANSI/IEEE 112 - IEEE Standard for Polyphase Induction Motors and Generators

## 1.3 SUBMITTALS

- A. Factory test reports for all 3-phase motors 20 hp and larger. Test report shall include:
  - 1. No load current
  - 2. Full load current
  - 3. Breakdown torque
  - 4. Locked rotor (starting) current
  - 5. Locked rotor torque
  - 6. Hi-potential test
- B. Product data and manufacturer's installation instructions.
- C. Operation and maintenance data.
  - 1. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

## 1.4 QUALITY ASSURANCE

- A. Qualifications - Manufacturer/Company specializing in manufacture of electric motors for industrial use, and their accessories, with minimum 3 years documented product development, testing, and manufacturing experience.
- B. Regulatory Requirements
  - 1. Conform to National Electrical Code
  - 2. Conform to local energy code.



## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. General Electric Co., Extra Severe Duty (XSD), energy saver design.
- B. Reliance, Model XE-XT.
- C. U.S. Motors - Corro-Duty, premium efficiency.
- D. Baldor - Super E, hostile environment.
- E. or equal.

### 2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Motors - Design for continuous operation in 40 degrees C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.
- B. Efficiency: Motors shall be premium efficiency type, as defined in NEMA MG 1
- C. Classified Locations - Motors installed within classified locations shall be designed to provide the appropriate NFPA 70 Class and Division protection requirements. Explosion-proof motors shall be UL approved and labeled for hazard classification, with over temperature protection.
- D. Visible Nameplate - Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency, AFBMA bearing numbers, manufacture date. Stainless steel nameplate attached with stainless steel pins.
- E. Electrical Connection - Oversized, diagonally split, cast-iron junction boxes with gaskets. Box provided with threaded conduit connection. Box shall be adjustable to all four mounting positions.
- F. Enclosures - Enclosures shall be TEFC (Totally Enclosed Fan Cooled). Fans for TEFC motors shall be non-sparking bronze-alloy or reinforced plastic.
- G. Motors less than 250 watts and intended for intermittent service need not conform to these specifications.

### 2.3 SINGLE PHASE CAPACITOR START MOTORS

- A. Starting Torque - Three times full load torque.
- B. Starting Current - Less than five times full load current.
- C. Pull-up Torque - Up to 350 percent of full load torque.
- D. Breakdown Torque - Approximately 250 percent of full load torque.

- E. Motors - Capacitor in series with starting winding; capacitor-start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Totally enclosed Motors - Class F insulation, 1.25 Service Factor, regreasable ball bearing.

#### 2.4 THREE PHASE SQUIRREL CAGE MOTORS

- A. Starting Torque - Between one and one and one-half times full load torque.
- B. Starting Current - Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque - NEMA Design B characteristics, unless specified otherwise.
- D. Design, Construction, Testing, and Performance - Conform to ANSI/NEMA MG 1 for Design B motors, unless specified otherwise.
- E. Insulation System - NEMA Class F or better.
- F. Motor Frames - NEMA standard T-frames of all cast iron construction with end brackets of cast iron.
- G. Bearings - Double shielded with waterproof non-washing grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 20, L-10 life of 26,280 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension.
- H. Sound Power Levels - To ANSI/NEMA MG 3 not over 90 dBA.
- I. Vertical Motors - Equip with oil-lubricated thrust bearings.
- J. Variable Frequency Drive Applications –
  - 1. Motors powered by variable frequency drives shall be specifically designed to continuously operate within a 15-60 Hz range for variable torque applications and 20-60 Hz range for constant torque applications.
  - 2. Motors shall be inverter duty rated and shall meet NEMA MG-1 Parts 30 and 31.
  - 3. Motor Bearing Protection – Provide shaft grounding rings for all motors larger than 100HP that are powered by adjustable frequency drives to protect motor bearings from shaft current discharge. Shaft grounding rings shall be manufactured by AEGIS, INPRO/SEAL, SGS or equal.

### PART 3 EXECUTION

#### 3.1 TESTING

- A. Test motors in accordance with 16080.

**3.2 NEMA MOTOR SERVICE FACTORS**

<b>HP</b>	<b>3600 RPM</b>	<b>1800 RPM</b>	<b>1200 RPM</b>	<b>900 RPM</b>
$\frac{1}{6} - \frac{1}{3}$	1.35	1.35	1.35	1.35
$\frac{1}{2}$	1.25	1.25	1.25	1.15
$\frac{3}{4}$	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
$1\frac{1}{2} - 500$	1.15	1.15	1.15	1.15

END OF SECTION

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## SECTION 16265

## AC VARIABLE FREQUENCY DRIVES

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. AC variable frequency drives (VFDs or AFDs).

## 1.2 REFERENCES

- A. ANSI/NEMA ICS 3 - Industrial Systems
- B. NEMA ICS 7.0 – Industrial Controls & Systems for AFDs
- C. IEEE 519 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

## 1.3 SUBMITTALS

- A. Shop drawings, product data and reports.
- B. Invoice for each drive to comply with terms of the utility company's rebate program.
- C. Project specific wiring diagrams.
- D. Operation and Maintenance Data
  - 1. Submit instruction manuals with recommended maintenance procedures and intervals, installation, operation and programming information.

## 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store drive in a warm, dry, non-corrosive location in original shipping carton to prevent damage.

## 1.5 SPARE PARTS

- A. One printed circuit board control card of each type furnished.
- B. Six fuses of each type furnished.

## PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. Eaton: DG1
- B. Square D: ATV 61, ATV 71
- C. ABB: ACQ580
- D. Allen-Bradley: Powerflex 700
- E. or equal

## 2.2 AC VARIABLE FREQUENCY DRIVE

- A. The variable frequency AC drive shall convert 3 phase, 60 hertz input power to a variable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The converter shall use a diode bridge rectifier to convert incoming AC power to a constant DC voltage bus. The inverter section shall be a voltage source design with a sine-weighted pulse-width modulated output. The output voltage is to vary proportionally with the output frequency to maintain a constant volts/hertz value up to 60 hz.
- B. Include in the controller, power conversion components, power control logic devices and regulator circuitry. Provide full digital control of frequency and voltage.
- C. The variable frequency drives shall all be by one manufacturer.
- D. Provide VFDs large enough to handle the nameplate full load current of the installed motor; do not select VFDs based solely on motor HP. Verify the nameplate full load current of the installed motor and provide the appropriately sized VFD for the installed motor.
- E. The VFD and all associated equipment shall have a short circuit current rating (SCCR) of at least that specified in 16050.
- F. The variable torque drives shall be rated for 100% continuous current, 110% current for one minute. Constant torque drives shall be rated for 100% continuous current, 150% current for one minute.
- G. The drive shall also include as functional components: capacitors for DC bus, single control logic board, terminal blocks for connection of incoming power, motor terminations, operator controls and transient suppressor.
- H. Include motor current overload protection.
- I. Provide keypad and backlit display for display and control, to be mounted on the front panel of the motor control center or VFD enclosure.
- J. Enclosure:
  - 1. NEMA 12 (unless otherwise shown on drawings) with thermostatically-controlled cabinet fan. Other components specified herein and shown on the drawings shall be installed in the enclosure.
  - 2. Outdoor enclosures shall include a 200W thermostatically-controlled cabinet heater and a lockable hinged cover over the keypad/controls. Outdoor enclosures shall be painted gloss-white.
- K. Drive shall include a total of at least 5% front end/line reactance (this can include integral AC/DC drive reactance, a line reactor or a combination of the two). An external line reactor will not be required if a low harmonic filter or active front-end drive is provided.

## 2.3 VARIABLE DRIVE FUNCTIONS

- A. Frequency Accuracy  $\pm 0.5\%$ .
- B. Operating Frequency Range Output: 0-60 Hz.

- C. Adjustable Two Step Acceleration and Deceleration Times: 0.1-1600 seconds.
- D. Lower Limit Frequency Adjustment: 0-60 Hz.
- E. Upper Limit Frequency Adjustment: 0-60 Hz.

#### 2.4 VARIABLE DRIVE CONTROLS

- A. Speed control, start/stop control, local/remote control on keypad.
- B. Manual speed adjustment potentiometer, 10 turn, with dial counter, (remote mounted where indicated on Drawings).
- C. Remote speed adjustment from 4-20 mA control signal, where indicated.
- D. Remote start/stop.
- E. Drive run and stop indicating lights.
- F. Contact closure for external indication of drive running and fault (rating 120 VAC, 1 AMP).
- G. Elapsed time meter.
- H. Automatic restart (without reset) after power loss.
- I. Other interlocks, indicating lights and controls indicated on Drawings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install drive equipment in and/or control panels as shown on the Drawings.
- B. Provide services of a factory trained technician for startup and training, a minimum of one day per type of drive installed, per location.
- C. Program the VFD to ensure it can be automatically restarted (without needing to be reset) following a power/communications outage once power/communications is restored.
- D. VFDs installed outdoors shall be programmed to operate at the lowest drive temperature rating.

END OF SECTION

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## SECTION 16410

## SWITCHES AND CIRCUIT BREAKERS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Circuit Breakers
  - 2. Switch Assemblies
- B. Related Sections
  - 1. Section 16070 – Electrical Hangers and Supports

## 1.2 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.
- B. NEMA KS 1 – Enclosed Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

## 1.3 SUBMITTALS

- A. Shop drawings, product data, and reports.
- B. Circuit breaker trip current and let-through current curves, outline dimensions, and terminal lug sizes.

## 1.4 REGULATORY REQUIREMENTS

- A. Use circuit breakers and switch assemblies listed by Underwriter's Laboratories, Inc., and suitable for specific application.

## PART 2 PRODUCTS

## 2.1 MANUFACTURERS

- A. ABB (General Electric)
- B. Eaton
- C. Square D
- D. Siemens
- E. Or equal

## 2.2 MOLDED CASE CIRCUIT BREAKER

- A. CIRCUIT BREAKER: NEMA AB-1. FS W-C-375.
- B. Service Conditions:
  - 1. Temperature: 40 C.

- C. Interrupting Rating: For circuit breakers that are part of a panelboard or other equipment, the interrupting rating shall be equal to or greater than that of the equipment. For stand-alone circuit breakers, the interrupting rating shall be a minimum of 35,000 AIC.
- D. Enclosure: NEMA 12 dust tight industrial indoor dry locations, NEMA 3R raintight (lockable) for outdoor locations, and NEMA 4X stainless steel for wet and damp locations. For Class I, Division 1 or 2 locations, provide NEMA 7 enclosures. For corrosive areas, provide NEMA 4X stainless steel or nonmetallic enclosures.
- E. Configuration: Inverse time automatic tripping. Instantaneous automatic tripping, for motor circuit protection.
- F. Field-Adjustable Trip Circuit Breaker: NEMA AB 1; provide circuit breakers with frame sizes 100 amperes and larger with mechanism for adjusting long time, short time continuous current, short time, long time pickup current, and instantaneous setting for automatic operation.
- G. Solid-State Circuit Breaker: Provide circuit breaker as scheduled with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.
- H. Ratings: NEMA AB 1; as scheduled.
- I. Provide a lockable hasp with each circuit breaker.

### 2.3 SWITCH ASSEMBLIES

- A. Interrupting Rating: The interrupting rating shall be a minimum of 35,000 AIC.
- B. Fusible Switch Assemblies: NEMA KS 1; FS W-S-865; heavy duty, quick-make, quick-break load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF and ON positions. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses unless otherwise indicated.
- C. The switch ampacity shall meet or exceed the circuit ampacity shown on the drawings.
- D. Accessories:
  - 1. Unless shown otherwise, provide all fusible disconnect switches with fuses rated for the full ampacity of the disconnect switch frame.
  - 2. Provide all disconnect switches downstream from VFDs or Soft-Starters with auxiliary contacts.
- E. Enclosure: NEMA 12 for indoor dry locations, NEMA 3R raintight (lockable) for outdoor locations, and NEMA 4X stainless steel for wet and damp locations. For Class I, Division 1 or 2 locations, provide NEMA 7 enclosures. For corrosive areas, provide NEMA 4X stainless steel or nonmetallic enclosures.

## PART 3 EXECUTION

### 3.1 EXAMINATION



- A. Verify that surfaces are ready to receive work.
- B. Verify field measurements are as shown on Drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.

### 3.2 INSTALLATION

- A. Install circuit breakers and switch assemblies where shown on Drawings, in accordance with manufacturer's instructions.
- B. Provide all necessary hardware and supports and make all wiring connections.
- C. Support equipment of this Section in accordance with Section 16070.
- D. Provide fuses in all fusible switch assemblies, whether fuses are shown on the drawings or not. For HVAC equipment, coordinate fuse size required with HVAC contractor.

### 3.3 ADJUSTING

- A. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in the circuit. Use trip settings provided by the Engineer. Coordinate with Engineer to request settings at least 2 weeks prior to starting up the equipment.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect visually and perform several mechanical ON-OFF operations on each circuit breaker and switch assembly.
- B. Verify circuit continuity on each pole in closed position.

END OF SECTION

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## SECTION 16421

## ENCLOSED MOTOR STARTERS

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes
  - 1. Fractional horsepower motor starters
  - 2. Enclosed motor starters
  - 3. Motor starters mounted in control panels
- B. Related Sections
  - 1. Section 16137 – Control Cabinets and Enclosures
  - 2. Section 16445 – Motor Control Center
  - 3. Section 16490 – Components and Accessories

## 1.2 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. NEMA AB 1 - Molded Case Circuit Breakers.
- C. NEMA ICS 1 - Standards for Industrial Control and Systems.
- D. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- E. ICS 3 - Industrial Systems.
- F. ICS 4 - Terminal Blocks.
- G. NEMA KS 1 - Enclosed Switches.

## 1.3 SUBMITTALS

- A. Product data on motor starters.
- B. Manufacturer's instructions.
- C. Project specific wiring diagrams.

## 1.4 OPERATION AND MAINTENANCE DATA

- A. Provide spare parts listing, source and current prices of spare parts and supplies, and recommended maintenance procedures and intervals.

## 1.5 SPARE PARTS

- A. Furnish the following spare parts. Each part shall be marked on its exterior packaging with typewritten labels identifying the specific part, part number, and manufacturer.
  - 1. One complete set of fuses for each kind of enclosed motor starter.

2. Two indicating lamps of each type.
3. One type overload of each type.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Eaton
- B. Square D
- C. Siemens
- D. Allen-Bradley
- E. Or equal

### 2.2 FRACTIONAL HORSEPOWER MOTOR STARTERS

- A. Description: NEMA ICS2, general purpose, Class A with toggle switch operation and overload protection.
- B. Enclosure: NEMA Type 12 for indoor dry locations; NEMA Type 4 for wet or damp locations. Enclosure shall be flush mount type for office and lab areas. For Class I Division 1 or 2, wet and corrosive locations, enclosures shall be rated NEMA 7 and NEMA 4.

### 2.3 ENCLOSED MOTOR STARTERS

- A. Description: NEMA ICS2, AC general purpose Class A magnetic motor starter for induction motors rated in horsepower, full voltage starting, non-reversing or reversing type, single speed or two-speed, as indicated on the Drawings (or as required).
- B. Motor starter assemblies shall have a short circuit current rating (SCCR) of at least that specified in 16050.
- C. Operating Voltage: voltage and phase as indicated on the Drawings.
- D. Coil Operating Voltage: 120 volts, 60 Hertz (or as required)
- E. Size: NEMA ICS2, size as shown on the Drawings or as required by the motor horsepower rating.
- F. Overload Relay: The overload relay assembly shall be of the electronic type with the following features:
  1. Ambient insensitive
  2. Class 10, 20 or 30 protection (selectable)
  3. Ground fault protection
  4. Network communication capabilities compatible with the existing SCADA system.
  5. Fixed phase loss protection (selectable on/off)
  6. Adjustable phase unbalance protection

- G. Combination Motor Starters: Combine motor starter with motor circuit protector in common enclosure.
- H. Enclosure: NEMA Type 12 for dry indoor locations, NEMA Type 4X stainless steel for wet or damp indoor locations, NEMA Type 3R for outdoor locations, other type as indicated on the Drawings. For Class I Division 1 or 2, wet and corrosive locations, enclosures shall be rated NEMA 7 and NEMA 4. Location classification types shown are shown on the electrical drawings.
- I. Control Power Transformer (if required): 120 volts secondary (24 volts if required for HVAC related starters), 75VA minimum or higher if required by the loads.
- J. Auxiliary Contacts – NEMA ICS 2: minimum of two normally open and one normally closed field convertible contacts in addition to seal-in contact. Provide additional contacts as required by the Drawings and one spare normally open contact.
- K. Motor Circuit Protection – NEMA AB 1; FS W-C 375; adjustable circuit breakers with integral instantaneous magnetic trip in each pole.
- L. Devices Included: Pushbuttons, selector switches, relays, auxiliary contacts, elapsed time meters, pilot lights, terminal boards, connecting lugs and other devices as required and as shown on the Drawings. Devices shall be as specified in Section 16490. Provide internal wiring.
- M. Pushbuttons, Indicating Lights, Selector Switches: NEMA ICS2; industrial, heavy duty, oil tight type. The “compact control components” are unacceptable. Provide transformer type pilot lights with lenses and color coded as indicated by the Plans.

#### 2.4 MOTOR STARTERS MOUNTED IN CONTROL PANELS

- A. Description: NEMA ICS2, AC general purpose Class A magnetic motor starter for induction motors rated in horsepower, full voltage starting, non-reversing or reversing type, single speed or two-speed, as indicated on the Drawings (or as required).
- B. Motor starter assemblies shall have a short circuit current rating (SCCR) of at least that specified in 16050. Motor starter assemblies being installed in existing equipment shall have a short circuit current rating (SCCR) of at least that of the existing equipment.
- C. Operating Voltage: voltage and phase as indicated on the Drawings.
- D. Coil Operating Voltage: 120 volts, 60 Hertz (or as required)
- E. Size: NEMA ICS2, size as shown on the Drawings or as required by the motor horsepower rating.
- F. Overload Relay: The overload relay assembly shall be of the electronic type with the following features:
  - 1. Ambient insensitive
  - 2. Class 10, 20 or 30 protection (selectable)
  - 3. Ground fault protection

4. Network communication capabilities compatible with the existing SCADA system.
  5. Fixed phase loss protection (selectable on/off)
- G. Adjustable phase unbalance protection
- H. Combination Motor Starters: Combine motor starter with motor circuit protector.
- I. Auxiliary Contacts: Provide auxiliary contacts as shown on the Drawings (or as required).
- J. Control Power Transformer (if required): 120 volts secondary, 24 volts if required by system supplier, 75VA minimum or higher if required by the loads.
- K. Devices Included: Provide devices as shown on the Drawings. Devices shall be as specified in Section 16137 and Section 16490.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions and as shown on the Drawings.
- B. Select and install heater elements in motor starters to match installed motor nameplate current and service factor.
- C. Motor Data - Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage/phase rating, MCP trip setting, overload heater size and motor starter size.
- D. Provide all conduit, wiring and grounding interconnections.
- E. Make all required continuity and operational tests.
- F. Set motor circuit protectors at lowest setting that permits operation of the motor without tripping the motor circuit protector.

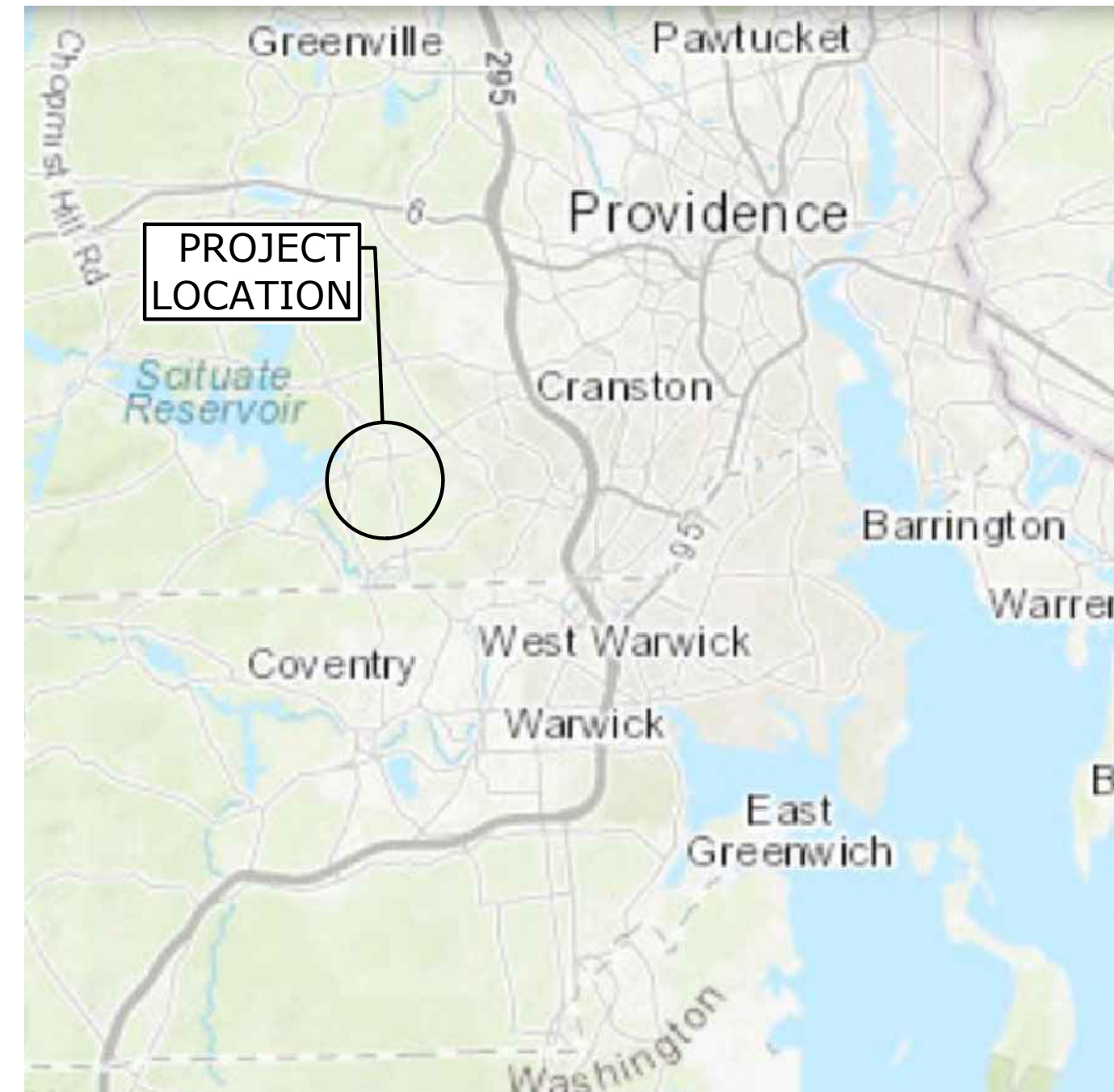
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# PROVIDENCE WATER SUPPLY BOARD DEHUMIDIFICATION SYSTEM DESIGN

## PHILIP J. HOLTON WATER PURIFICATION PLANT

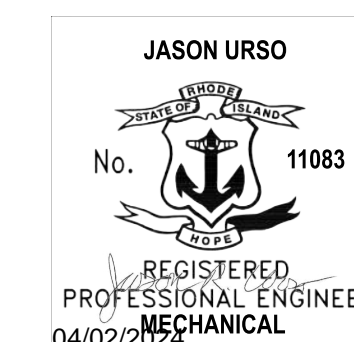
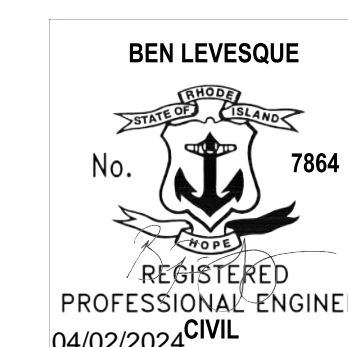
### CONSTRUCTION DOCUMENTS APRIL 2, 2024



LOCATION MAP  
NO SCALE

PREPARED BY:

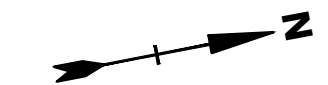
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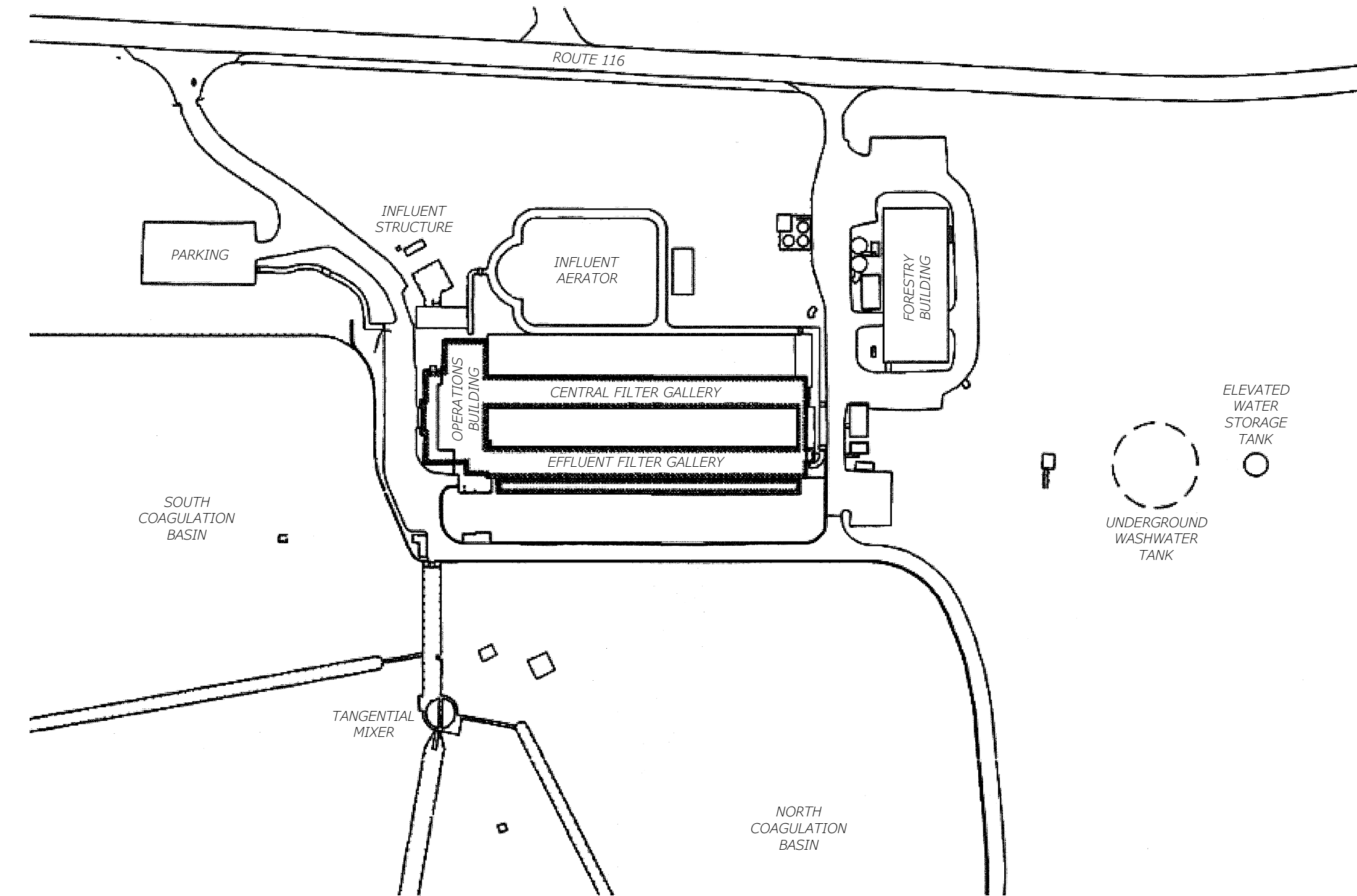
PREPARED FOR:

PROVIDENCE WATER SUPPLY BOARD

**COMPLETE SET 52 SHEETS**



LIST OF DRAWINGS			
SHEET NO.	DRAWING NO.	DRAWING TITLE	WORK AREA SUBDIVISION
GENERAL			
1	G-001	COVER SHEET	
2	G-002	SHEET INDEX AND SITE KEY PLAN	
STRUCTURAL			
3	S-001	STRUCTURAL LEGEND, GENERAL NOTES, AND DETAILS	ALL AREAS
4	S-101	STRUCTURAL - CENTRAL FILTER GALLERY ROOF PLAN - NORTH	AREA 2
5	S-102	STRUCTURAL - CENTRAL FILTER GALLERY ROOF PLAN - SOUTH	AREA 2
6	S-103	STRUCTURAL WASHWATER UTILITY STRUCTURE ROOF PLAN - NORTH AND SOUTH	AREA 1, AREA 4
7	S-104	STRUCTURAL - EFFLUENT GALLERY AND WASHWATER UTILITY STRUCTURE - NORTH AND SOUTH	AREA 1
8	S-105	STRUCTURAL CHLORINE STORAGE ROOF PLAN AND INFLUENT BUILDING FLOOR PLAN	AREA 3
9	S-201	SECTIONS	ALL AREAS
HVAC			
10	H-001	HVAC LEGEND AND GENERAL NOTES	ALL AREAS
11	HD-101	HVAC DEMOLITION - CENTRAL FILTER GALLERY & FILTER BED PLANS - NORTH	AREA 2
12	HD-102	HVAC DEMOLITION - CENTRAL FILTER GALLERY & FILTER BED PLANS - SOUTH	AREA 2
13	HD-103	HVAC DEMOLITION - ROOF PLAN - NORTH	AREA 2
14	HD-104	HVAC DEMOLITION - ROOF PLAN - SOUTH	AREA 2
15	HD-105	HVAC DEMOLITION - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN	AREA 1
16	HD-106	HVAC DEMOLITION - WASHWATER UTILITY STRUCTURE ROOF PLAN	AREA 1
17	H-101	HVAC - CENTRAL FILTER GALLERY & FILTER BED PLANS - NORTH	AREA 2
18	H-102	HVAC - CENTRAL FILTER GALLERY & FILTER BED PLANS - SOUTH	AREA 2
19	H-103	HVAC - ROOF PLAN - NORTH	AREA 2
20	H-104	HVAC - ROOF PLAN - SOUTH	AREA 2, AREA 3
21	H-105	HVAC - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN	AREA 1, AREA 4
22	H-106	HVAC - WASHWATER UTILITY STRUCTURE ROOF PLAN	AREA 1, AREA 4
23	H-107	HVAC - PARTIAL BASEMENT, INFLUENT BLDG & LOWER PUMP RM PLANS	AREA 1, AREA 3
24	H-108	HVAC - CHLORINE STORAGE PLANS	AREA 3
25	H-201	HVAC SECTIONS - 1	AREA 1, AREA 3
26	H-202	HVAC SECTIONS - 2	AREA 1, AREA 2, AREA 3
27	H-501	HVAC DETAILS - 1	ALL AREAS
28	H-502	HVAC DETAILS - 2	ALL AREAS
29	H-601	HVAC SCHEDULES - 1	AREA 1, AREA 2, AREA 3
30	H-602	HVAC SCHEDULES - 2	ALL AREAS
31	H-700	HVAC CONTROL DIAGRAMS - 1	ALL AREAS
32	H-701	HVAC CONTROL DIAGRAMS - 2	AREA 2
33	H-702	HVAC CONTROL DIAGRAMS - 3	AREA 1, AREA 3
ELECTRICAL			
34	E-001	ELECTRICAL LEGEND	ALL AREAS
35	E-002	ELECTRICAL GENERAL NOTES	ALL AREAS
36	ED-101	ELECTRICAL DEMOLITION - CENTRAL FILTER GALLERY - NORTH	ALL AREAS
37	ED-102	ELECTRICAL DEMOLITION - CENTRAL FILTER GALLERY - SOUTH	AREA 2
38	ED-103	ELECTRICAL DEMOLITION - ROOF PLAN - NORTH	AREA 2
39	ED-104	ELECTRICAL DEMOLITION - ROOF PLAN - SOUTH	AREA 2
40	ED-105	ELECTRICAL DEMOLITION - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN	AREA 1, AREA 4
41	ED-106	ELECTRICAL DEMOLITION - PARTIAL BASEMENT AND LOWER PUMP RM	AREA 1, AREA 2, AREA 3
42	E-101	ELECTRICAL - CENTRAL FILTER GALLERY POWER PLAN - NORTH	ALL AREAS
43	E-102	ELECTRICAL - CENTRAL FILTER GALLERY POWER PLAN - SOUTH	AREA 2, AREA 3
44	E-103	ELECTRICAL - ROOF POWER PLAN - NORTH	AREA 2
45	E-104	ELECTRICAL - ROOF POWER PLAN - SOUTH	AREA 2, AREA 3
46	E-105	ELECTRICAL - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN	AREA 1, AREA 4
47	E-106	ELECTRICAL - WASHWATER UTILITY STRUCTURE ROOF PLAN	AREA 1, AREA 4
48	E-107	ELECTRICAL - PARTIAL BASEMENT, INFLUENT BLDG & LOWER PUMP RM POWER PLANS	AREA 1, AREA 2, AREA 3
49	E-601	ELECTRICAL ONE-LINE DIAGRAM	ALL AREAS
50	E-602	ELECTRICAL SCHEDULES - 1	ALL AREAS
51	E-603	ELECTRICAL SCHEDULES - 2	ALL AREAS
52	E-604	ELECTRICAL SCHEDULES - 3	AREA 1, AREA 3



**SITE KEY PLAN**  
NO SCALE

**BEN LEVESQUE**  
No. 7864  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 CIVIL

**JASON URSO**  
No. 11083  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 MECHANICAL

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P0740-047  
DATE: APRIL 2024  
FILE: P0740-047-G-002.dwg  
DRAWN BY: RAK, OLR  
DESIGNED/CHECKED BY: SJP, JRJ  
APPROVED BY: BRL

**SHEET INDEX AND SITE KEY PLAN**

SCALE: NO SCALE

**G-002**

**WORK AREA SUBDIVISION:**

1. THE CONTRACT PRICE SHALL BE SUBDIVIDED INTO FOUR DIFFERENT WORK AREAS (AREA 1, AREA 2, AREA 3, AND AREA 4). THE WORK AREA SUBDIVISION COLUMN IN THE LIST OF DRAWINGS IDENTIFIES THE AREAS FOR EACH DRAWING. WORK ON SOME DRAWINGS MAY APPLY TO MULTIPLE WORK AREAS.

**GENERAL**

- STRUCTURAL WORK SHALL CONFORM TO STATE BUILDING CODE, LATEST EDITION, INCLUDING MOST RECENT ADDENDA, AND CONTRACT DOCUMENTS. IN CASE OF CONFLICT, MOST STRINGENT REQUIREMENT SHALL GOVERN.
- CONTRACTOR SHALL VERIFY AND COORDINATE DIMENSIONS RELATED TO THIS PROJECT.
- CONTRACTOR SHALL EXAMINE DRAWINGS FOR ALL TRADES FOR THE VERIFICATION OF LOCATION AND DIMENSIONS OF ALL CHASES, INSERTS, OPENINGS, SLEEVES AND OTHER PROJECT REQUIREMENTS NOT SHOWN ON THE STRUCTURAL DRAWINGS.
- ALL ROOFING WORK TO BE CERTIFIED BY CARLISLE UPON COMPLETION.

**STRUCTURAL STEEL**

- ALL STRUCTURAL STEEL WORK SHALL CONFORM TO A.I.S.C. "SPECIFICATIONS FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS", LATEST EDITION.
- UNLESS MODIFIED BELOW OR ON THE CONTRACT DRAWINGS, THE FABRICATION AND ERECTION OF ALL STRUCTURAL STEEL SHALL BE ACCORDING TO THE A.I.S.C. CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES, LATEST EDITION.
- STRUCTURAL STEEL SHALL BE NEW STEEL CONFORMING TO ASTM A36 UNLESS NOTED OTHERWISE ON DRAWINGS. TUBING SHALL CONFORM TO ASTM A5000 GRADE B (FY=46KSI).
- ALL JOINTS SHALL BE AS SHOWN ON THE CONTRACT DRAWINGS OR SHALL BE DESIGNED AS TYPE 2 (SIMPLE) FRAMING PER THE A.I.S.C. "SPECIFICATION FOR THE DESIGN, FABRICATION, AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS", LATEST EDITION, AND OTHERWISE SHOWN ON THE CONTRACT DRAWINGS OR SPECIFIED. ALL JOINTS INTENDED TO BE CONNECTED IN THE SHOP SHALL BE WELDED AND ALL JOINTS INTENDED TO BE CONNECTED IN THE FIELD SHALL BE BOLTED UNLESS NOTED OTHERWISE ON DRAWINGS.
- IN THE DESIGN OF THE FRAMED BEAM CONNECTIONS (BOLTED), THE FOLLOWING SHALL GOVERN, UNLESS OTHERWISE SPECIFICALLY INDICATED:
  - FASTENER DIAMETER - 3/4" MINIMUM.
  - FASTENER DESIGNATION - A325.
  - NUMBER OF BOLT ROWS - THE MAXIMUM NUMBER AS INDICATED IN TABLE 10-1 OF THE A.I.S.C. "MANUAL OF STEEL CONSTRUCTION, 13<sup>TH</sup> EDITION, PART 10 - DESIGN OF SIMPLE SHEAR CONNECTIONS".
  - CONNECTION ANGLE THICKNESS - AS INDICATED IN TABLE 10-1 OR 10-2.
  - MINIMUM CONNECTION PLATE THICKNESS SHALL BE 3/8".
  - WELDED CONNECTIONS - SERIES E-70 ELECTRODES. THE WELD CONNECTION CAPACITY SHALL BE EQUAL TO OR GREATER THAN THAT FOR THE SAME BOLTED CONNECTION AS SPECIFIED HEREIN. THE MINIMUM WELD SIZE FOR ANY CONNECTION SHALL NOT BE LESS THAN 3/16".
  - USE HARDENED WASHERS UNDER BOLT HEAD AND NUT, CONFORMING TO ASTM F436. USE NO MORE THAN 2 WASHERS.
  - BOLT INSTALLATION IN ACCORDANCE WITH TURN-OF-NUT METHOD OUTLINED IN SPECIFICATIONS FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS.
- ALL WELDING SHALL CONFORM TO A.W.S D1.1, LATEST REVISION, "STRUCTURAL WELDING CODE".
- HOLES, CUTS AND OTHER MODIFICATIONS TO THE STRUCTURAL STEEL SHALL NOT BE MADE IN THE FIELD EXCEPT WITH THE SPECIFIC PERMISSION OF THE ENGINEER.
- COUNCIL SPECIFICATIONS PREPARATION SHALL BE ACCORDING TO SSPC-SP3 FOR STEEL TO BE LEFT UNPAINTED AND SSPC-SP6 FOR STEEL TO BE FINISHED. REFER TO SPECIFICATIONS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD TOUCH-UP PAINTING OF ALL STRUCTURAL STEEL AFTER THE STEEL ERECTION INCLUDING ALL NUTS, BOLTS, AND WELDS AND ANY DAMAGE TO THE PRIME COAT, INCURRED DURING AND AFTER FIELD ERECTION.
- THE STRUCTURAL STEEL CONTRACTOR SHALL INSPECT ALL FOUNDATIONS INCLUDING ANCHOR BOLTS FOR ACCEPTABILITY AND PROVIDE A WRITTEN REPORT TO THE RESIDENT ENGINEER TO THIS EFFECT PRIOR TO INITIATING WORK.
- ANCHOR BOLTS, LEVELING PLATES, OR BEARING PLATES SHALL BE LOCATED AND BUILT INTO CONNECTING WORK, PRESET BY TEMPLATES OR SIMILAR METHODS. PLATES SHALL BE SET IN FULL BEDS OF NON-SHRINK GROUT.
- STRUCTURAL STEEL DETAILS NOT SPECIFICALLY SHOWN SHALL BE SIMILAR TO THOSE SHOWN FOR MOST NEARLY SIMILAR SITUATIONS AS DETERMINED BY THE STRUCTURAL ENGINEER.
- STRUCTURAL STEEL FRAMING SHALL BE TRUE AND PLUMB BEFORE CONNECTIONS ARE FINALLY BOLTED OR WELDED.
- TEMPORARY ERECTION BRACING AND SUPPORTS SHALL BE PROVIDED TO HOLD STRUCTURAL STEEL FRAMING SECURELY IN POSITION. SUCH TEMPORARY BRACING AND SUPPORTS SHALL NOT BE REMOVED UNTIL PERMANENT BRACING HAS BEEN INSTALLED AND FLOOR SLABS HAVE ATTAINED 75 PERCENT OR SPECIFIED CONCRETE STRENGTH.

**FIELD VERIFICATION**

- EXISTING SECTIONS ARE BASED ON AVAILABLE, LIMITED CONSTRUCTION DRAWINGS. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS AND CONDITIONS PRIOR TO FABRICATION.
- VERIFY SIZE AND LOCATIONS OF ALL OPENINGS OR INSERTS WITH ROOF TOP UNIT SPECIFICATIONS. ANY OPENINGS OR INSERTS SHOWN ON STRUCTURAL DRAWINGS ARE FOR GENERAL INFORMATION ONLY AND SHALL BE VERIFIED IN FIELD PRIOR FRAMING.

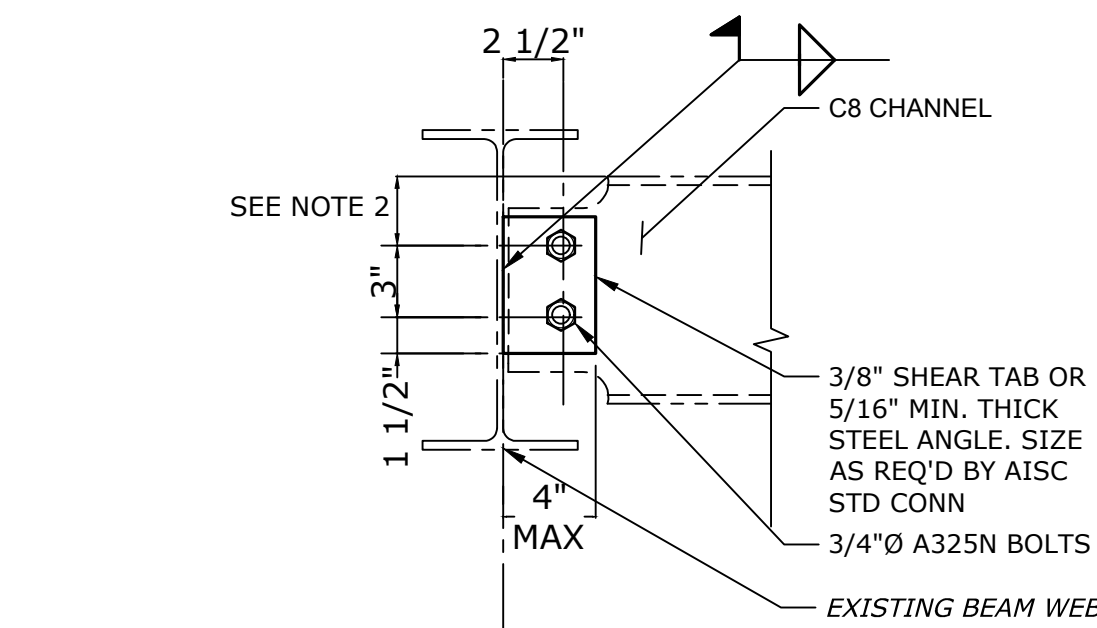
**GROUT**

- GROUT FOR THE FILLING OF CMU CELLS SHALL CONFORM TO ASTM C-476 FINE OR COARSE. 1 PART CEMENT, 0 TO 1/10 LIME, 2-14 TO 3 SAND (ASTM C476), PLUS COARSE AGGREGATE.
- DRYPACK GROUT SHALL BE NON-SHRINK WITH A COMPRESS STRENGTH NOT LESS THAN 5000 PSI AT 7 DAYS, AND 7500 PSI AT 28 DAYS.

**SUBMITTALS**

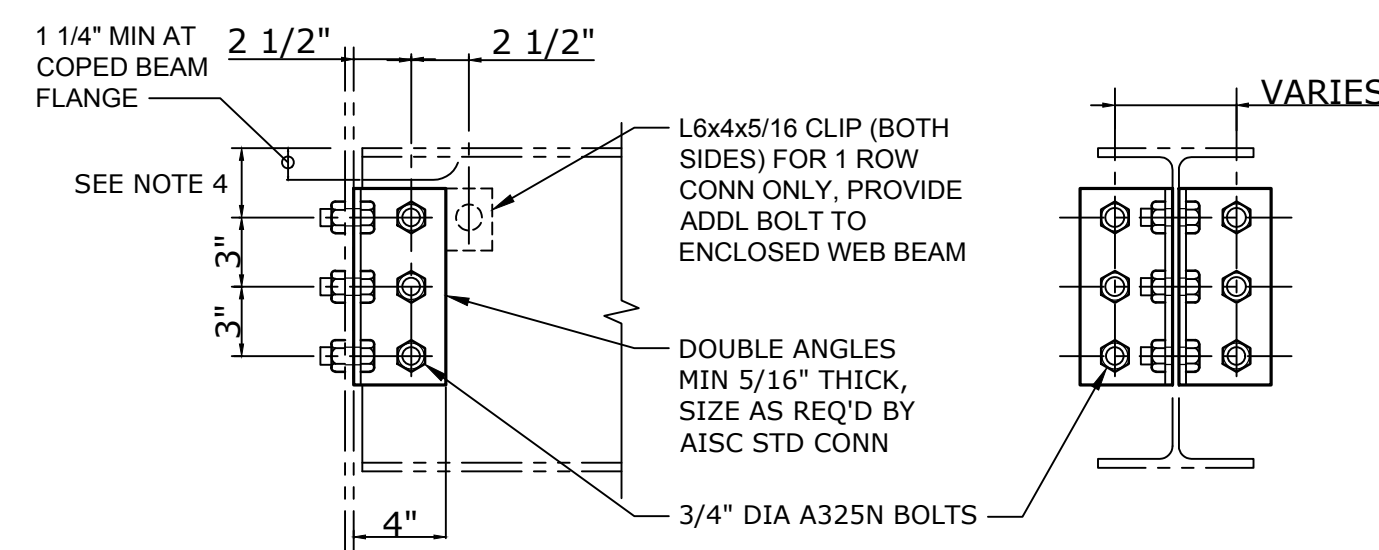
- GROUT**
  - SUBMIT DATA AND DESCRIPTIVE LITERATURE FOR DRYPACK GROUT.
- STRUCTURAL STEEL**
  - SHOP DRAWINGS: DETAILED SHOP DRAWINGS THAT INCLUDE GRADES OF STEEL, DIMENSIONS, SIZE AND ARRANGEMENT OF MEMBERS, CONNECTION DETAILS, AND IDENTIFICATION OF MEMBERS THAT ARE TO BE GALVANIZED ALONG WITH THE GALVANIZING STANDARD.
- SELECTIVE DEMOLITION**
  - METHODS OF DEMOLITION AND EQUIPMENT PROPOSED FOR SELECTIVE DEMOLITION. THIS SUBMITTAL SHOULD BE SUFFICIENT TO DEMONSTRATE A THOROUGH UNDERSTANDING OF THE WORK TO BE COMPLETED AND THE MEANS THAT WILL BE IMPLEMENTED TO SAFELY COMPLETE THE WORK WITHIN THE CONTRACT TIME WITHOUT DAMAGE TO SURROUNDING STRUCTURES OR RESOURCES. THE ENGINEER WILL REVIEW THE SUBMITTAL FOR COMPLETENESS BUT WILL NOT "APPROVE" THE MEANS AND METHODS.

BASIC STRUCTURAL DESIGN CRITERIA (RHODE ISLAND STATE BUILDING CODE (IBC 2018))	
<b>A. BUILDING CLASSIFICATION</b>	1. RISK CATEGORY III - WATER PURIFICATION PLANT
<b>B. SNOW LOAD REQUIREMENTS</b>	1. GROUND SNOW LOAD (Pg) - 35 psf 2. SNOW EXPOSURE FACTOR (Ce) - 0.9 3. THERMAL FACTOR (Ct) - 1.0 4. SNOW LOAD IMPORTANCE FACTOR (I) - 1.10 5. FLAT ROOF SNOW LOAD (Pf) - 30 psf
<b>C. WIND LOAD REQUIREMENTS</b>	1. HURRICANE - PRONE REGION 2. ULTIMATE DESIGN WIND SPEED - V <sub>ULT</sub> = 137 MPH 3. WIND EXPOSURE CATEGORY - C
<b>D. EARTHQUAKE LOAD REQUIREMENTS</b>	1. SEISMIC IMPORTANCE FACTOR (I <sub>e</sub> ) - 1.25 MAPPED SPECTRAL ACCELERATION: a. SHORT PERIOD RESPONSE (S <sub>s</sub> ) - 0.173 b. 1 - SECOND PERIOD RESPONSE (S <sub>1</sub> ) - 0.061



- NOTES:**
- NUMBER OF ROWS IS EQUAL TO NUMBER OF BOLTS TO ENCLOSED WEB.
  - 3" DIMENSION TYPICAL EXCEPT AS RECOMMENDED BY AISC FOR LARGER MEMBERS.
  - PROVIDE PAINT TOUCH UP AFTER STEEL ERECTION AND FIELD WELDING TO EXISTING STEEL MEMBERS PER SPECIFICATIONS 05500.

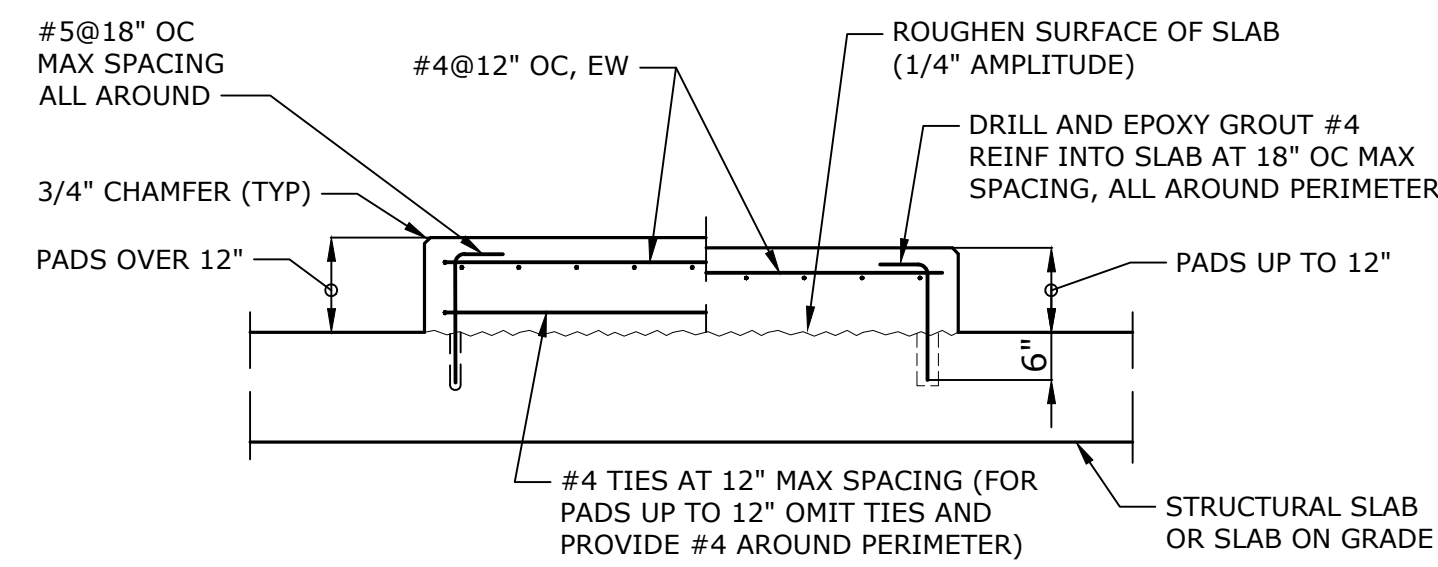
**TYPICAL CHANNEL BEAM FRAMING CONNECTION**  
NO SCALE



NOMINAL BEAM DEPTH, INCHES	ROWS OF BOLTS	LENGTH (3) OF ANGLE
8-10	2	5 1/2"
12-15	3	8 1/2"

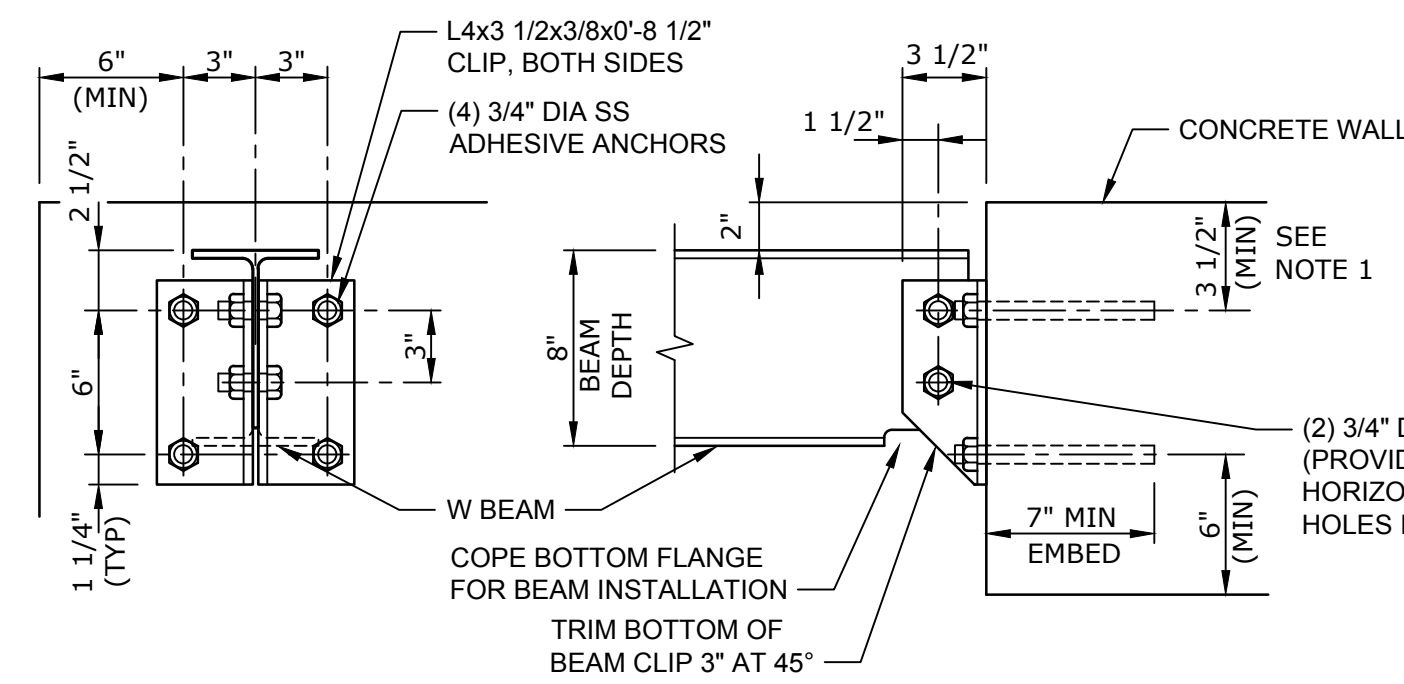
- NOTES:**
- NUMBER OF ROWS IS EQUAL TO NUMBER OF BOLTS TO ENCLOSED WEB.
  - ALL FRAMING CONNECTIONS SHALL CONFORM TO SCHEDULE UNLESS DETAILED OTHERWISE ON FRAMING PLANS.
  - ADD 1 1/2" TO ANGLE LENGTH FOR STAGGERED BOLT CONNECTIONS.
  - 3" DIMENSION TYPICAL EXCEPT AS RECOMMENDED BY AISC FOR LARGER MEMBERS.

**TYPICAL CHANNEL BEAM FRAMING CONNECTION**  
NO SCALE

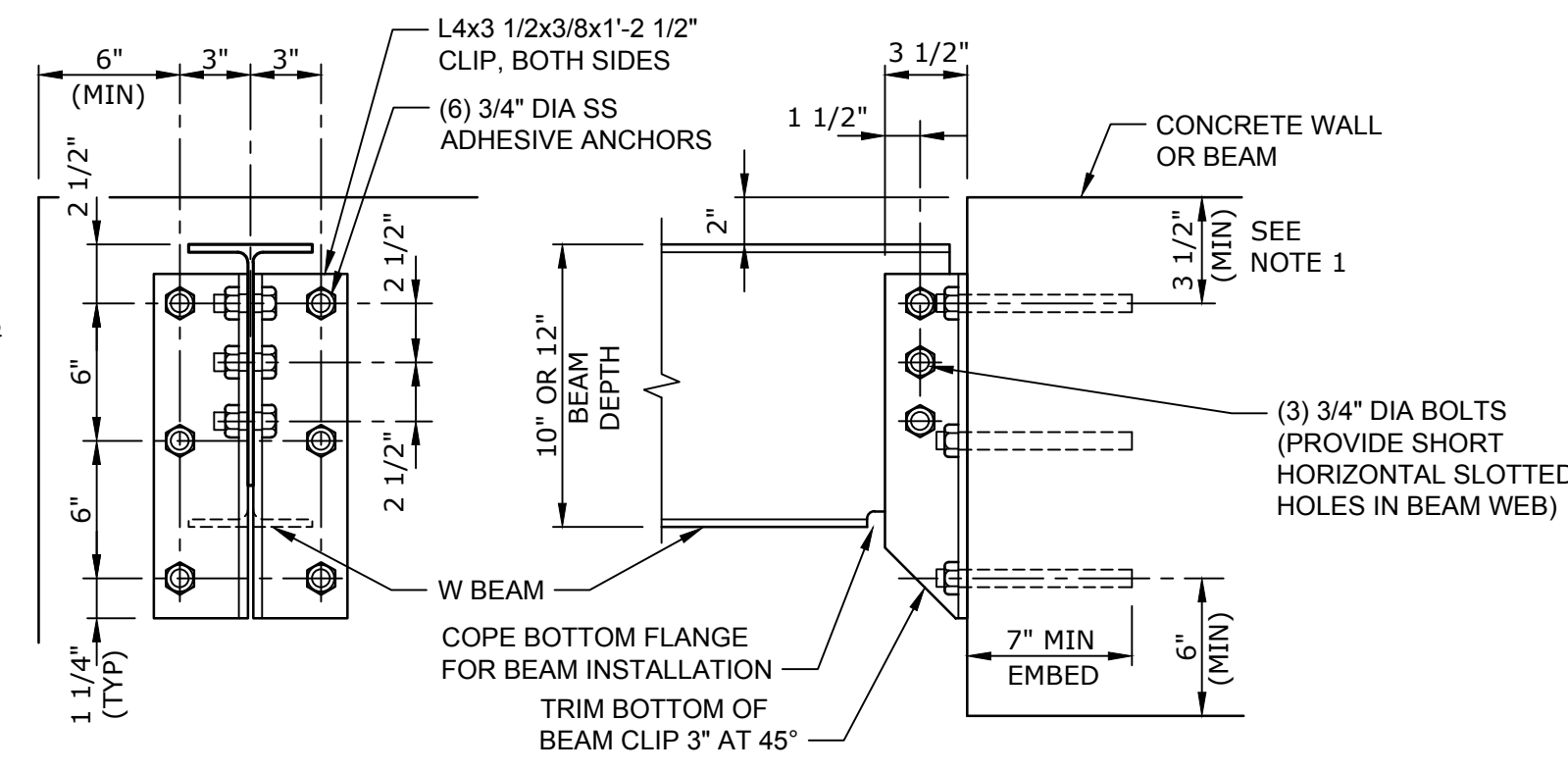


- NOTES:**
- COORDINATE SIZE OF THE EQUIPMENT PAD WITH THE EQUIPMENT SHOP DRAWING.
  - CONCRETE WORK SHALL CONFORM TO THE LATEST DRAWING EDITIONS OF THE BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE (ACI 318), AND SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDING (ACI 301).
  - CONCRETE SHALL BE NORMAL WEIGHT CONCRETE AND SHALL BE ENTRAINED BETWEEN 4.5 AND 7.5 PERCENT, SHALL HAVE A MAXIMUM WATER/CEMENT RATIO OF 0.45, AND SHALL HAVE A TOTAL CEMENTITIOUS MATERIAL IN THE MIX BETWEEN 635 LBS (MIN) AND 658 LBS (MAX) PER CUBIC YARD

**EQUIPMENT PAD DETAIL**  
NO SCALE

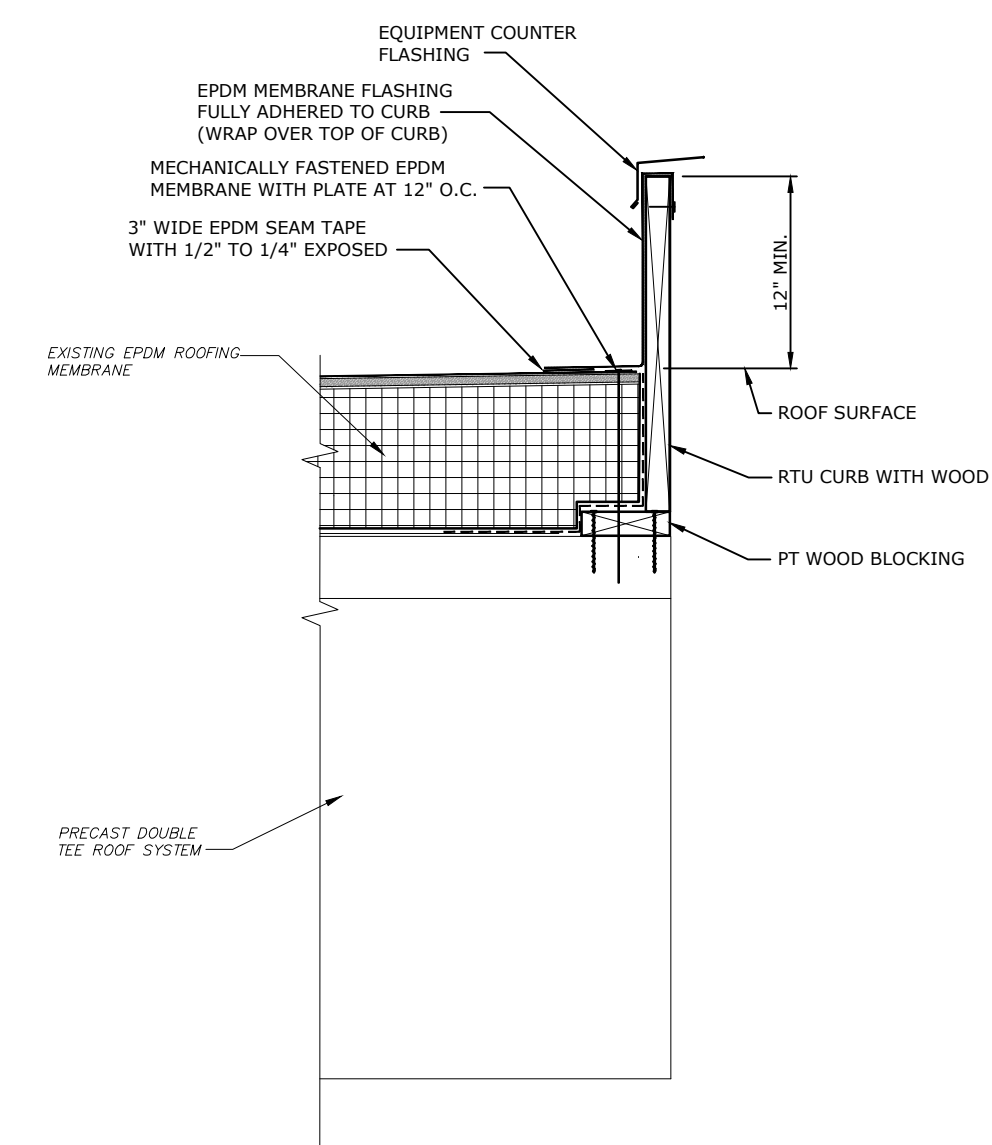


**8" BEAM CONNECTION**

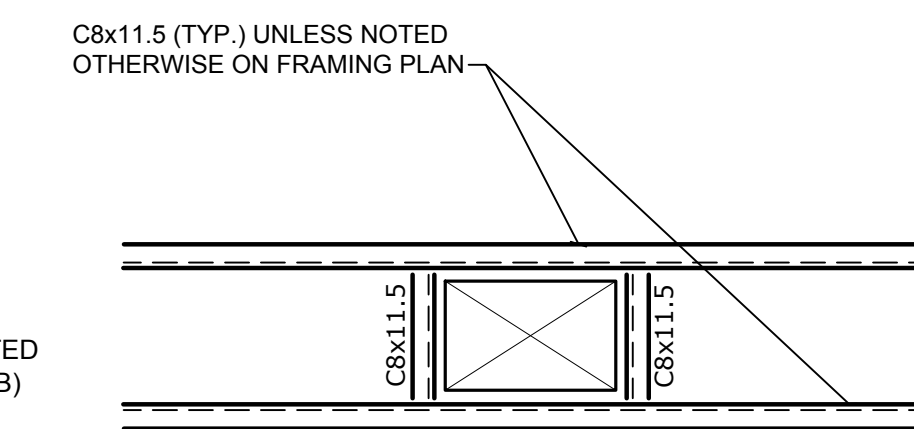


- NOTES:**
- DO NOT CUT EXISTING CONCRETE REINFORCING BARS DURING DRILL-IN ANCHOR INSTALLATION. FIELD LOCATE REINFORCING PRIOR TO FABRICATION. ADD LENGTH TO CLIP ANGLES AS REQUIRED TO LOWER ANCHORS TO CLEAR REINFORCING WHILE MAINTAINING SPACING AND EDGE DISTANCES AS SHOWN.
  - PROVIDE STAINLESS STEEL FRAMING CLIPS AND CONNECTION BOLTS WHEN FRAMING MEMBERS ARE ALUMINUM.
  - ALL ALUMINUM IN CONTACT WITH CONCRETE SHALL BE BACK PAINTED IN ACCORDANCE WITH SPECIFICATION SECTION 09900.

**BEAM TO CONCRETE WALL CONNECTIONS**



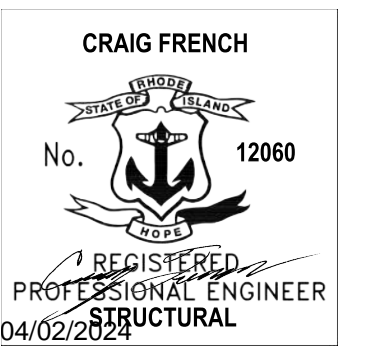
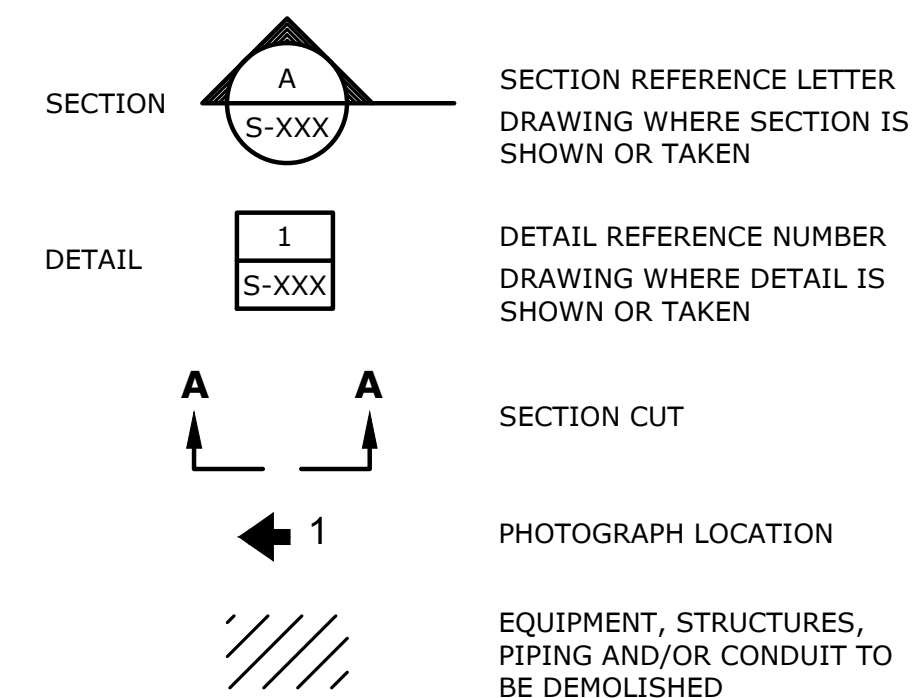
**RTU CURB DETAIL**  
NO SCALE



- NOTES:**
- COORDINATE SPACING OF MEMBERS WITH EXISTING MECHANICAL ROOF TOP UNITS.
  - STEEL CHANNEL CONNECTIONS TO BE FULLY WELDED OR BOLTED CONNECTED PER TYPICAL CHANNEL CONNECTION DETAIL.

**TYPICAL CHANNEL FRAME AT METAL ROOF DECK OPENING**  
NO SCALE

**GENERAL SYMBOLS**



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

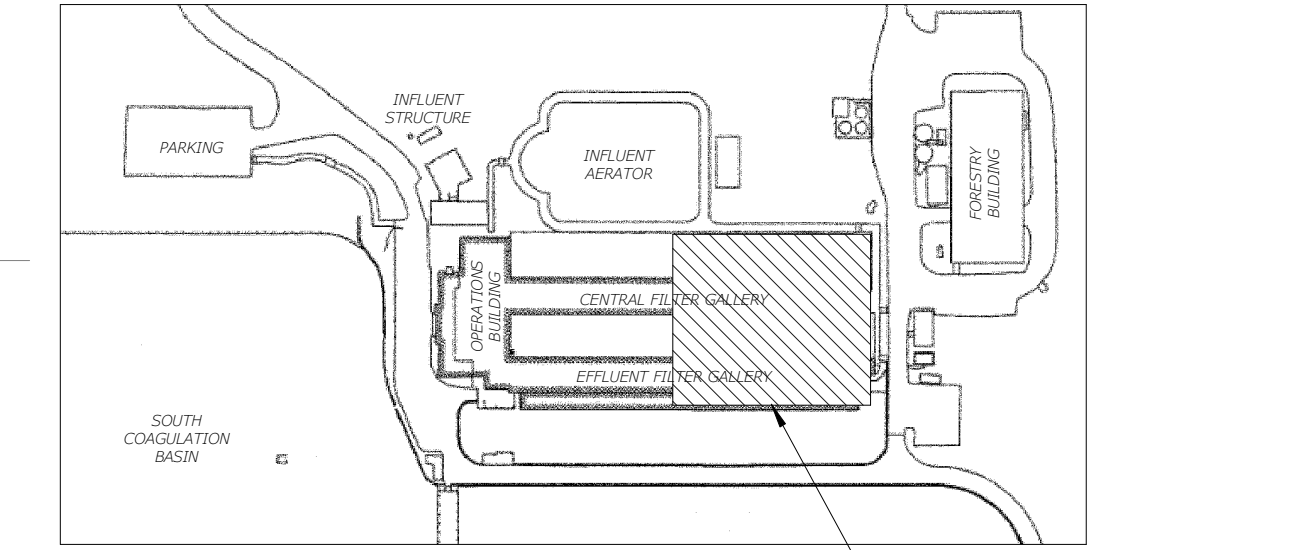
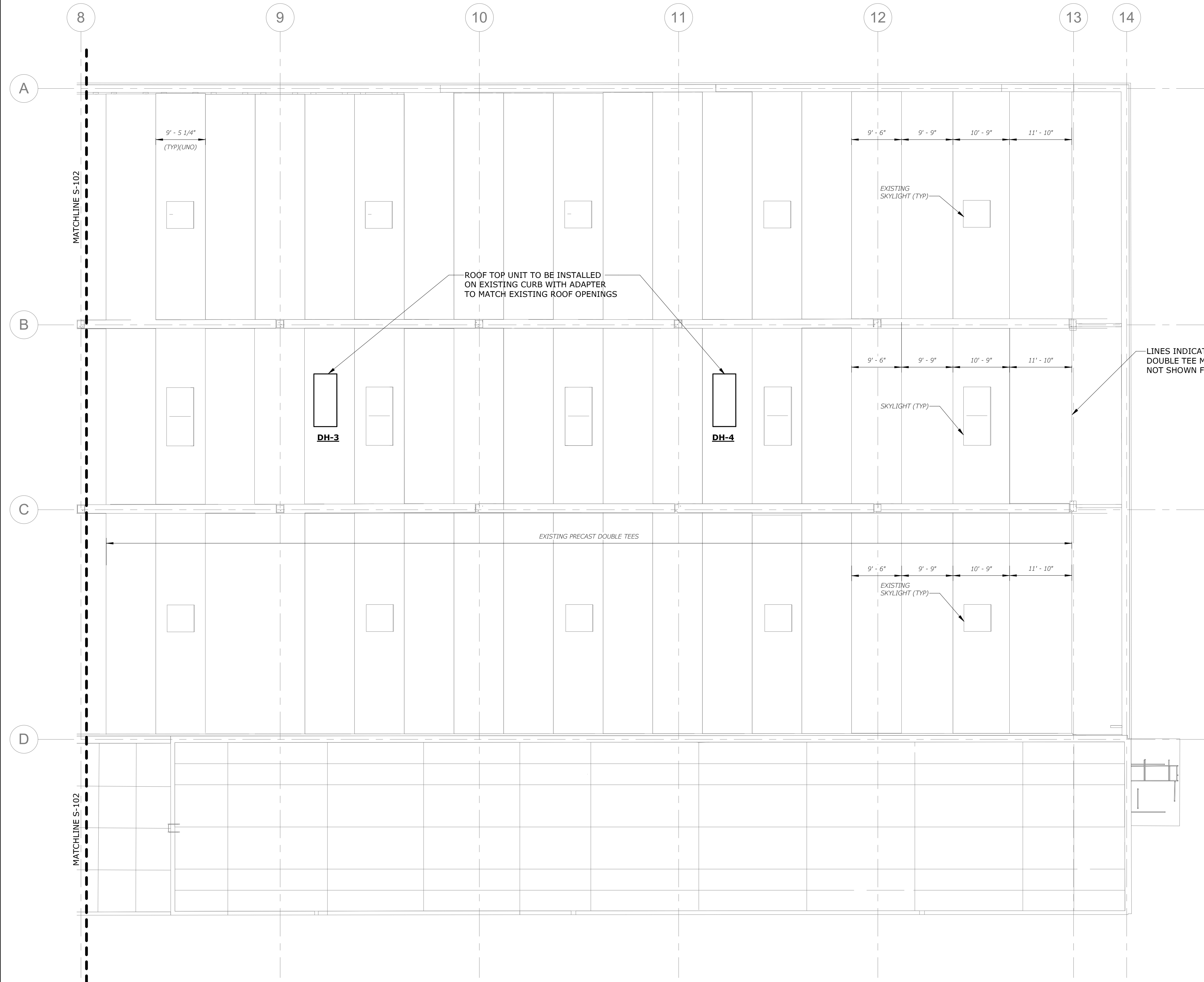
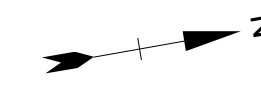
MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P0740-047  
DATE: APRIL 2024  
FILE: P0740-047-S-001.dwg  
DRAWN BY: CS, JC  
DESIGNED/CHECKED BY: DBS, CSF  
APPROVED BY: BRL

STRUCTURAL LEGEND, GENERAL NOTES, AND DETAILS

SCALE: NO SCALE





**KEY PLAN**  
NO SCALE

**BEN LEVESQUE**  
No. 7864  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 CIVIL

**CRAIG FRENCH**  
No. 12060  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 STRUCTURAL

LINES INDICATE JOINTS BETWEEN PRECAST DOUBLE TEE MEMBERS. DOUBLE TEE STEMS NOT SHOWN FOR CLARITY

ROOF TOP UNIT TO BE INSTALLED ON EXISTING CURB WITH ADAPTER TO MATCH EXISTING ROOF OPENINGS

DH-3

DH-4

EXISTING PRECAST DOUBLE TEES

EXISTING SKYLIGHT (TYP)

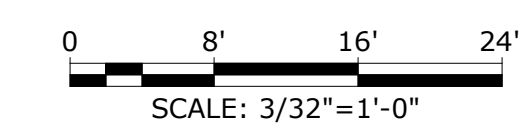
SKYLIGHT (TYP)

EXISTING SKYLIGHT (TYP)

**STRUCTURAL- CENTRAL FILTER GALLERY ROOF PLAN - NORTH**  
SCALE: 3/32" = 1'-0"

**NOTE(S):**

- CONTRACTOR SHALL REPAIR/PATCH EXISTING ROOF FOR WEATHER TIGHT FINISH. VERIFY WATER-TIGHT SEAL AFTER WORK IS COMPLETED. SEE ROOF TOP UNIT CURB DETAIL IN S-001.
- WHERE EXISTING RTU IS TO BE REPLACED, NEW ROOF TOP UNIT TO BE INSTALLED ON EXISTING CURB WITH NEW ADAPTER TO MATCH EXISTING ROOF OPENINGS. SIZE AND LOCATION OF EXISTING ROOF OPENINGS TO BE VERIFIED IN FIELD.



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
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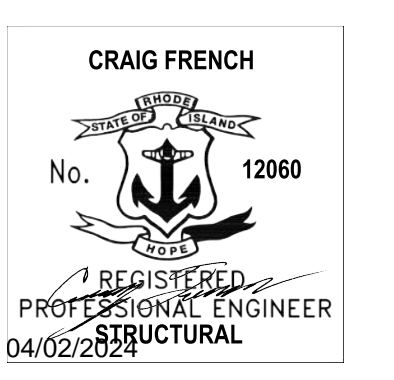
PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: CS, JC  
DESIGNED/CHECKED BY: DBS, CSF  
APPROVED BY: BRL

STRUCTURAL- CENTRAL FILTER GALLERY ROOF PLAN - NORTH

SCALE: AS SHOWN

S-101

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**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

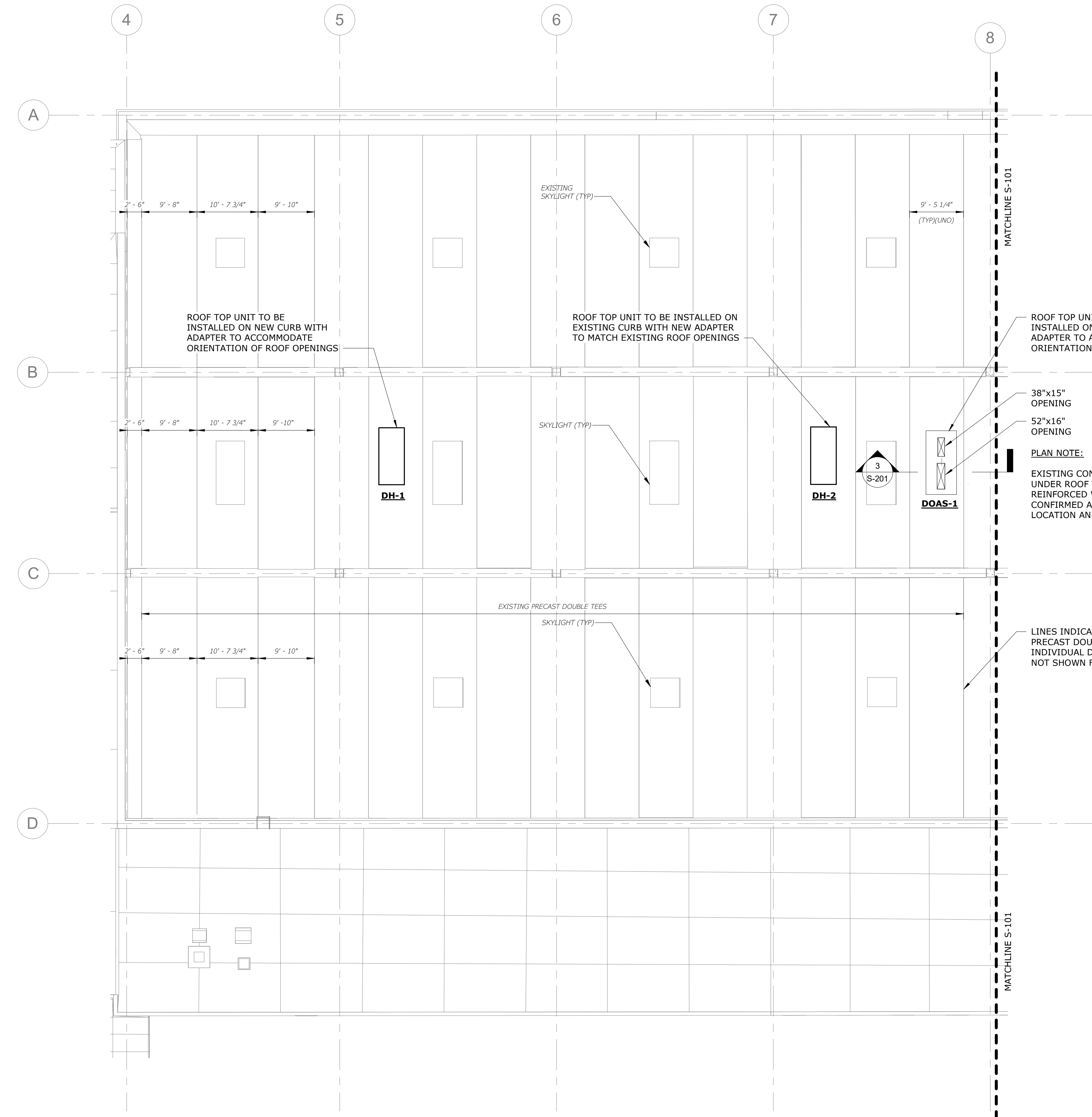
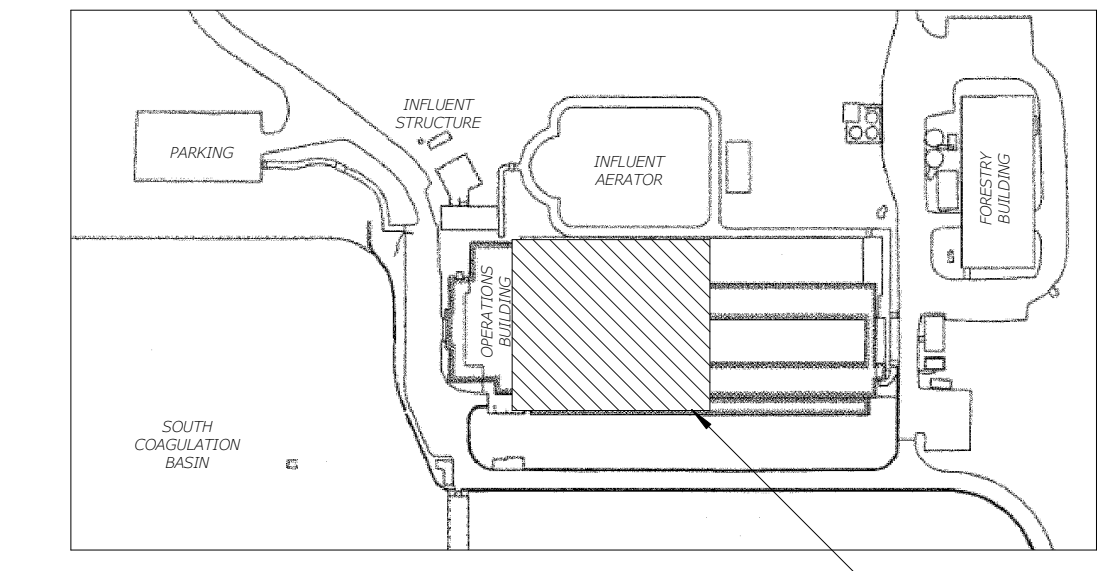
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PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: CS, JC  
DESIGNED/CHECKED BY: DBS, CSF  
APPROVED BY: BRL

STRUCTURAL - CENTRAL FILTER GALLERY ROOF PLAN - SOUTH

SCALE: AS SHOWN

S-102



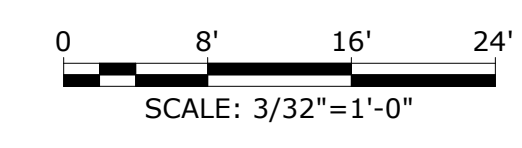
ROOF TOP UNIT TO BE INSTALLED ON NEW CURB WITH ADAPTER TO ACCOMMODATE ORIENTATION OF NEW ROOF OPENINGS

38"x15" OPENING  
52"x16" OPENING

**PLAN NOTE:**  
EXISTING CONCRETE PRECAST DOUBLE TEES FLANGES UNDER ROOF TOP UNIT (DOAS-1) TO BE REINFORCED WITH FRP. STRUCTURAL REINFORCING TO BE CONFIRMED AND DETERMINED BASED ON ACTUAL LOCATION AND SIZE OF OPENINGS

LINES INDICATE JOINTS BETWEEN PRECAST DOUBLE TEE MEMBERS. INDIVIDUAL DOUBLE TEE STEMS NOT SHOWN FOR CLARITY

- NOTE(S):**
- CONTRACTOR SHALL REPAIR/PATCH EXISTING ROOF FOR WEATHER TIGHT FINISH. VERIFY WATER-TIGHT SEAL AFTER WORK IS COMPLETED. SEE ROOF TOP UNIT CURB DETAIL IN S-001.
  - WHERE EXISTING RTU IS TO BE REPLACED, NEW ROOF TOP UNIT TO BE INSTALLED ON EXISTING CURB WITH NEW ADAPTER TO MATCH EXISTING ROOF OPENINGS. SIZE AND LOCATION OF EXISTING ROOF OPENINGS TO BE VERIFIED IN FIELD.

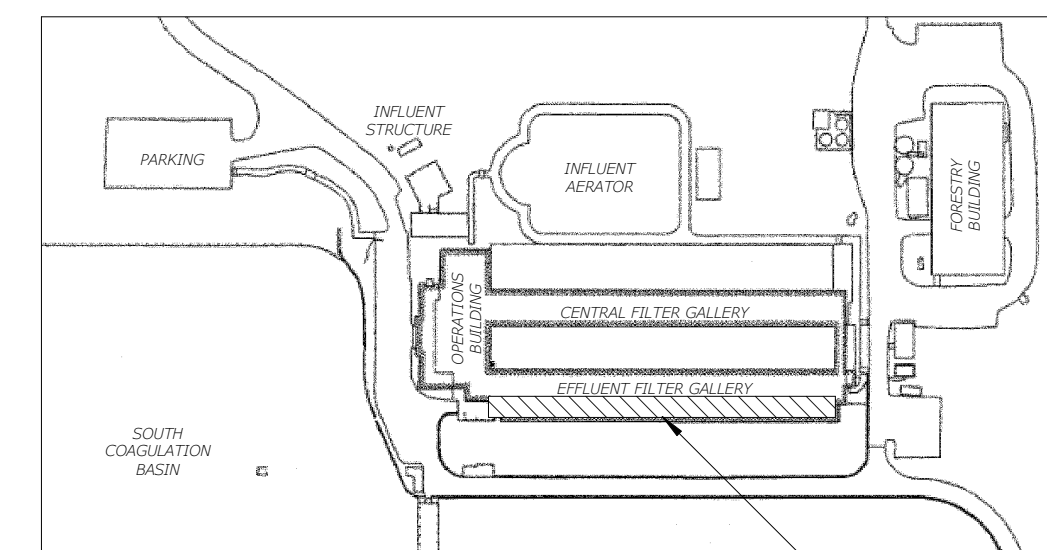


**STRUCTURAL - CENTRAL FILTER GALLERY ROOF PLAN - SOUTH**  
SCALE: 3/32" = 1'-0"

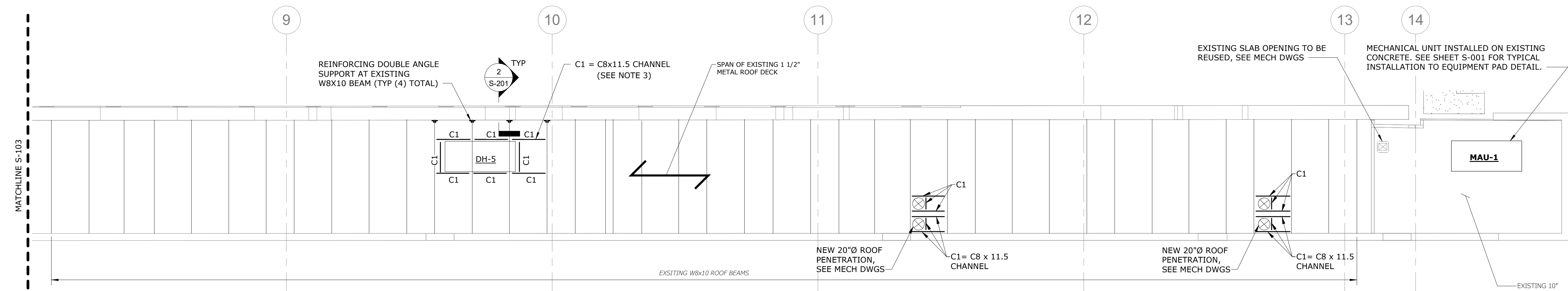
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 Tighe & Bond

BEN LEVESQUE  
No. 7864  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 CIVIL

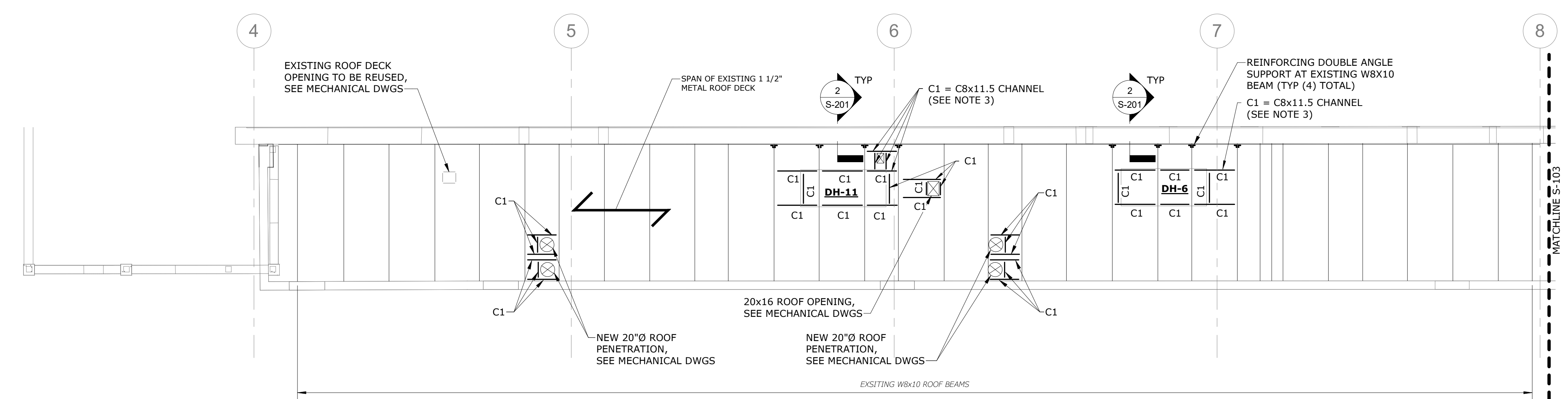
CRAIG FRENCH  
No. 12060  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 STRUCTURAL



**KEY PLAN**  
NO SCALE  
WASHWATER UTILITY STRUCTURE (WORK AREA)

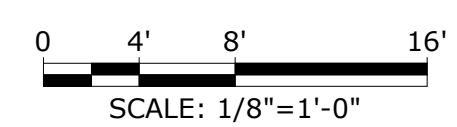


**STRUCTURAL WASHWATER UTILITY STRUCTURE ROOF PLAN - NORTH**  
SCALE: 1/8" = 1'-0"



**STRUCTURAL WASHWATER UTILITY STRUCTURE ROOF PLAN - SOUTH**  
SCALE: 1/8" = 1'-0"

- NOTE(S):**
- CONTRACTOR TO COORDINATE LOCATION OF ROOF TOP UNIT EQUIPMENT SUPPORT FRAMING WITH MECHANICAL DRAWINGS AND MECHANICAL UNIT MANUFACTURER'S REQUIREMENTS
  - ALL NEW STEEL WITHIN WASHWATER UTILITY STRUCTURE SHOULD BE GALVANIZED.
  - SEE SHEET S-001 FOR TYPICAL STEEL CHANNEL AND W-FLANGE BEAM SHEAR CONNECTION DETAILS



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

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DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: CS, JC  
DESIGNED/CHECKED BY: DBS, CSF  
APPROVED BY: BRL

STRUCTURAL WASHWATER UTILITY STRUCTURE ROOF PLAN - NORTH AND SOUTH

SCALE: AS SHOWN

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 File: C:\Users\Bbond\Documents\SP-0740-47\_ARCH Model 2020\_R00app\YNUF.dwg  
 By: CS, JC  
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 04/02/2024

CRAIG FRENCH  
 No. 12060  
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 STRUCTURAL  
 04/02/2024

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

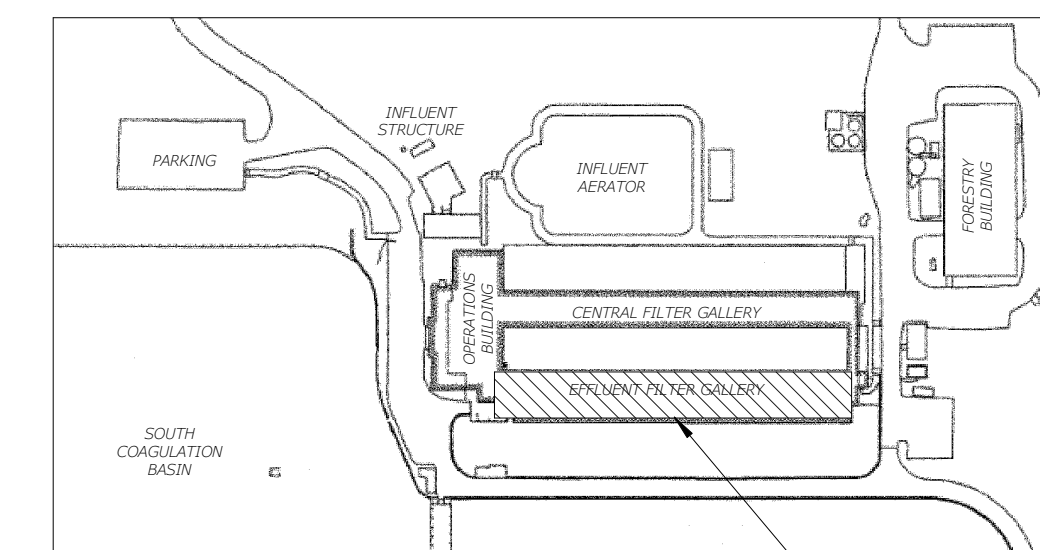
MARK	DATE	DESCRIPTION
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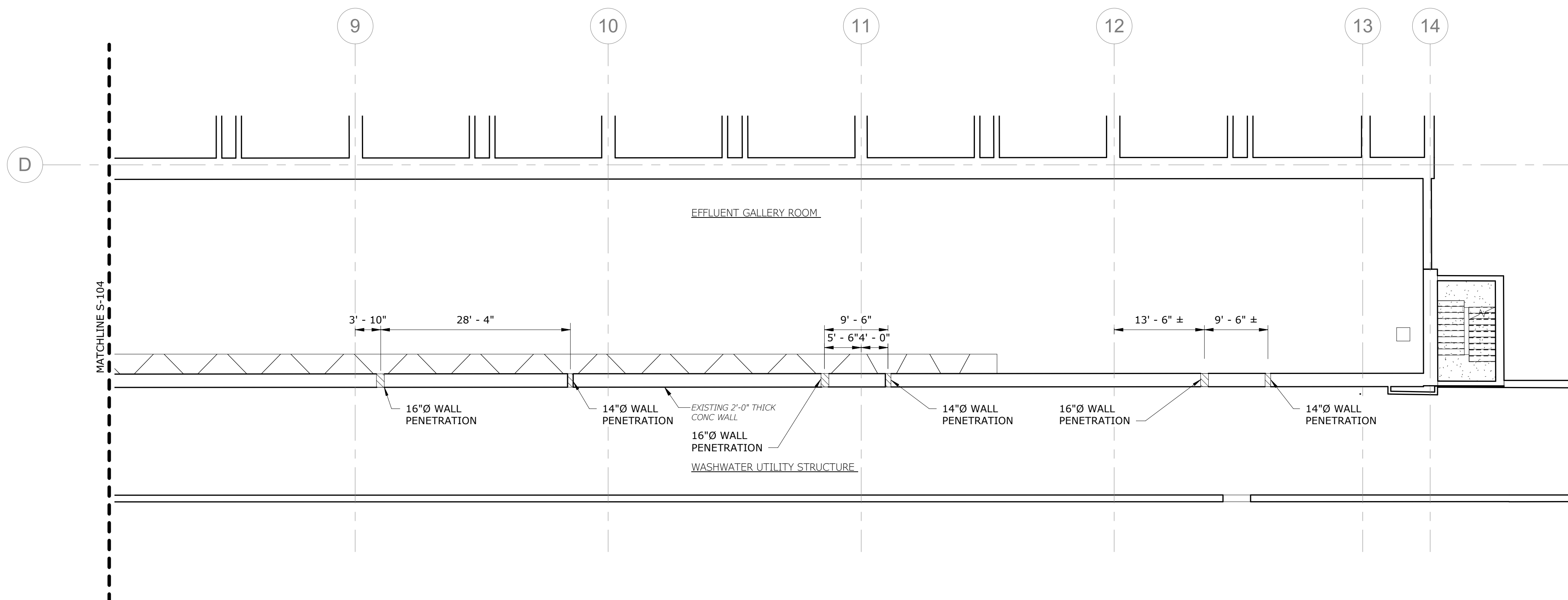
STRUCTURAL - EFFLUENT GALLERY AND WASHWATER UTILITY STRUCTURE - NORTH AND SOUTH

SCALE: AS SHOWN

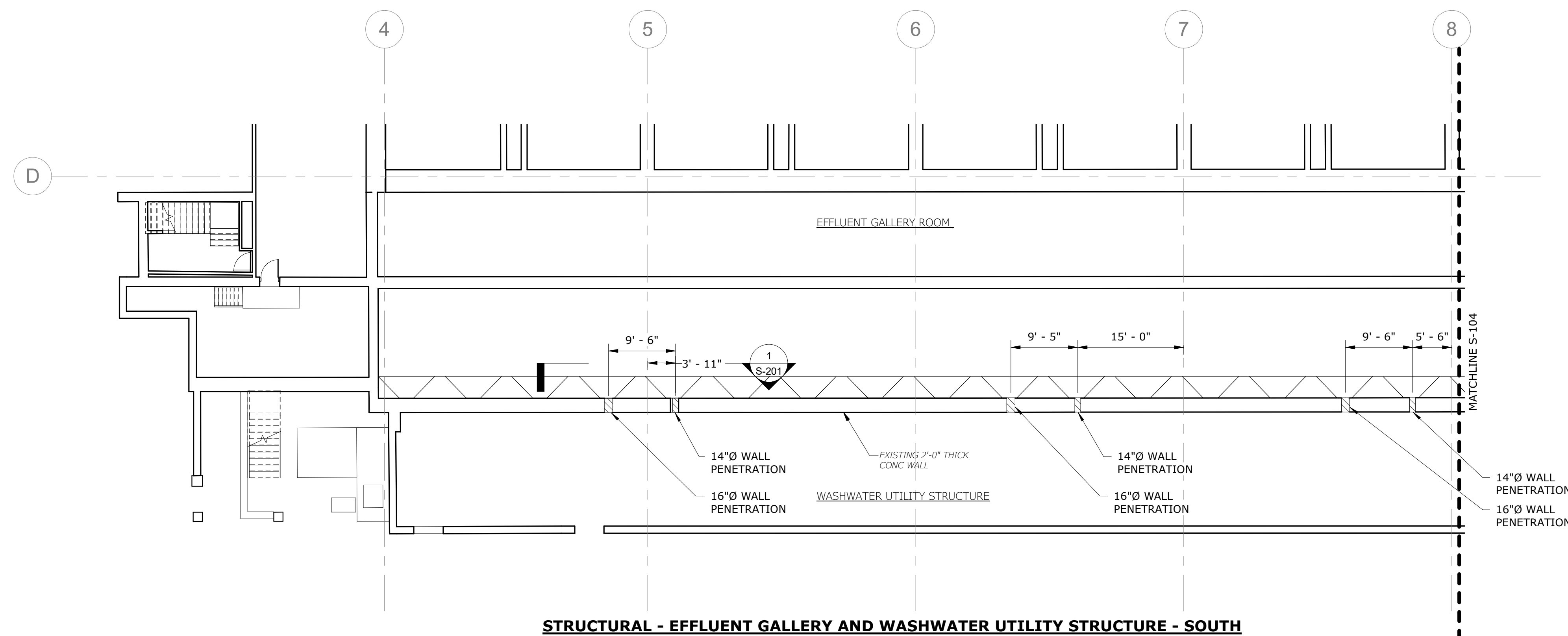
S-104



**KEY PLAN**  
 NO SCALE  
 EFFLUENT GALLERY AND WASHWATER UTILITY STRUCTURE (WORK AREA)



**STRUCTURAL - EFFLUENT GALLERY AND WASHWATER UTILITY STRUCTURE - NORTH**  
 SCALE: 3/32" = 1'-0"



**STRUCTURAL - EFFLUENT GALLERY AND WASHWATER UTILITY STRUCTURE - SOUTH**  
 SCALE: 3/32" = 1'-0"

**NOTE(S):**

- COORDINATE THIS SHEET WITH DEMOLITION PLANS HD-101 THRU HD-106 FOR ADDITIONAL DEMOLITION AREAS, SECTIONS AND DETAILS.
- SEE DETAIL 1/S-201 FOR ADDITIONAL WALL PENETRATION LOCATION INFORMATION.
- DIMENSIONS SHOWN ARE APPROXIMATE, FINAL LOCATION OF OPENINGS SHALL BE COORDINATED WITH DETAIL 1/S-201.



**BEN LEVESQUE**  
 No. 7864  
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 04/02/2024

**CRAIG FRENCH**  
 No. 12060  
 REGISTERED PROFESSIONAL ENGINEER  
 STRUCTURAL  
 04/02/2024

**Dehumidification System Design**

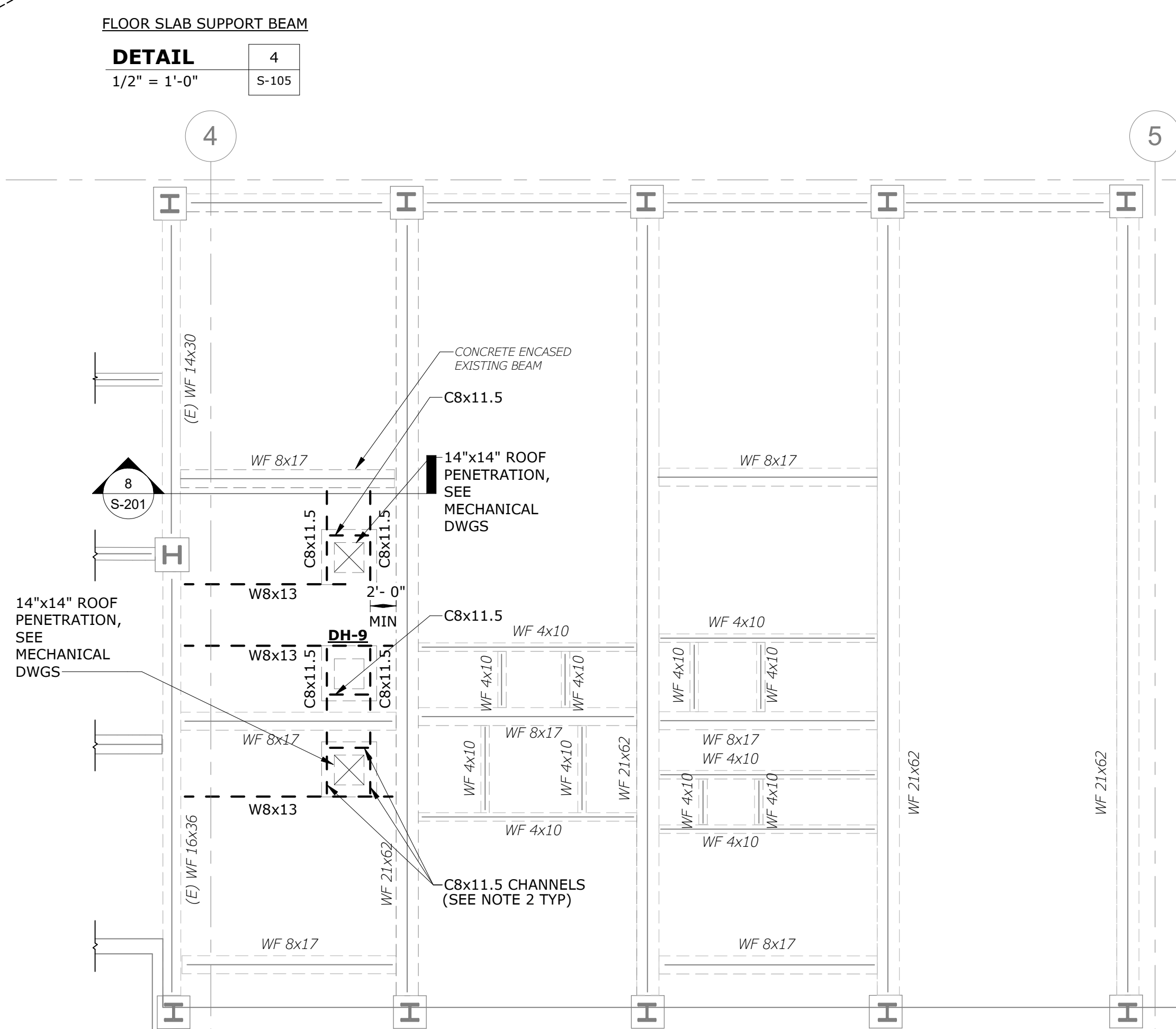
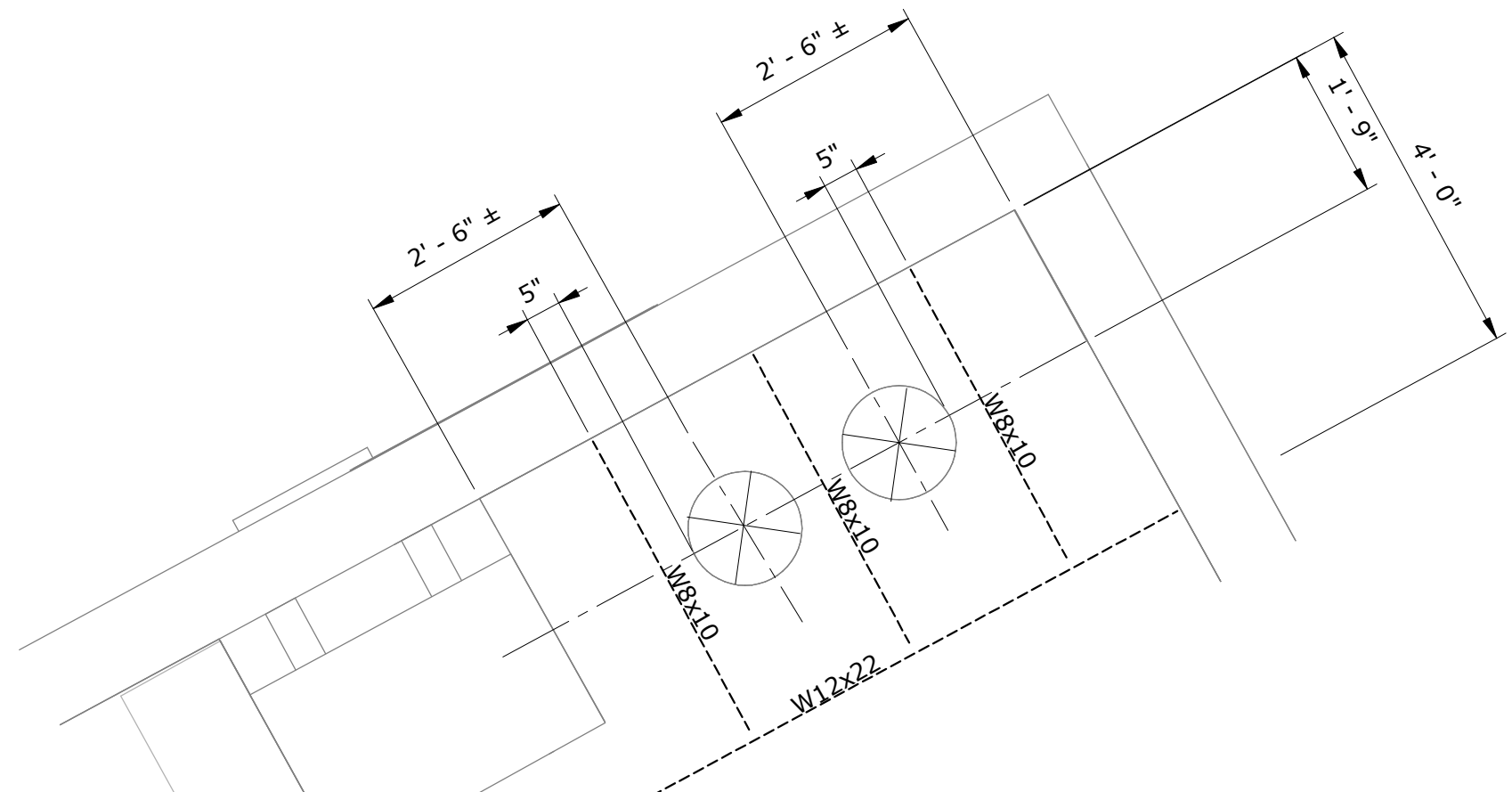
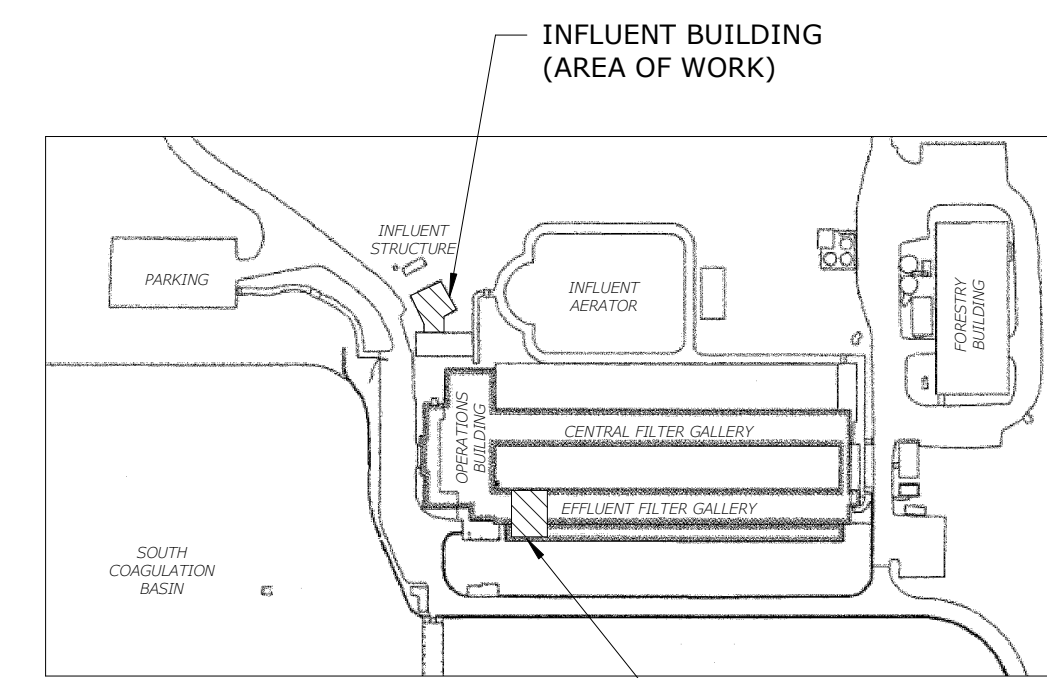
Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO:	P-0740-047	
DATE:	APRIL 2024	
FILE:	P-0740-047	
DRAWN BY:	CS, JC	
DESIGNED/CHECKED BY:	DBS, CSF	
APPROVED BY:	BRL	

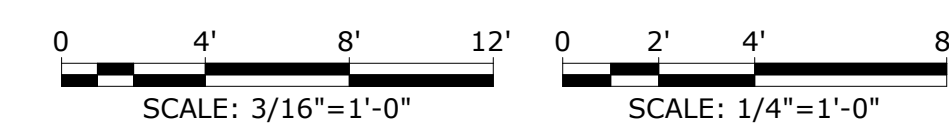
STRUCTURAL CHLORINE STORAGE ROOF PLAN AND INFLUENT BUILDING FLOOR PLAN

SCALE: AS SHOWN

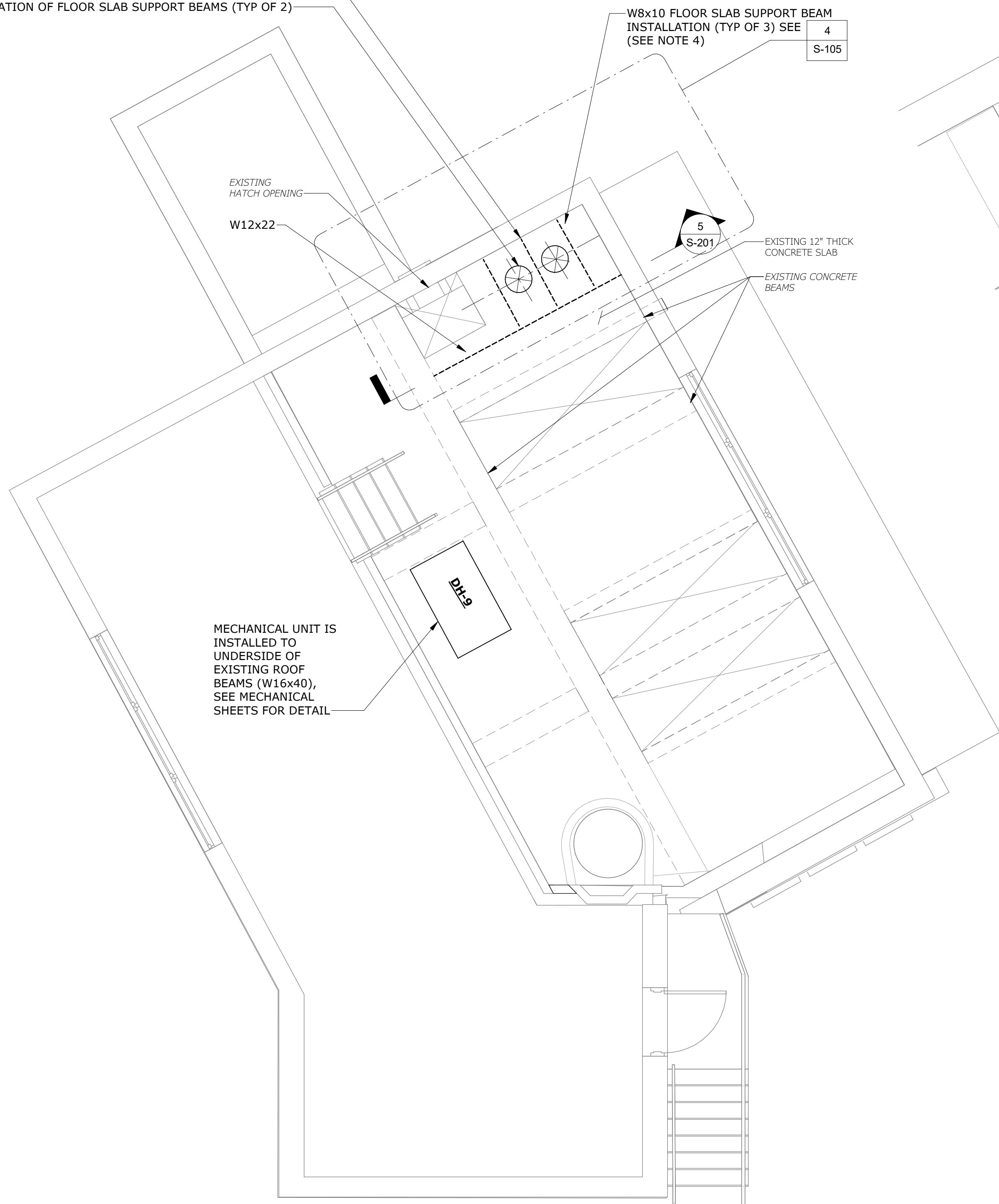


**NOTE(S):**

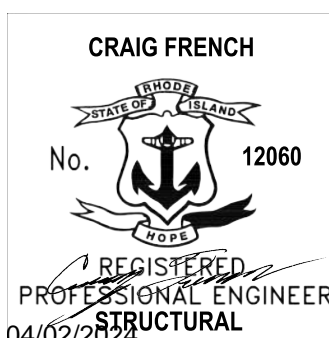
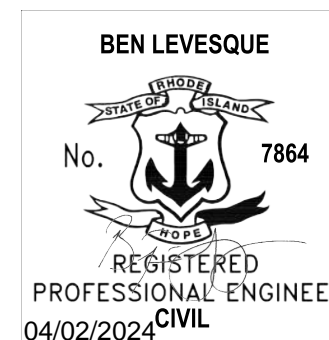
- CONTRACTOR TO COORDINATE LOCATION OF ROOF TOP UNIT EQUIPMENT SUPPORT FRAMING WITH MECHANICAL DRAWINGS AND MECHANICAL UNIT MANUFACTURER'S REQUIREMENT. LOCATE PENETRATIONS ACCORDINGLY TO MINIMIZE THE NUMBER OF EXISTING BARS TO BE CUT.
- EXISTING STEEL FRAMING IS CONCRETE ENCASED, SEE DETAILS 8/S-201.
- ALL FRAMING STEEL, CONNECTION ANGLES AND FASTENERS SHALL BE GALVANIZED PRIOR TO INSTALLATION.



CENTERED BETWEEN DUCT PENETRATIONS  
 16"Ø FLOOR PENETRATION. USE GPR SCAN PRIOR TO DEMOLITION TO LOCATE EXISTING BARS. LOCATE HOLE ACCORDINGLY TO MINIMIZE NUMBER OF EXISTING BARS TO BE CUT COORDINATE WORK WITH INSTALLATION OF FLOOR SLAB SUPPORT BEAMS (TYP OF 2)



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 Title: S-105



**Dehumidification System Design**

Providence Water Supply Board

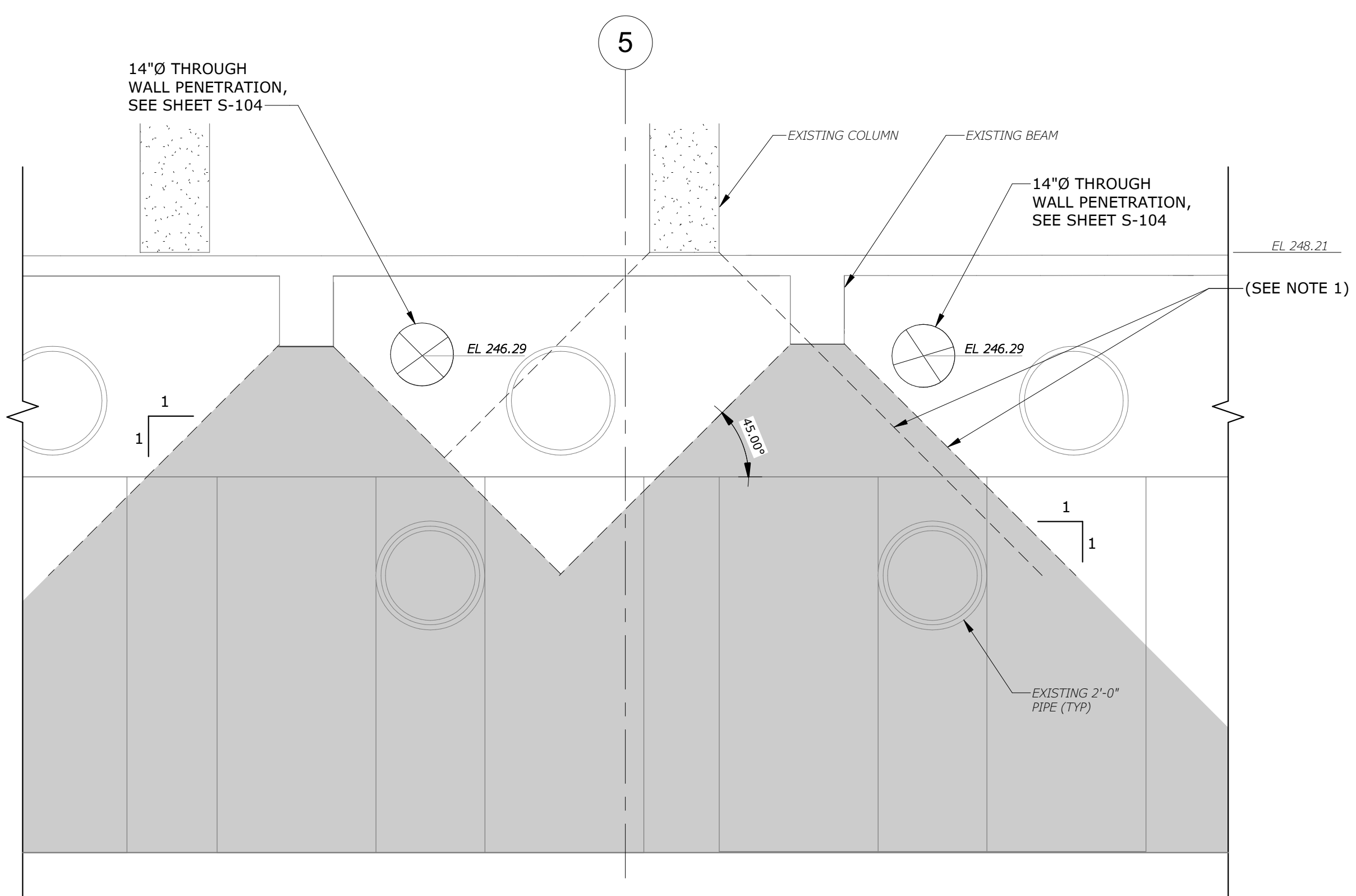
Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
		P-0740-047
PROJECT NO:		APRIL 2024
DATE:		P-0740-047
FILE:		CS, JC
DRAWN BY:		DBS, CSF
DESIGNED/CHECKED BY:		BRL
APPROVED BY:		

SECTIONS

SCALE: AS SHOWN

**S-201**

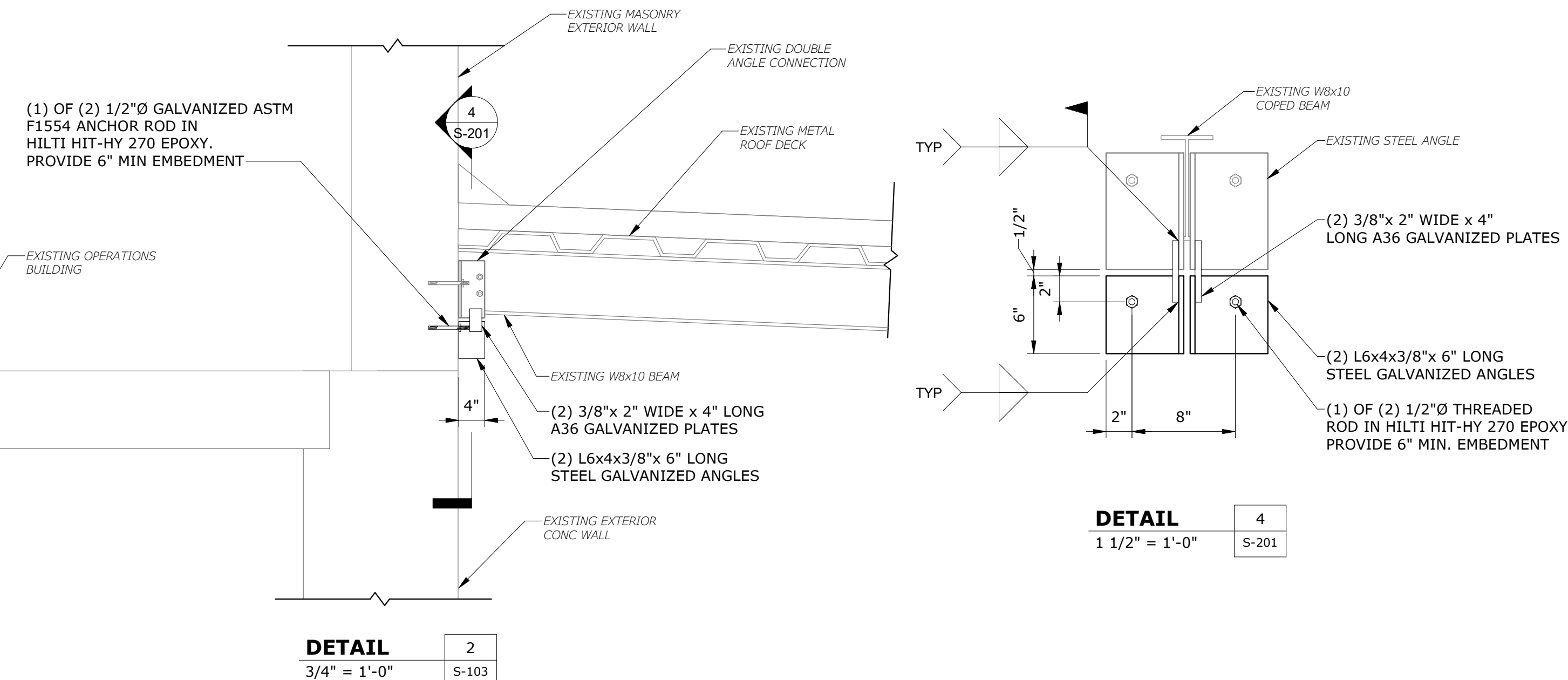


DUCT WALL PENETRATION SECTION

<b>DETAIL</b>	1
1/2" = 1'-0"	S-104

**NOTES:**

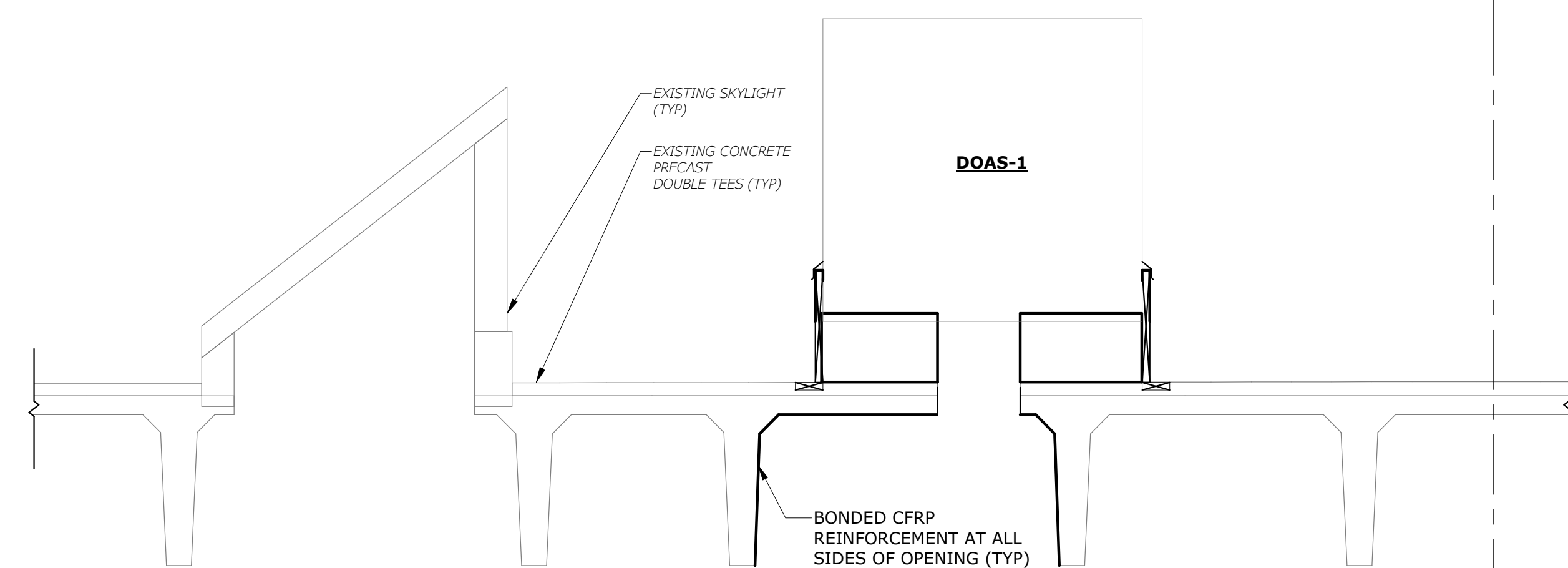
1. NEW WALL PENETRATIONS SHOULD BE LOCATED ABOVE SHADED AREA AS SHOWN IN SECTION.
2. CONTRACTOR TO VERIFY IN FIELD AND MARK LOCATION FOR NEW WALL PENETRATIONS.
3. CONTRACTOR TO CONTACT ENGINEER TO CONFIRM MARKED LOCATION FOR WALL PENETRATIONS BEFORE CONCRETE CORING.
4. THIS SECTION DETAILS THE WALL PENETRATIONS NEAR COLUMN LINE #5 BUT IS TYPICAL OF THE ELEVATION AND LAYOUT PROCEDURE OF ALL WALL PENETRATIONS ON S-104.



<b>DETAIL</b>	2
3/4" = 1'-0"	S-103

**NOTES:**

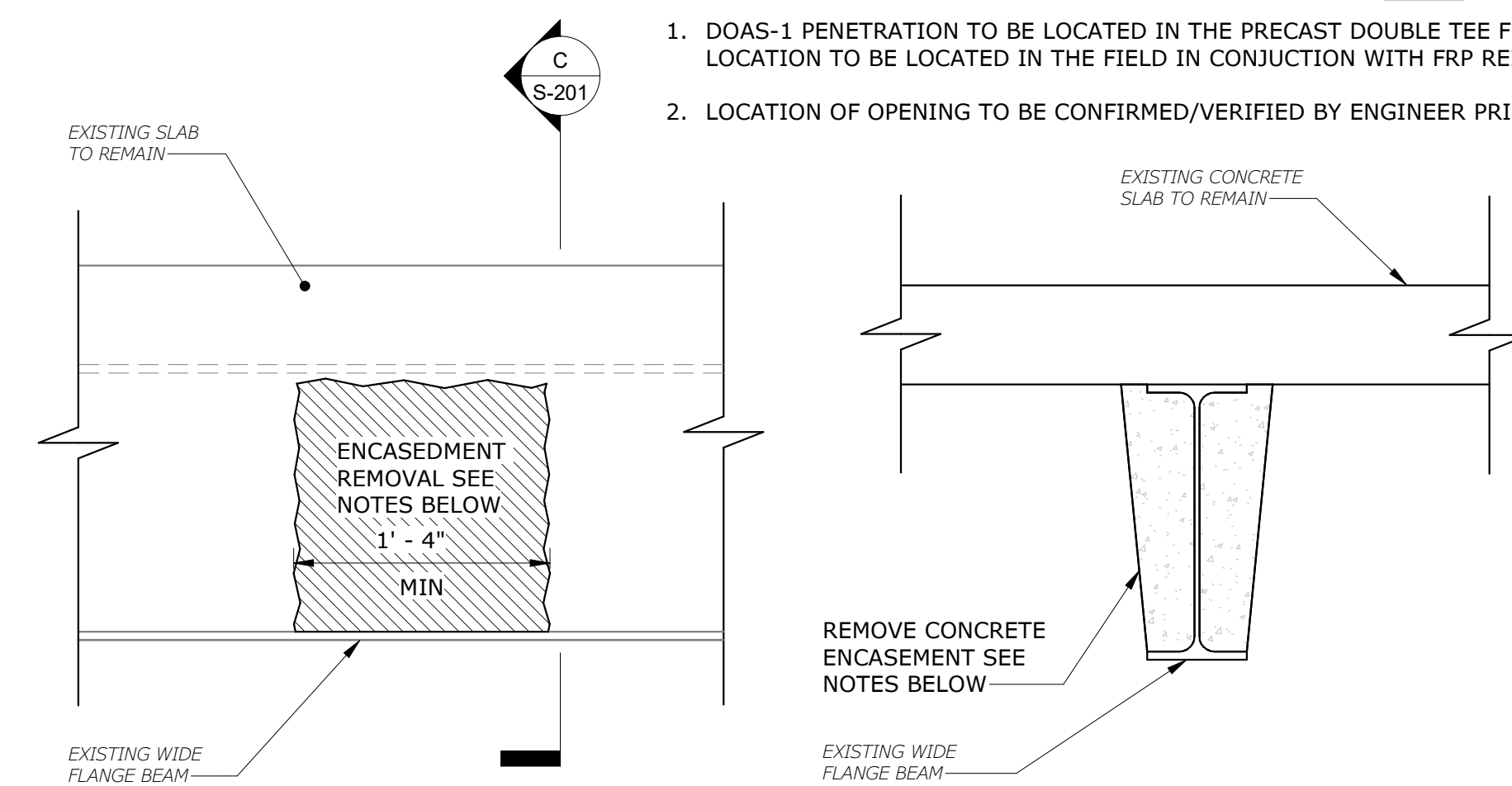
1. ENSURE EXISTING CMU CELL IS GROUTED PRIOR TO INSTALLATION ANCHOR ROD. SEE S-001 FOR ADDITIONAL GROUT INFORMATION.



<b>DETAIL</b>	3
1/2" = 1'-0"	S-102

**NOTES:**

1. DOAS-1 PENETRATION TO BE LOCATED IN THE PRECAST DOUBLE TEE FLANGE ONLY. PENETRATION LOCATION TO BE LOCATED IN THE FIELD IN CONJUNCTION WITH FRP REINFORCEMENT WORK.
2. LOCATION OF OPENING TO BE CONFIRMED/VERIFIED BY ENGINEER PRIOR TO CUTTING PRECAST TEE.



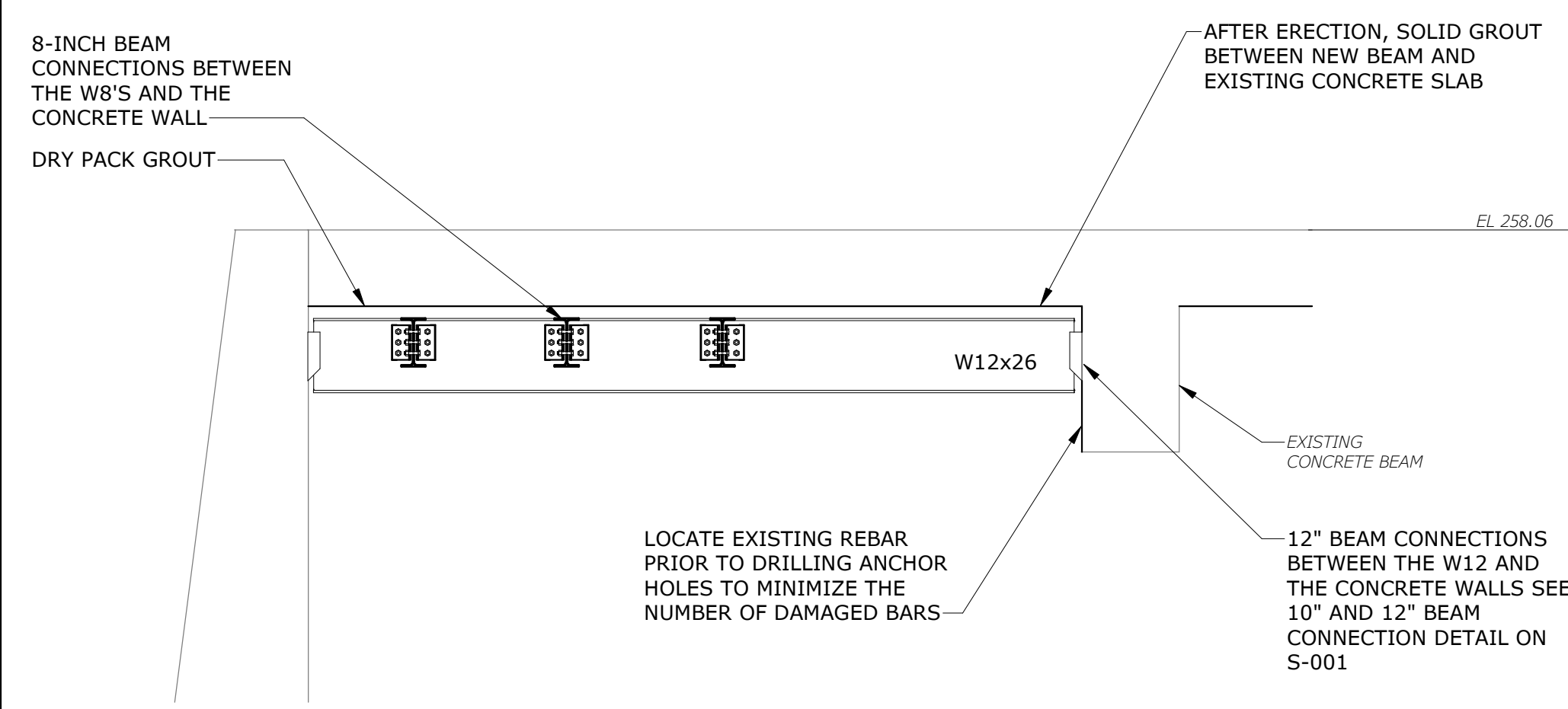
<b>SECTION</b>	C
1 1/2" = 1'-0"	S-201

**NOTES:**

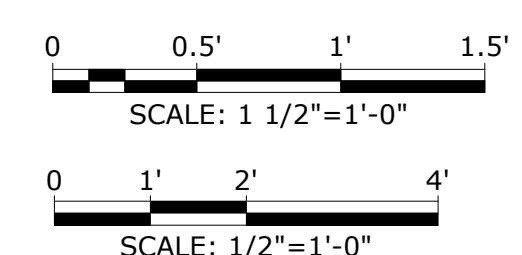
1. DEMOLISH CONCRETE ENCASEMENT TO ALLOW FOR INSTALLATION OF PROPOSED FRAMING CONNECTIONS.
2. CLEAN AND PREP EXISTING STEEL
3. FIELD GALVANIZE EXPOSED AREAS OF EXISTING STEEL FRAMING AFTER REMOVAL OF CONCRETE ENCASEMENT.

**CONCRETE ENCASEMENT BEAM REPAIR**

<b>DETAIL</b>	8
1 1/2" = 1'-0"	S-105

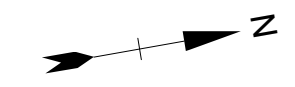


<b>SECTION</b>	5
1/2" = 1'-0"	S-105



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 User: CS, JC  
 Title: S-201





BEN LEVESQUE  
 No. 7864  
 REGISTERED PROFESSIONAL ENGINEER  
 04/02/2024 CIVIL

JEREMY N. RAPOZA  
 No. 14627  
 REGISTERED PROFESSIONAL ENGINEER  
 04/02/2024 MECHANICAL

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

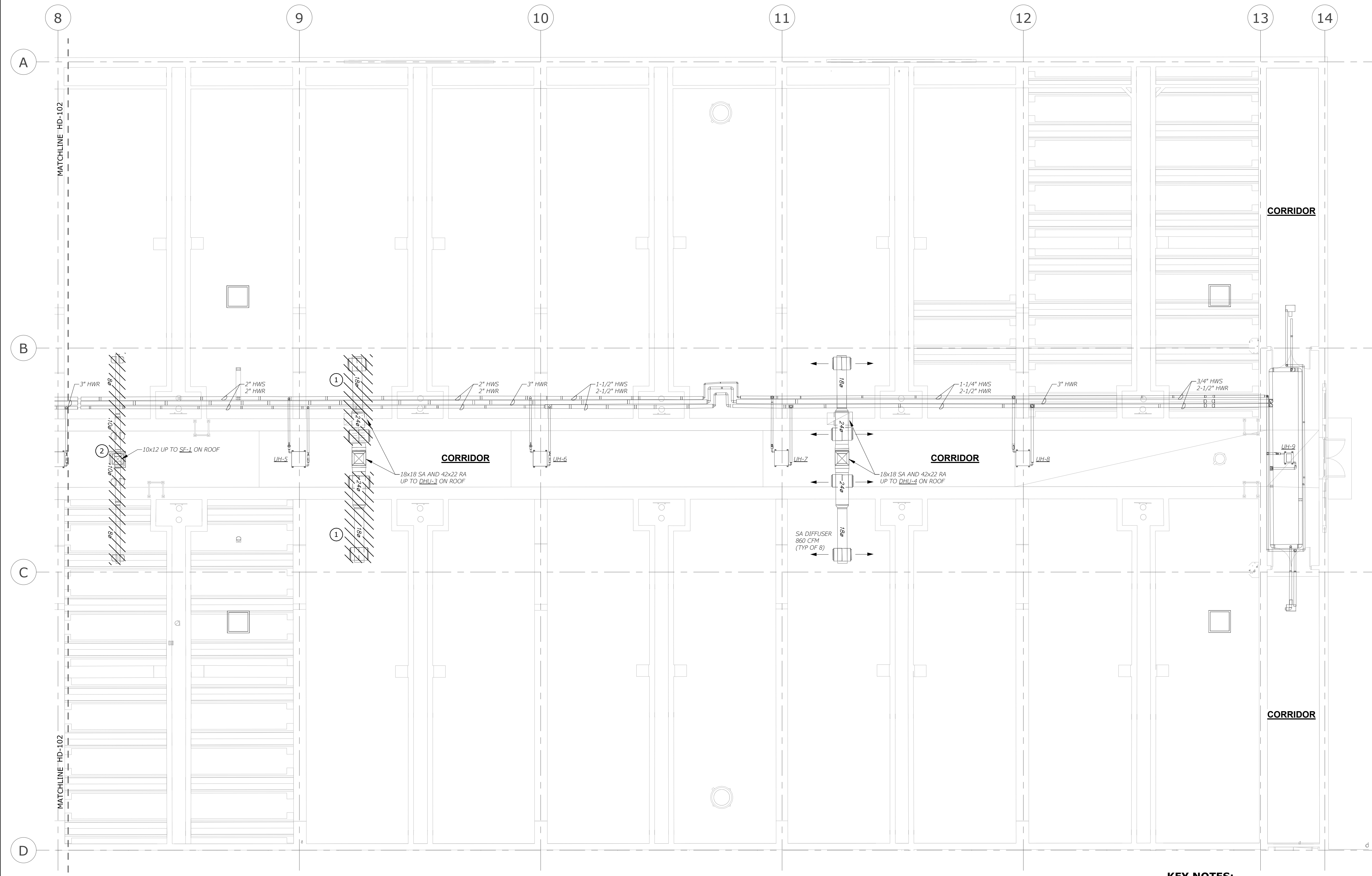
MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, OLR  
 DESIGNED/CHECKED BY: JNR, SJP  
 APPROVED BY: BRL

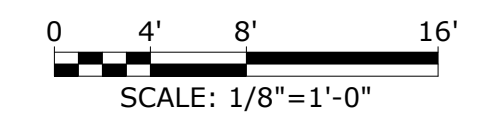
HVAC DEMOLITION - CENTRAL FILTER GALLERY & FILTER BED PLANS - NORTH

SCALE: AS SHOWN

HD-101

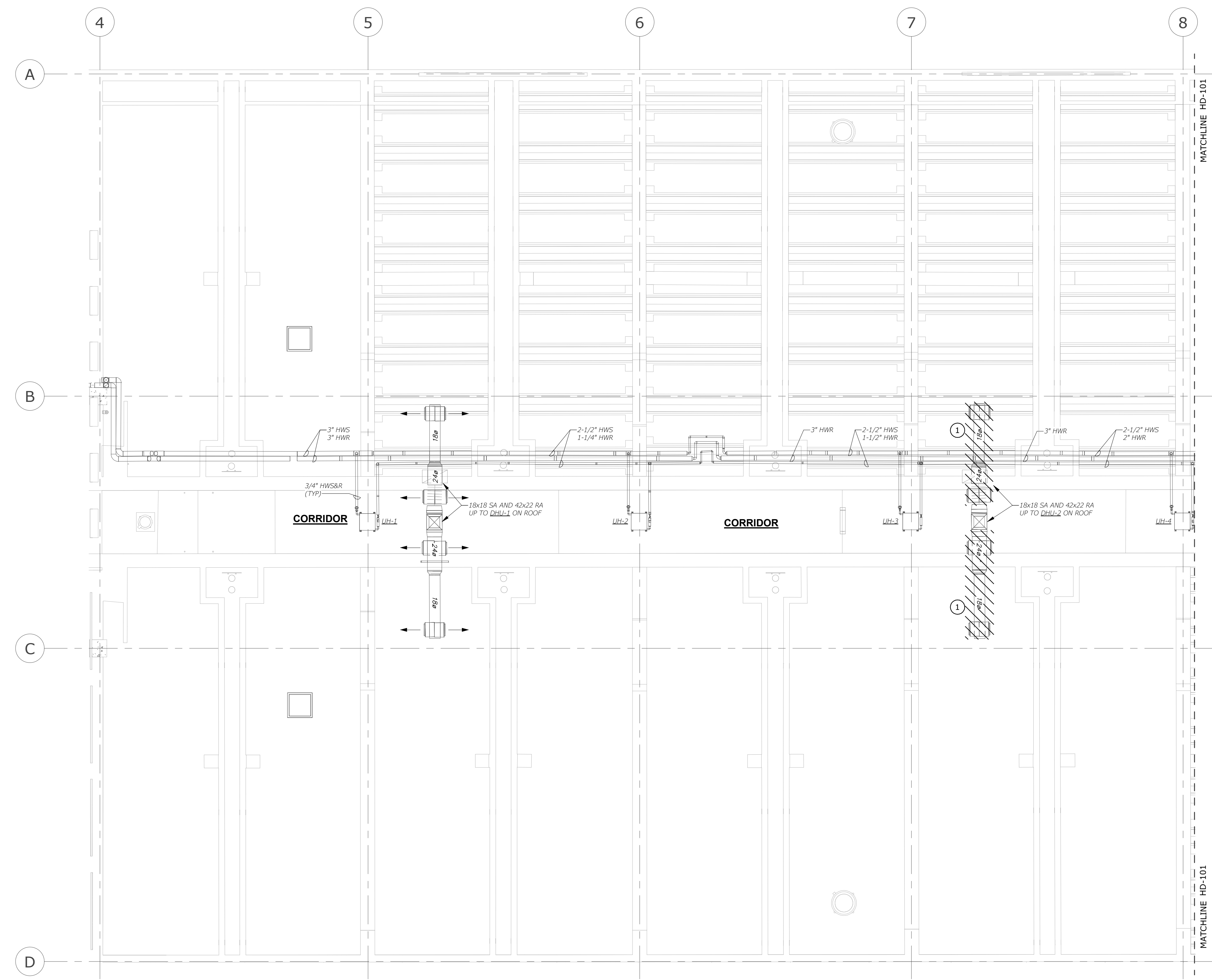
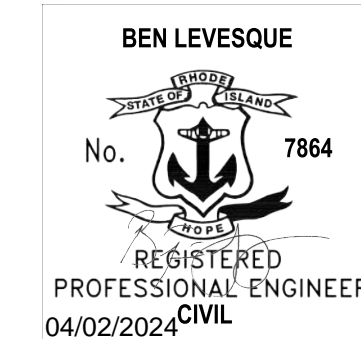
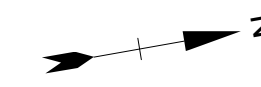


- KEY NOTES:**
- ① DEMOLISH DUCTWORK TO THE EXTENT SHOWN. RISERS UP TO DHU-3 TO REMAIN.
  - ② DEMOLISH SF-1 AND ASSOCIATED DUCTWORK. CAP CURB WITH INSULATED CURB CAP.



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 Tighe & Bond





**KEY NOTES:**

- ① DEMOLISH EXISTING DUCTWORK TO THE EXTENT SHOWN. RISERS UP TO DHU-2 TO REMAIN.



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate,  
Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, OLR  
 DESIGNED/CHECKED BY: JNR, SJP  
 APPROVED BY: BRL

HVAC DEMOLITION - CENTRAL FILTER GALLERY & FILTER BED PLANS - SOUTH

SCALE: AS SHOWN

**HD-102**



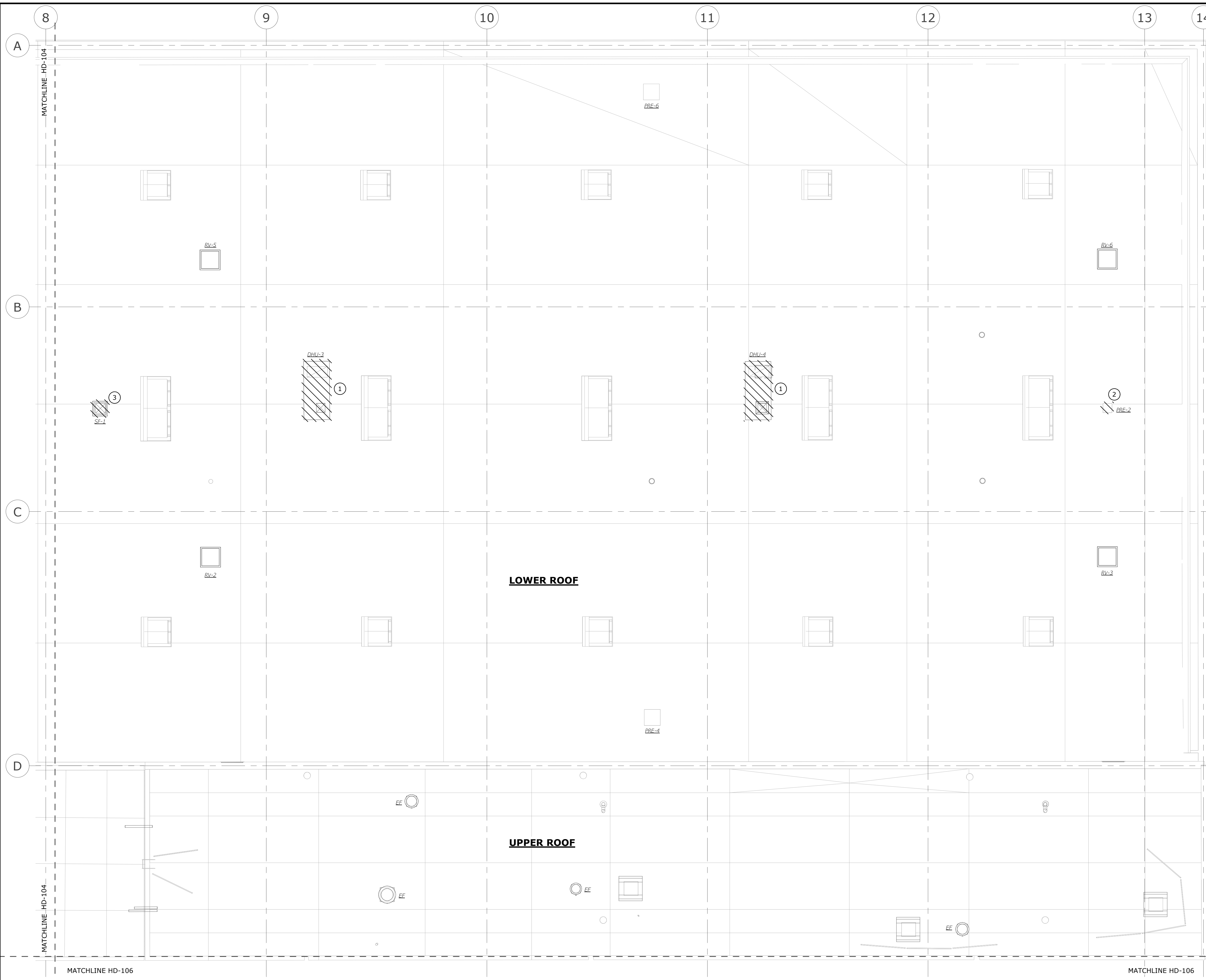
**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

**KEY NOTES:**

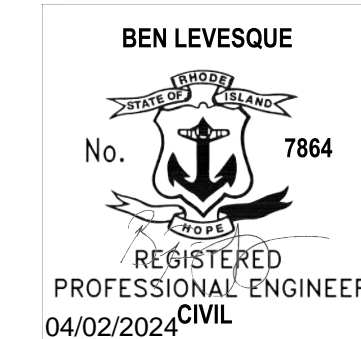
- ① DEMOLISH DEHUMIDIFIER AND ASSOCIATED CONTROLS. CURB TO REMAIN. TEMPORARILY CAP OPENINGS UNTIL NEW DH UNITS ARE INSTALLED.
- ② DEMOLISH EXHAUST FAN AND ASSOCIATED CONTROLS. CURB TO REMAIN. PROVIDE INSULATED CURB CAP TO COVER.
- ③ DEMOLISH GRAVITY VENTILATOR INTAKE AND SUPPLY FAN. TEMPORARILY CAP OPENING UNTIL NEW DOAS IS INSTALLED.



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SCALE: AS SHOWN

**HD-103**



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

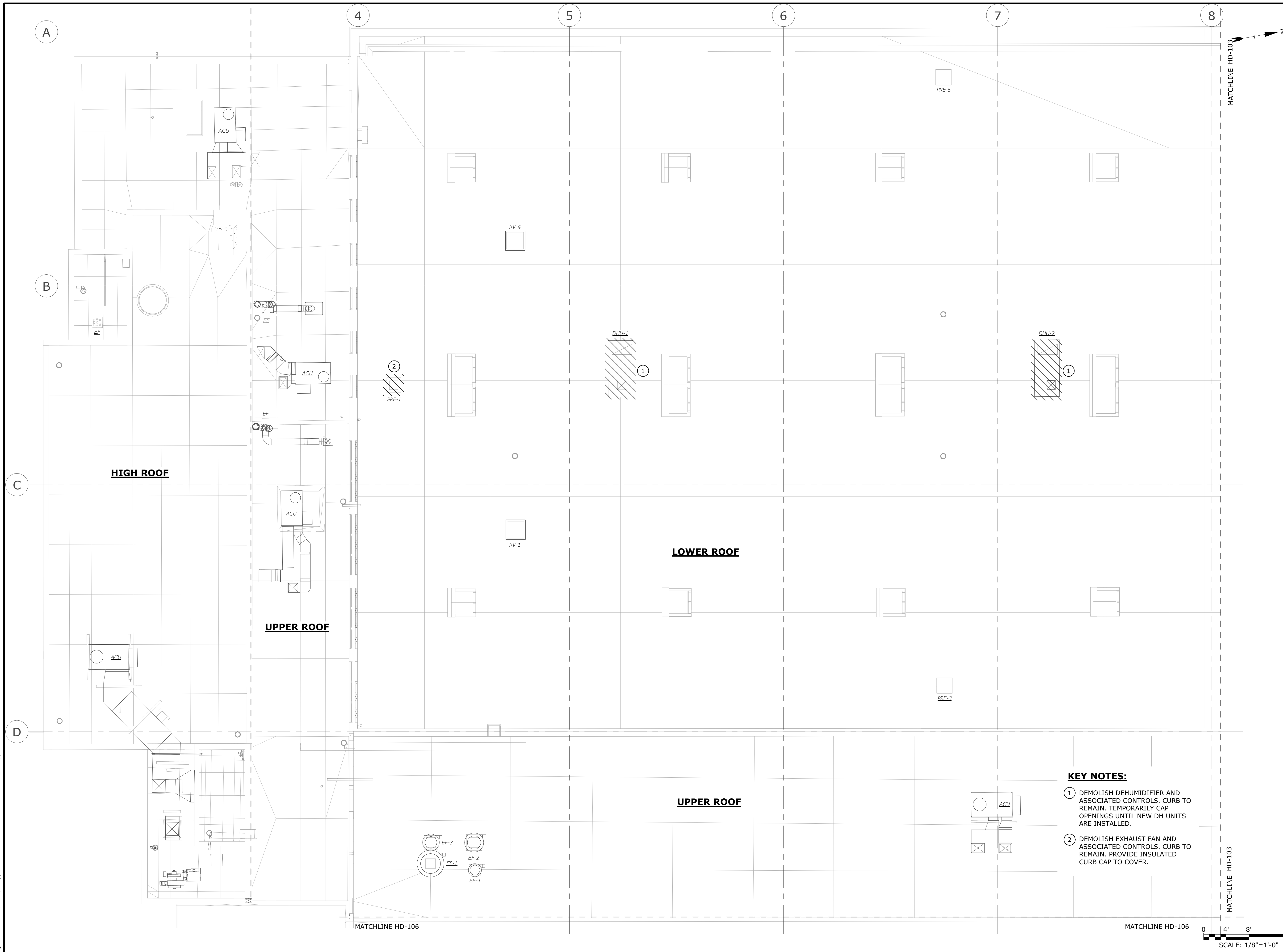
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PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: RAK, OLR  
DESIGNED/CHECKED BY: JNR, SJP  
APPROVED BY: BRL

HVAC DEMOLITION - ROOF PLAN - SOUTH

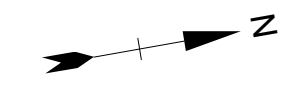
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**HD-104**



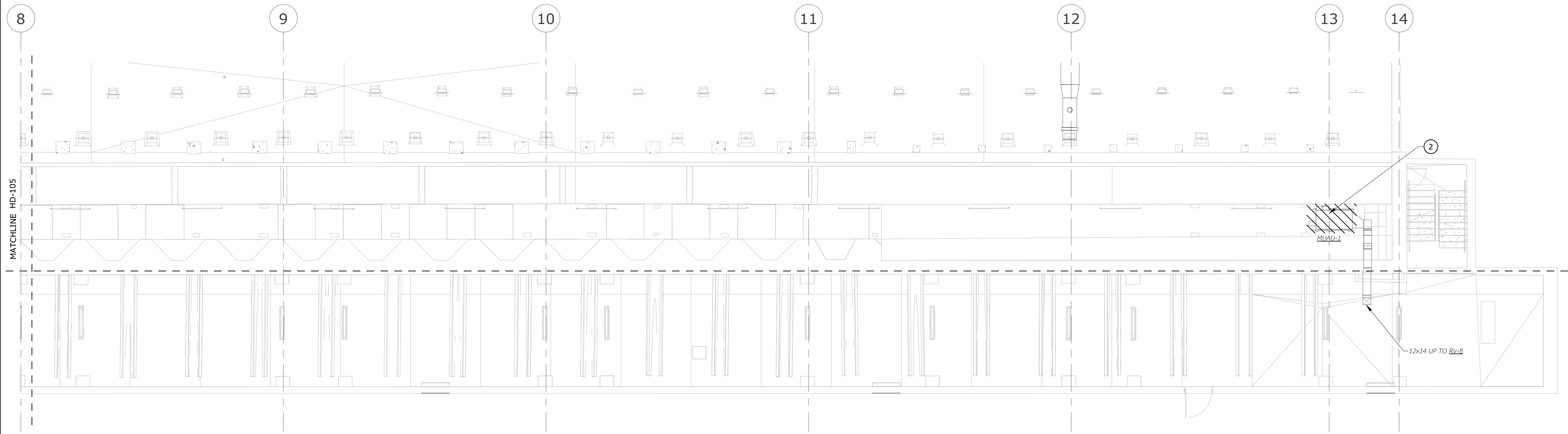
- KEY NOTES:**
- ① DEMOLISH DEHUMIDIFIER AND ASSOCIATED CONTROLS. CURB TO REMAIN. TEMPORARILY CAP OPENINGS UNTIL NEW DH UNITS ARE INSTALLED.
  - ② DEMOLISH EXHAUST FAN AND ASSOCIATED CONTROLS. CURB TO REMAIN. PROVIDE INSULATED CURB CAP TO COVER.

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 Tighe & Bond

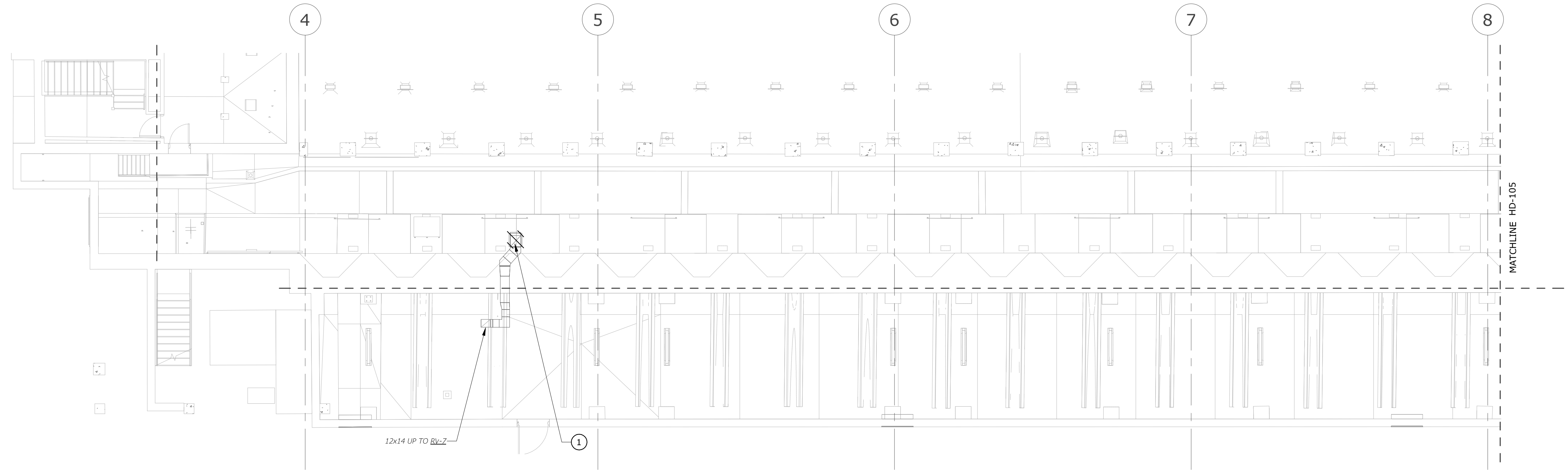


BEN LEVESQUE  
 No. 7864  
 REGISTERED PROFESSIONAL ENGINEER  
 04/02/2024 CIVIL

JEREMY N. RAPOZA  
 No. 14627  
 REGISTERED PROFESSIONAL ENGINEER  
 04/02/2024 MECHANICAL



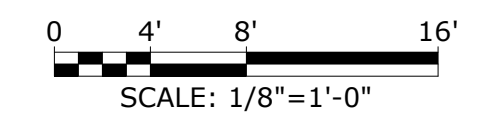
**HVAC DEMOLITION - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - NORTH**



**HVAC DEMOLITION - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - SOUTH**

**KEY NOTES:**

- ① DEMOLISH EXHAUST FAN AND ASSOCIATED CONTROLS. CURB TO REMAIN. PROVIDE INSULATED CURB CAP TO COVER.
- ② DEMOLISH MUAU-1 AND ASSOCIATED CONTROLS. CURB TO REMAIN. PROVIDE INSULATED CURB CAP TO COVER.



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

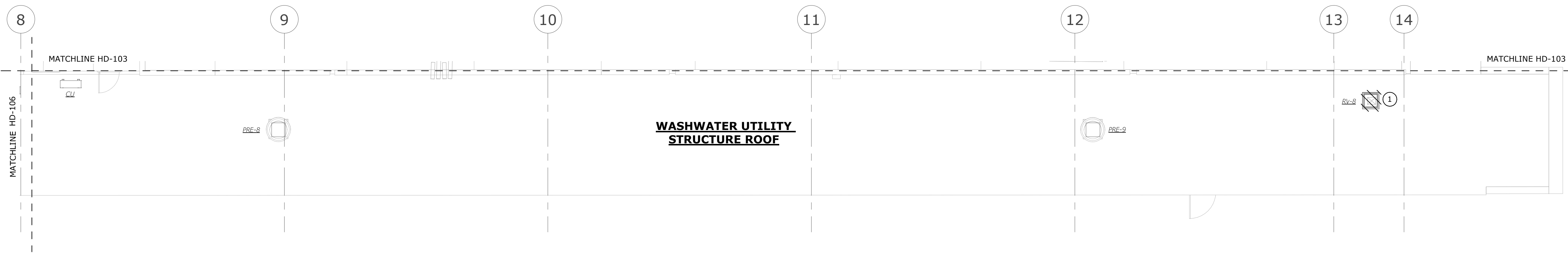
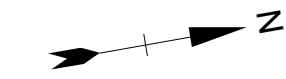
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PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, OLR  
 DESIGNED/CHECKED BY: JNR, SJP  
 APPROVED BY: BRL

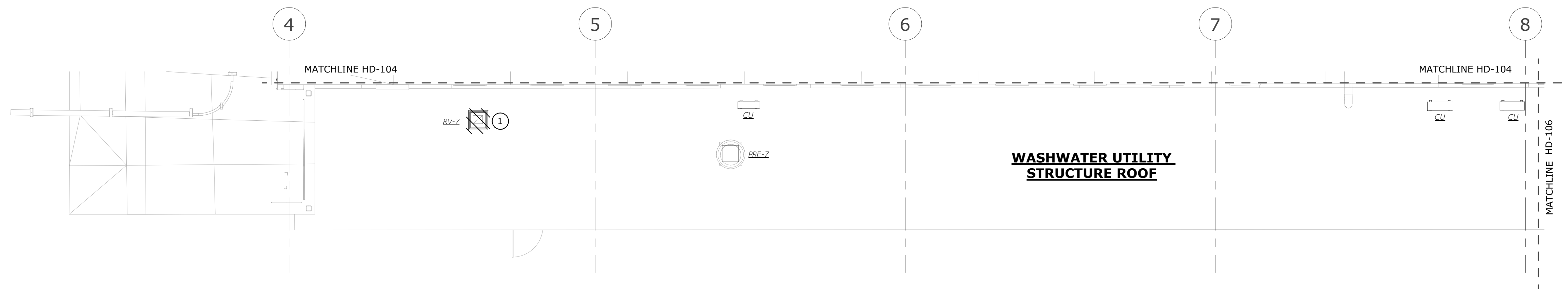
HVAC DEMOLITION - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN

SCALE: AS SHOWN

**HD-105**



**HVAC DEMOLITION - WASHWATER UTILITY STRUCTURE ROOF PLAN - NORTH**



**HVAC DEMOLITION - WASHWATER UTILITY STRUCTURE ROOF PLAN - SOUTH**

**Dehumidification System Design**

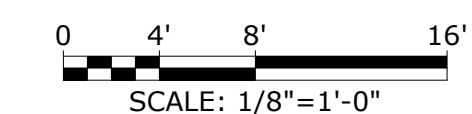
Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate,  
Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

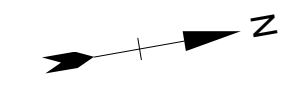
**KEY NOTES:**

- 1 DEMOLISH GRAVITY VENTILATOR. CURB TO REMAIN. PROVIDE INSULATED CURB CAP TO COVER.



SCALE: AS SHOWN

**HD-106**



BEN LEVESQUE  
No. 7864  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 CIVIL

JEREMY N. RAPOZA  
No. 14627  
REGISTERED PROFESSIONAL ENGINEER  
04/02/2024 MECHANICAL

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

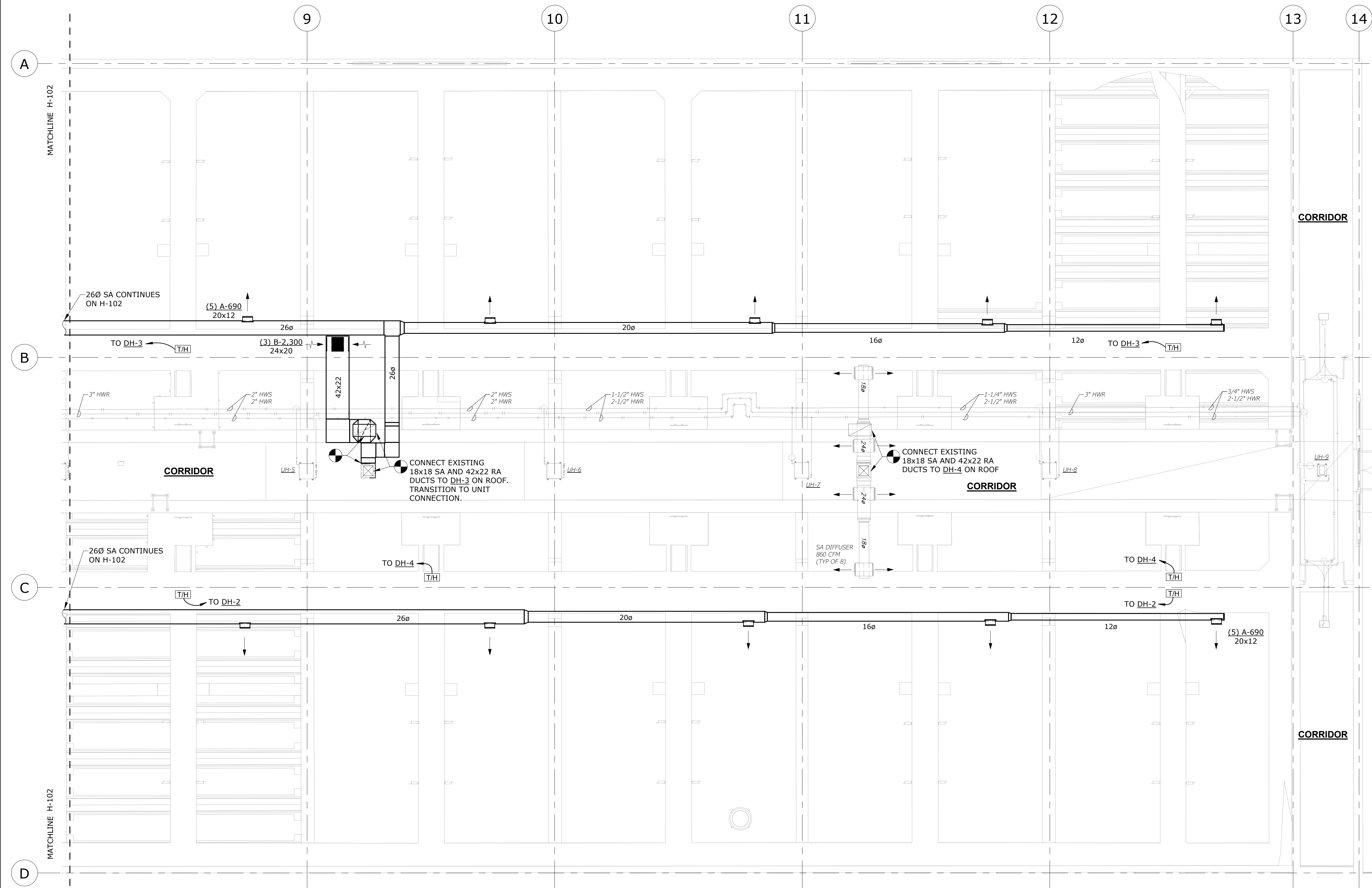
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PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: RAK, OLR  
DESIGNED/CHECKED BY: JNR, SJP  
APPROVED BY: BRL

HVAC - CENTRAL FILTER GALLERY & FILTER BED PLANS - NORTH

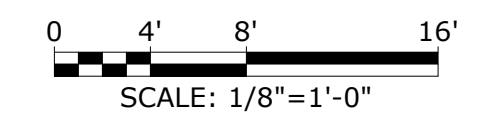
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H-101

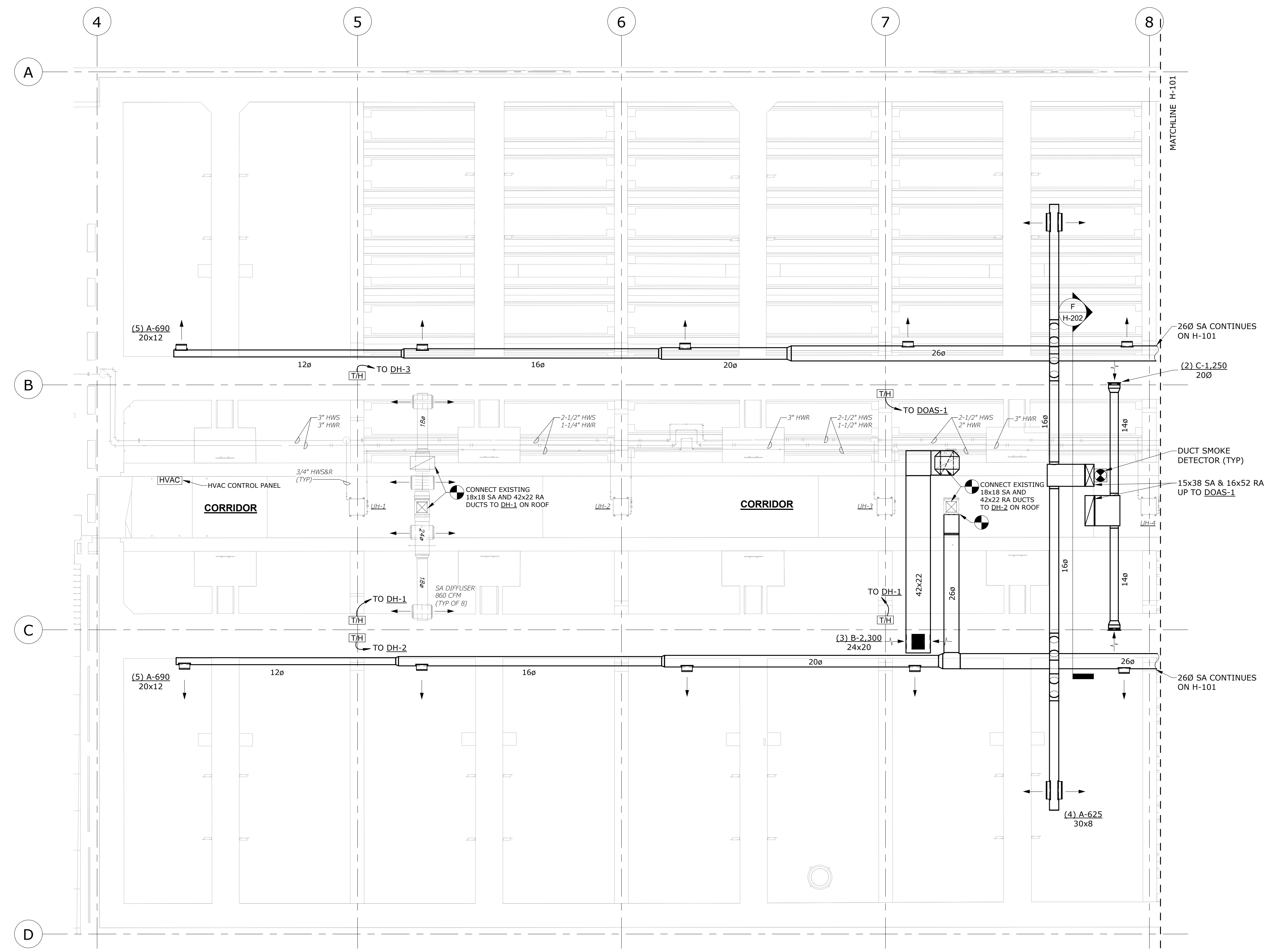
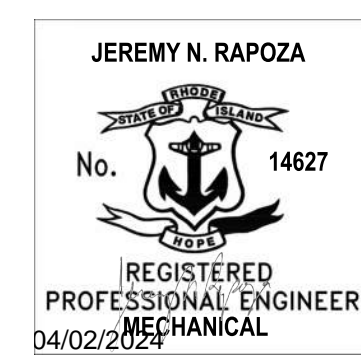
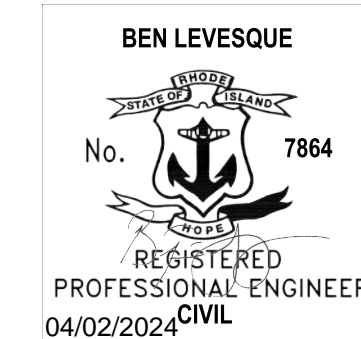
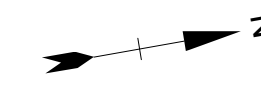


**NOTES:**

- BALANCE EXISTING AIR INLETS AND OUTLETS TO THE AIRFLOWS SHOWN.



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 Title: Tighe & Bond



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, OLR  
 DESIGNED/CHECKED BY: JNR, SJP  
 APPROVED BY: BRL

SCALE: AS SHOWN

H-102

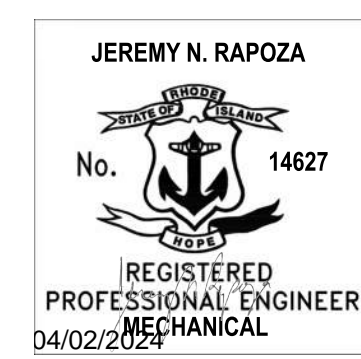
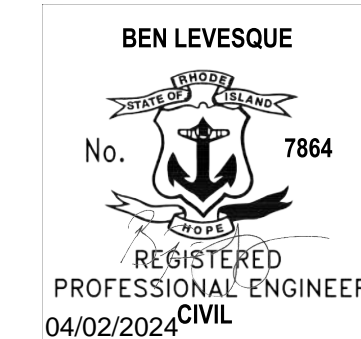
- NOTES:**
- BALANCE EXISTING AIR INLETS AND OUTLETS TO THE AIRFLOWS SHOWN.



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 Tighe & Bond



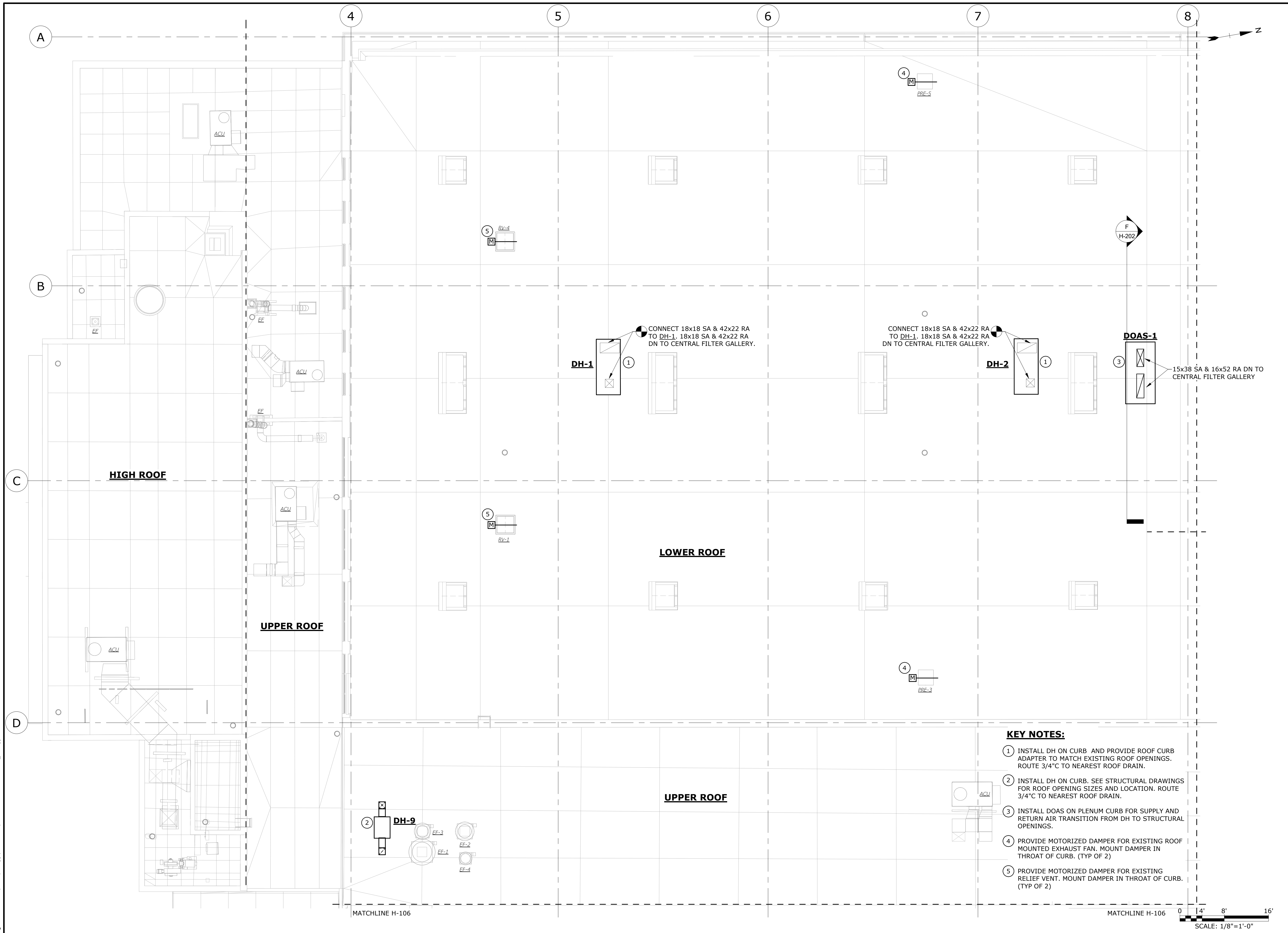




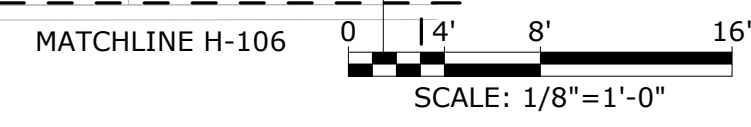
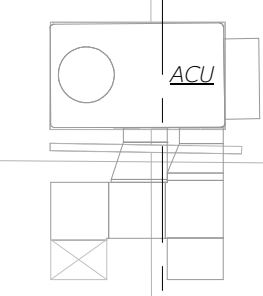
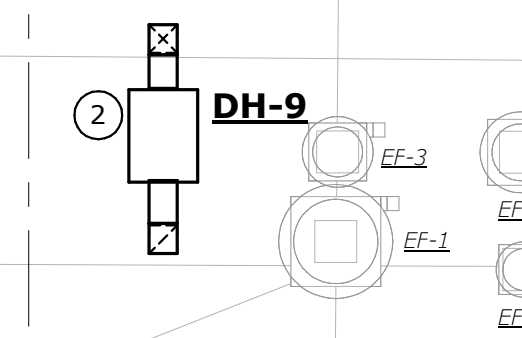
**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island



- KEY NOTES:**
- ① INSTALL DH ON CURB AND PROVIDE ROOF CURB ADAPTER TO MATCH EXISTING ROOF OPENINGS. ROUTE 3/4" C TO NEAREST ROOF DRAIN.
  - ② INSTALL DH ON CURB. SEE STRUCTURAL DRAWINGS FOR ROOF OPENING SIZES AND LOCATION. ROUTE 3/4" C TO NEAREST ROOF DRAIN.
  - ③ INSTALL DOAS ON PLENUM CURB FOR SUPPLY AND RETURN AIR TRANSITION FROM DH TO STRUCTURAL OPENINGS.
  - ④ PROVIDE MOTORIZED DAMPER FOR EXISTING ROOF MOUNTED EXHAUST FAN. MOUNT DAMPER IN THROAT OF CURB. (TYP OF 2)
  - ⑤ PROVIDE MOTORIZED DAMPER FOR EXISTING RELIEF VENT. MOUNT DAMPER IN THROAT OF CURB. (TYP OF 2)



MATCHLINE H-106

MATCHLINE H-106

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 Title: Tighe & Bond

MARK	DATE	DESCRIPTION
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PROJECT NO: P-0740-047  
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 DRAWN BY: RAK, OLR  
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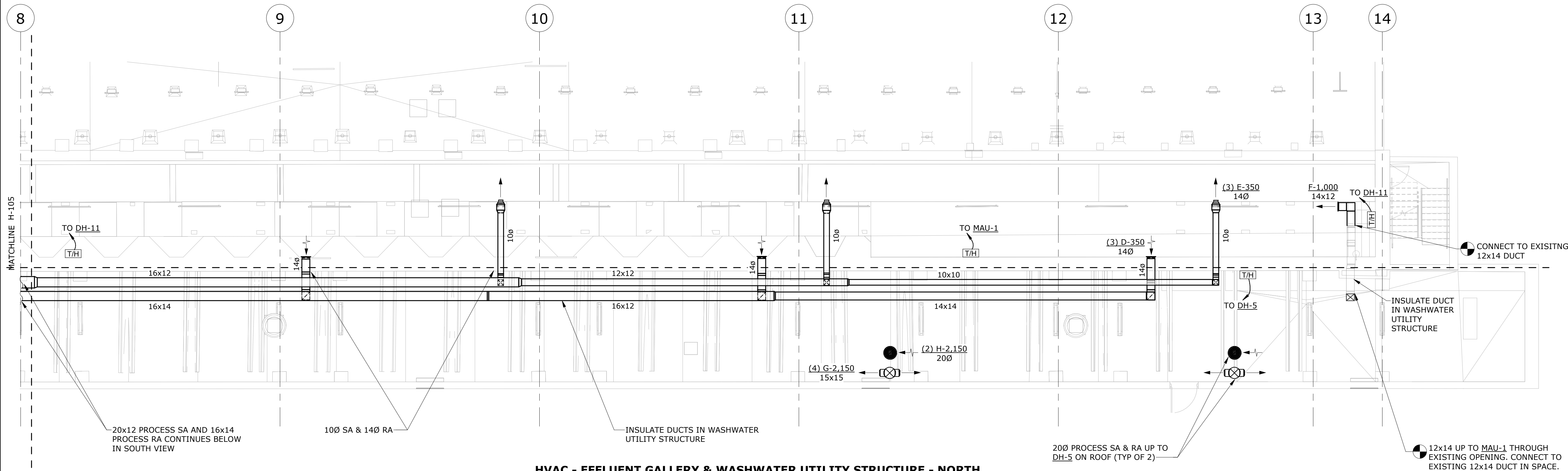
HVAC - ROOF PLAN - SOUTH

SCALE: AS SHOWN

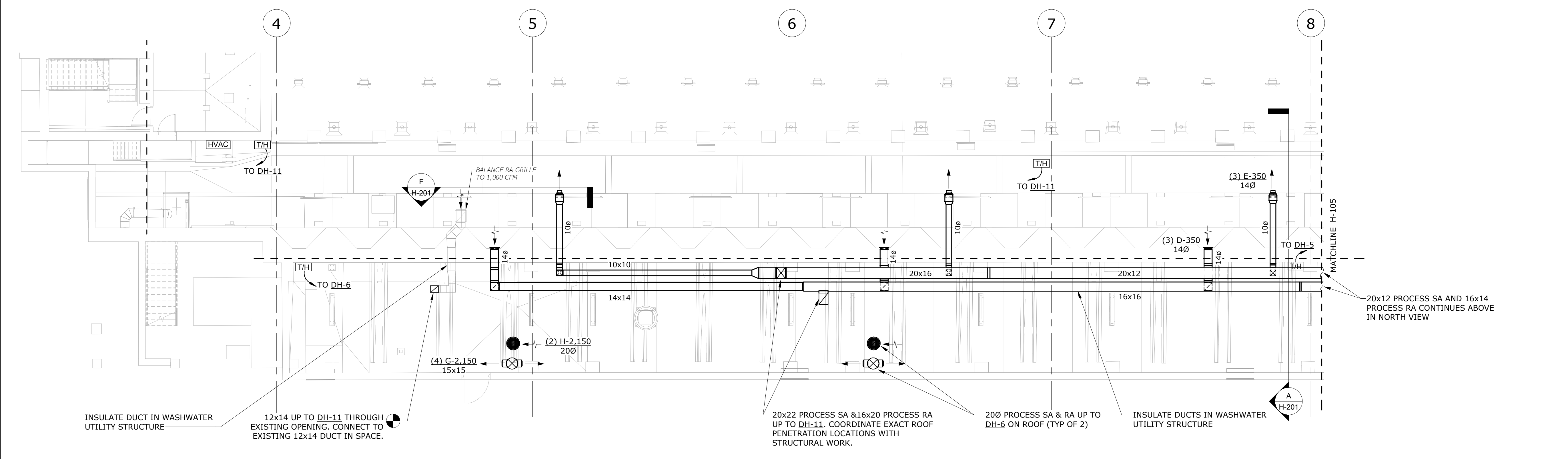


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 04/02/2024 MECHANICAL



**HVAC - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - NORTH**



**HVAC - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - SOUTH**

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO:	P-0740-047	
DATE:	APRIL 2024	
FILE:	P-0740-047	
DRAWN BY:	RAK, OLR	
DESIGNED/CHECKED BY:	JNR, SJP	
APPROVED BY:	BRL	

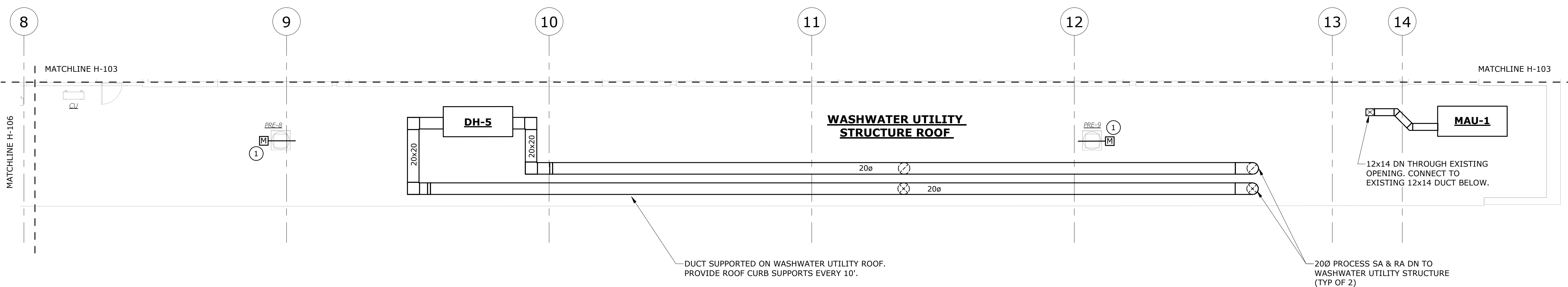
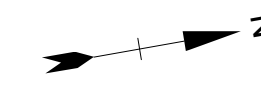
HVAC - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN

SCALE: AS SHOWN

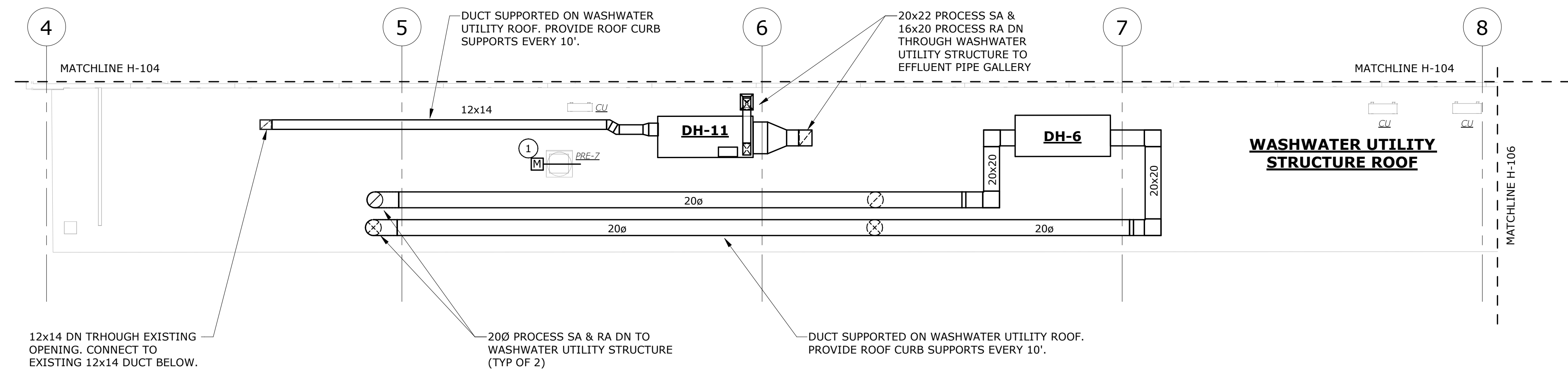


H-105

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 By: RAK, OLR  
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 Tighe & Bond



**HVAC - WASHWATER UTILITY STRUCTURE ROOF PLAN - NORTH**



**HVAC - WASHWATER UTILITY STRUCTURE ROOF PLAN - SOUTH**

- KEY NOTES:**
- 1 PROVIDE MOTORIZED DAMPER FOR EXISTING ROOF MOUNTED EXHAUST FAN. MOUNT DAMPER IN THROAT OF CURB. (TYP OF 3)



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
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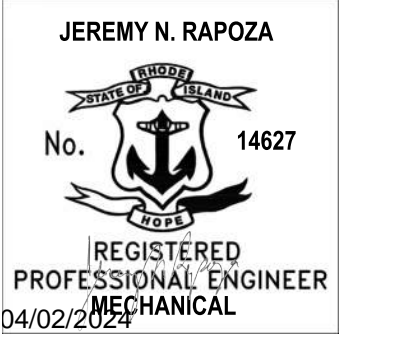
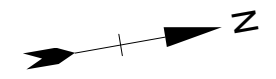
PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: RAK, OLR  
DESIGNED/CHECKED BY: JNR, SJP  
APPROVED BY: BRL

HVAC - WASHWATER UTILITY STRUCTURE ROOF PLAN

SCALE: AS SHOWN

H-106

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 Title: H-106



**Dehumidification System Design**

Providence Water Supply Board

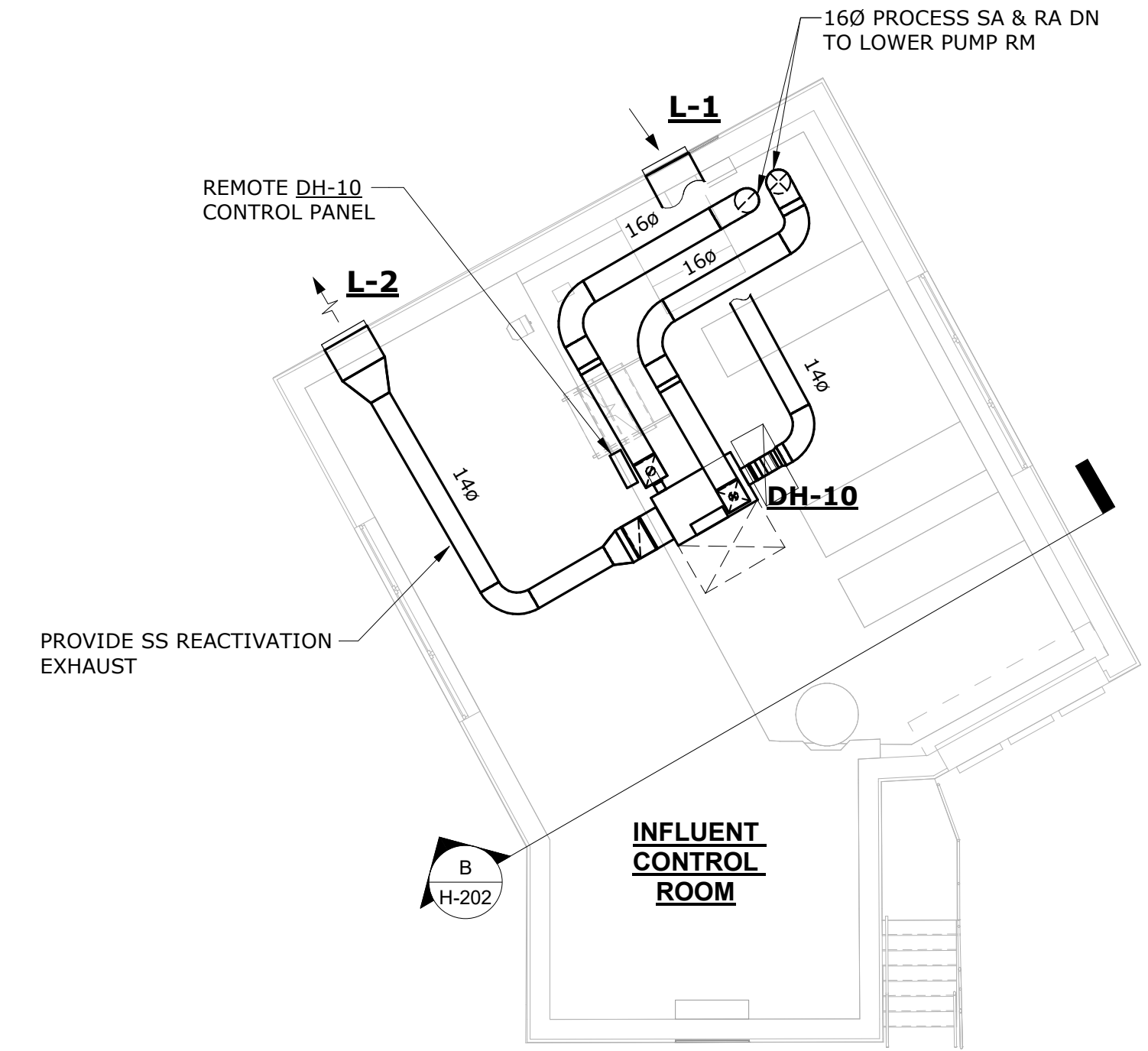
Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

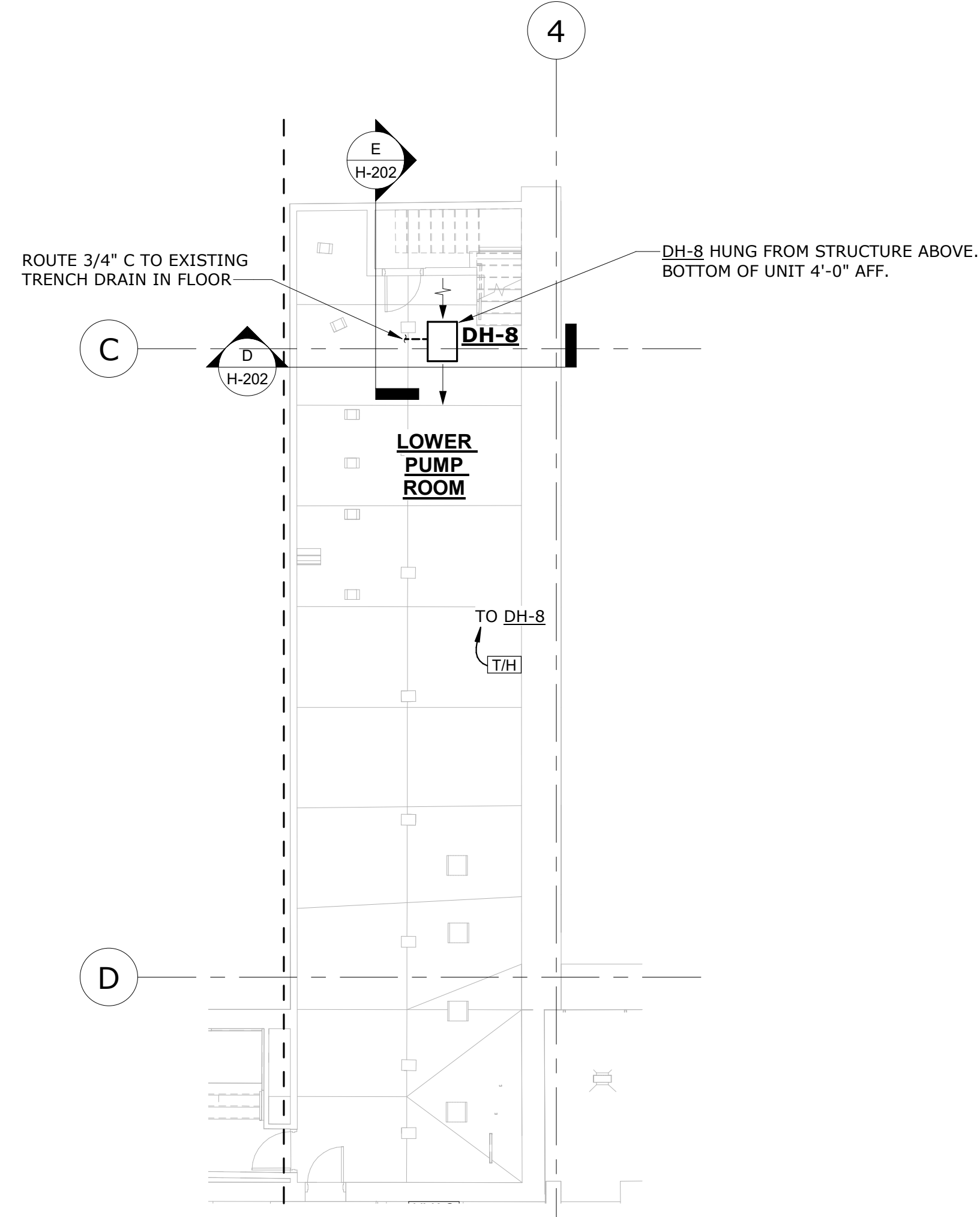
PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: RAK, OLR  
DESIGNED/CHECKED BY: JNR, SJP  
APPROVED BY: BRL

HVAC - PARTIAL BASEMENT, INFLUENT BLDG & LOWER PUMP RM PLANS

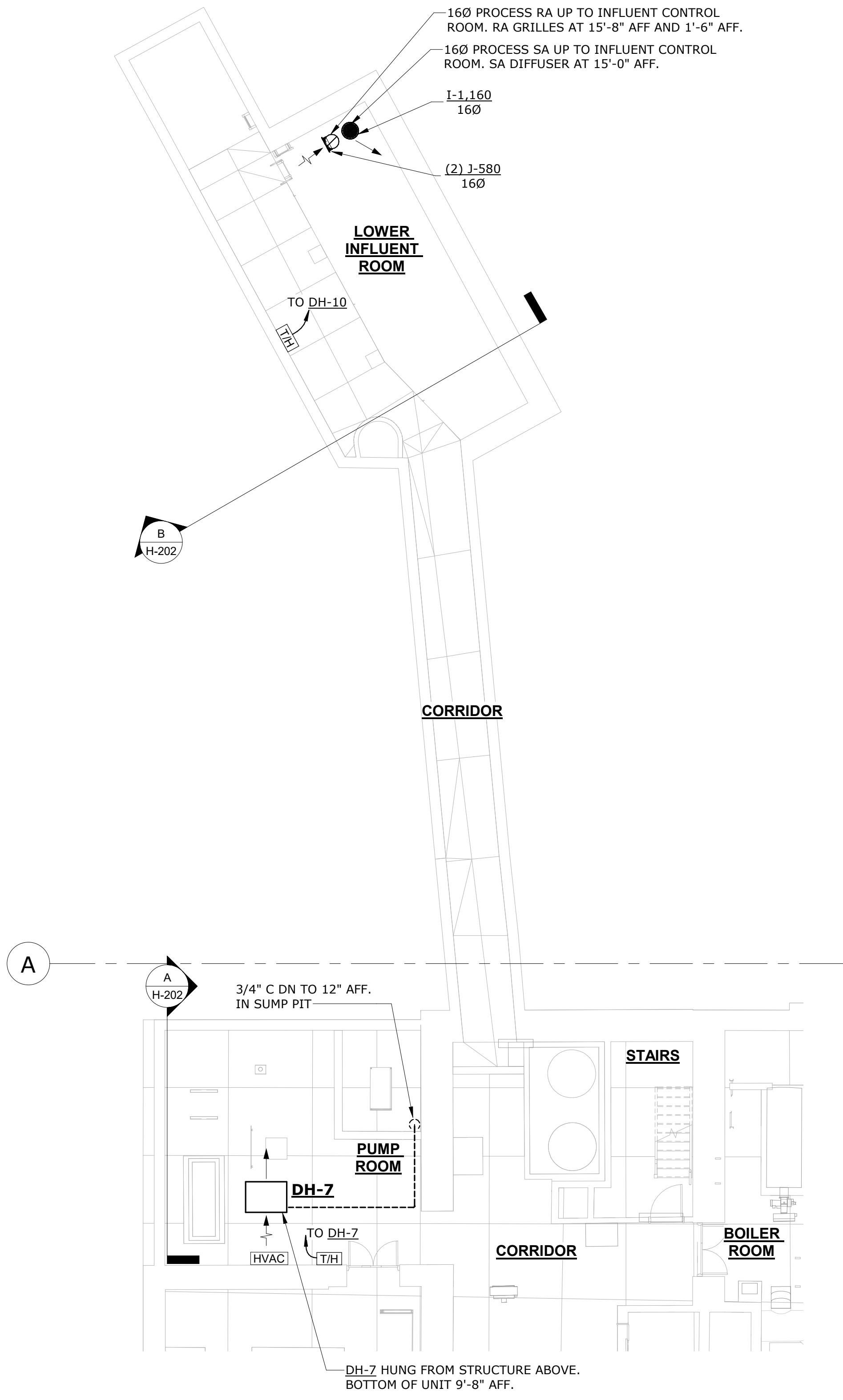
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**HVAC - INFLUENT BUILDING PLAN FIRST FLOOR**



**HVAC - LOWER PUMP RM EFFLUENT GALLERY**

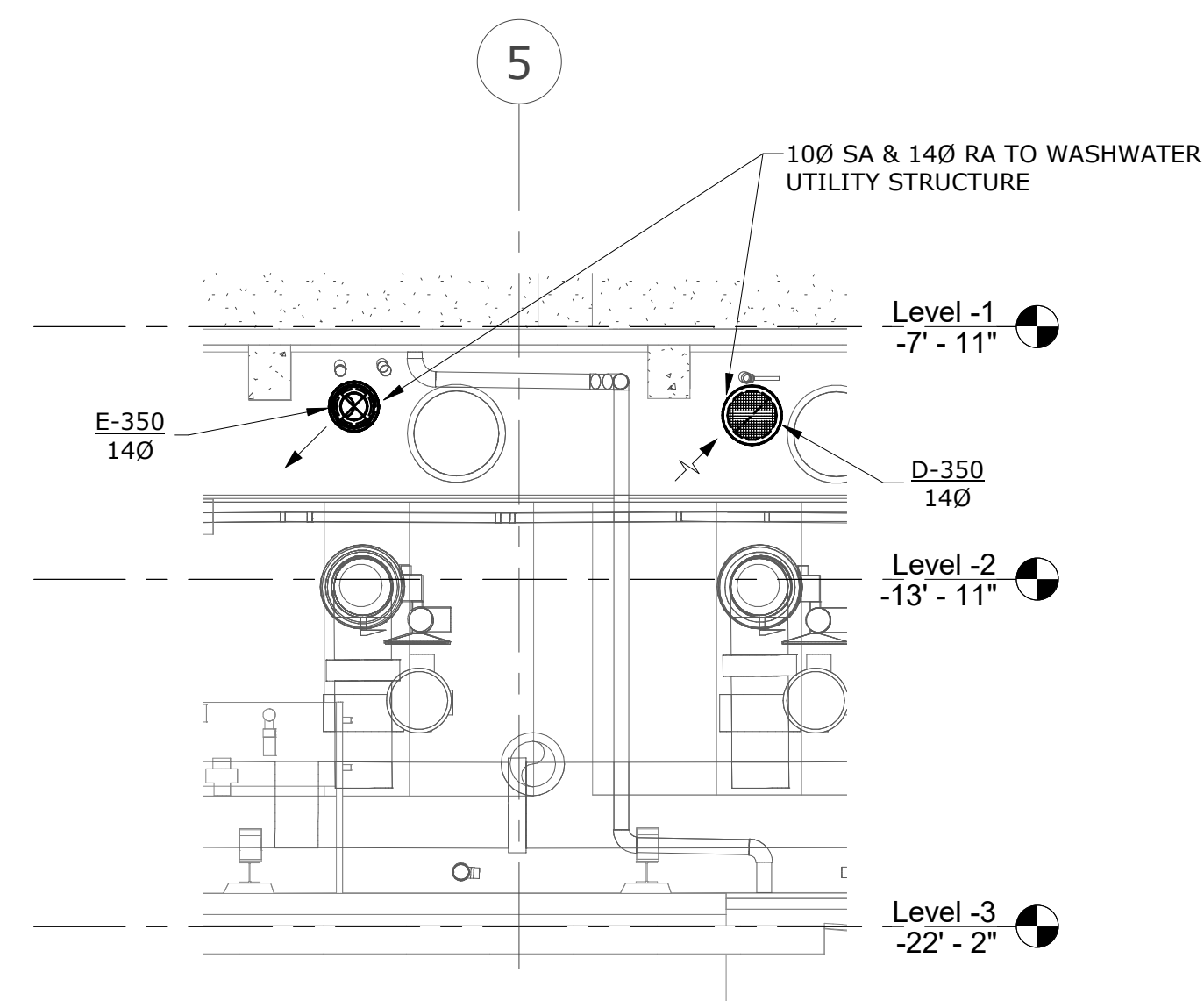
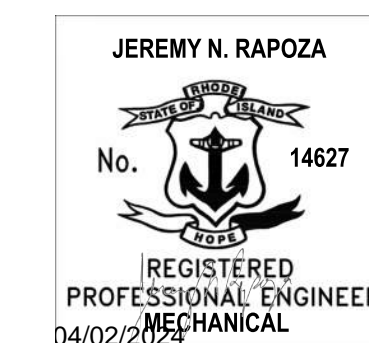
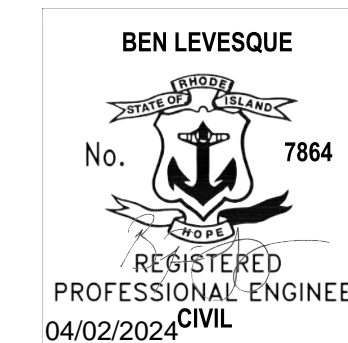


**HVAC - PARTIAL BASEMENT**

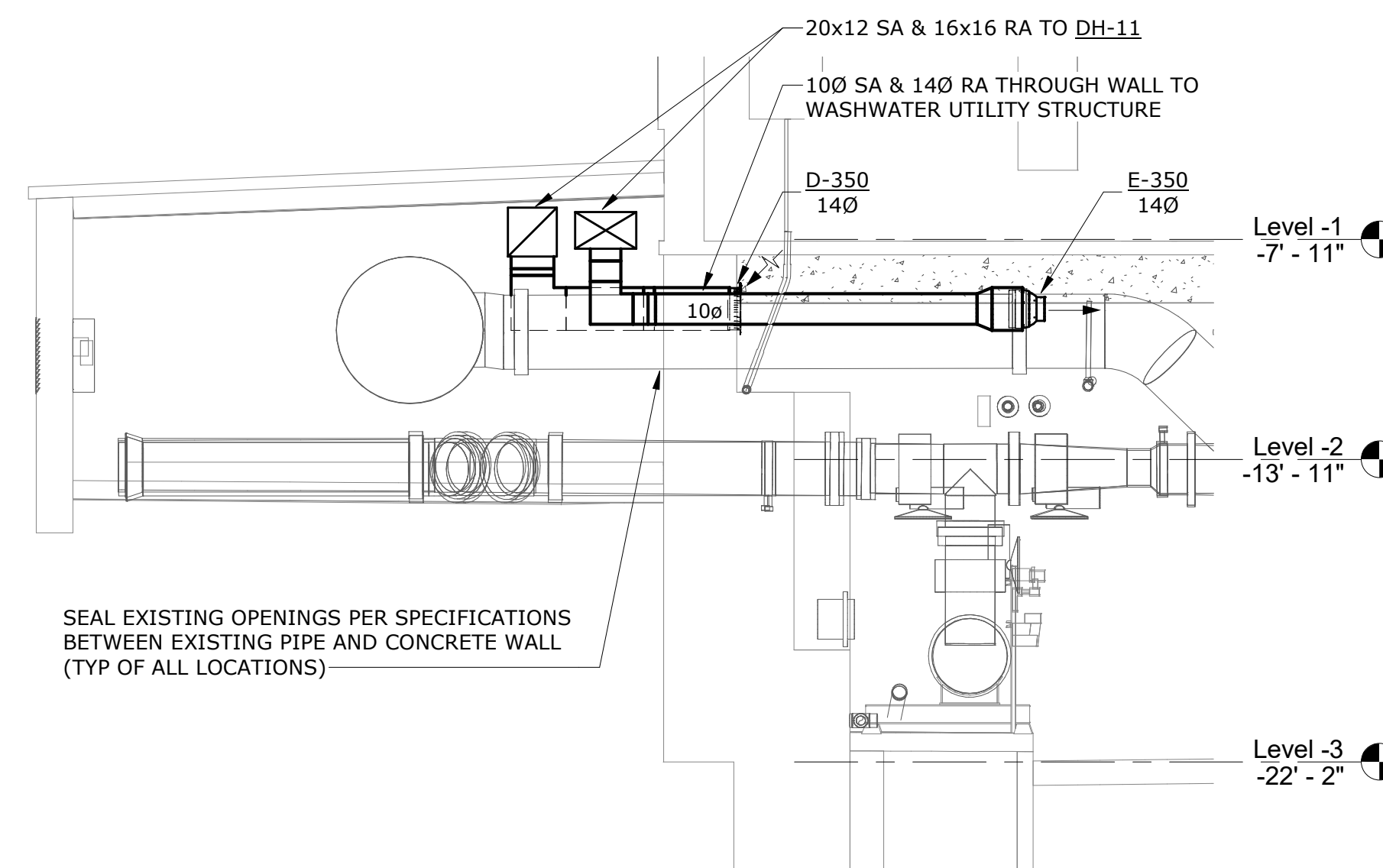


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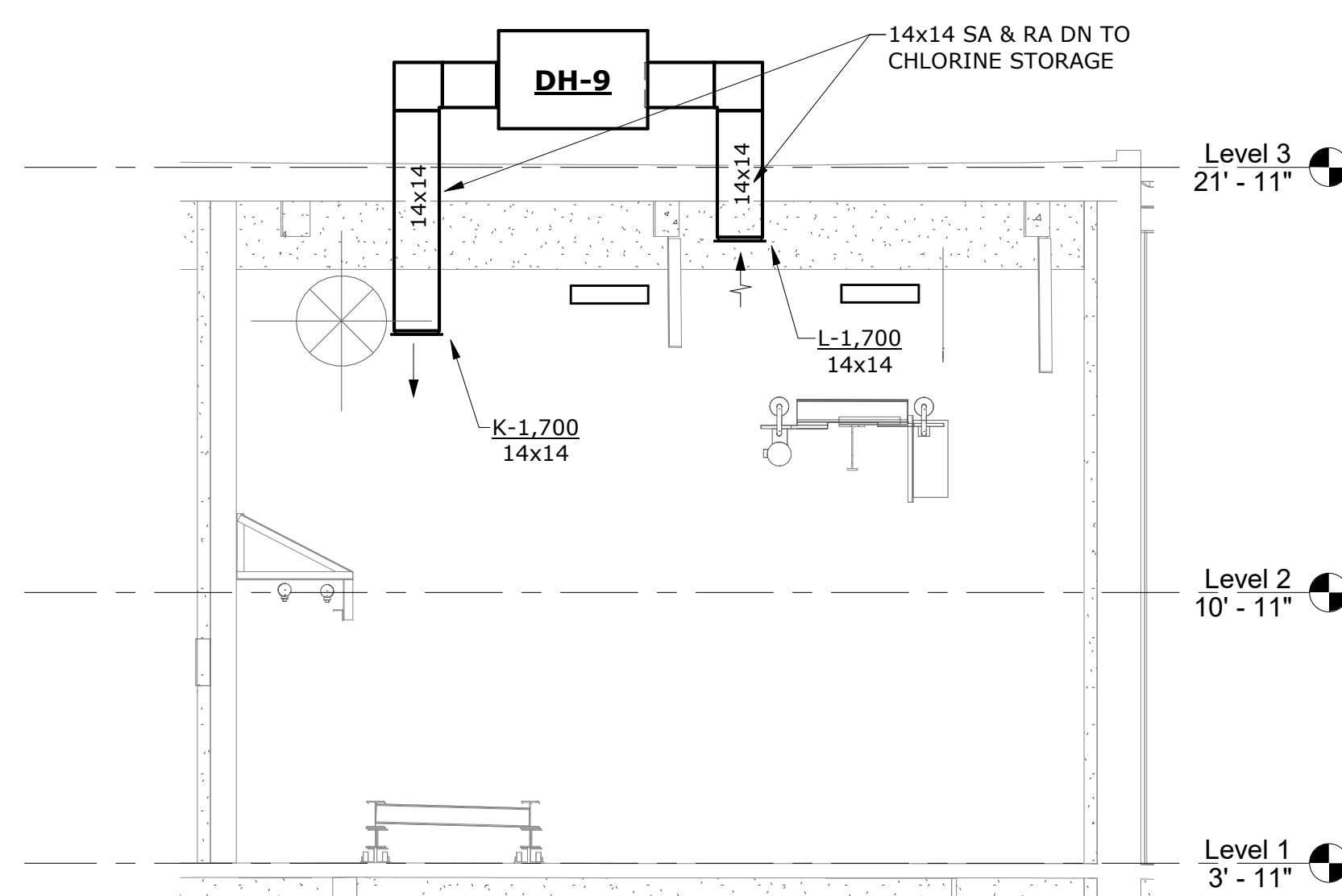




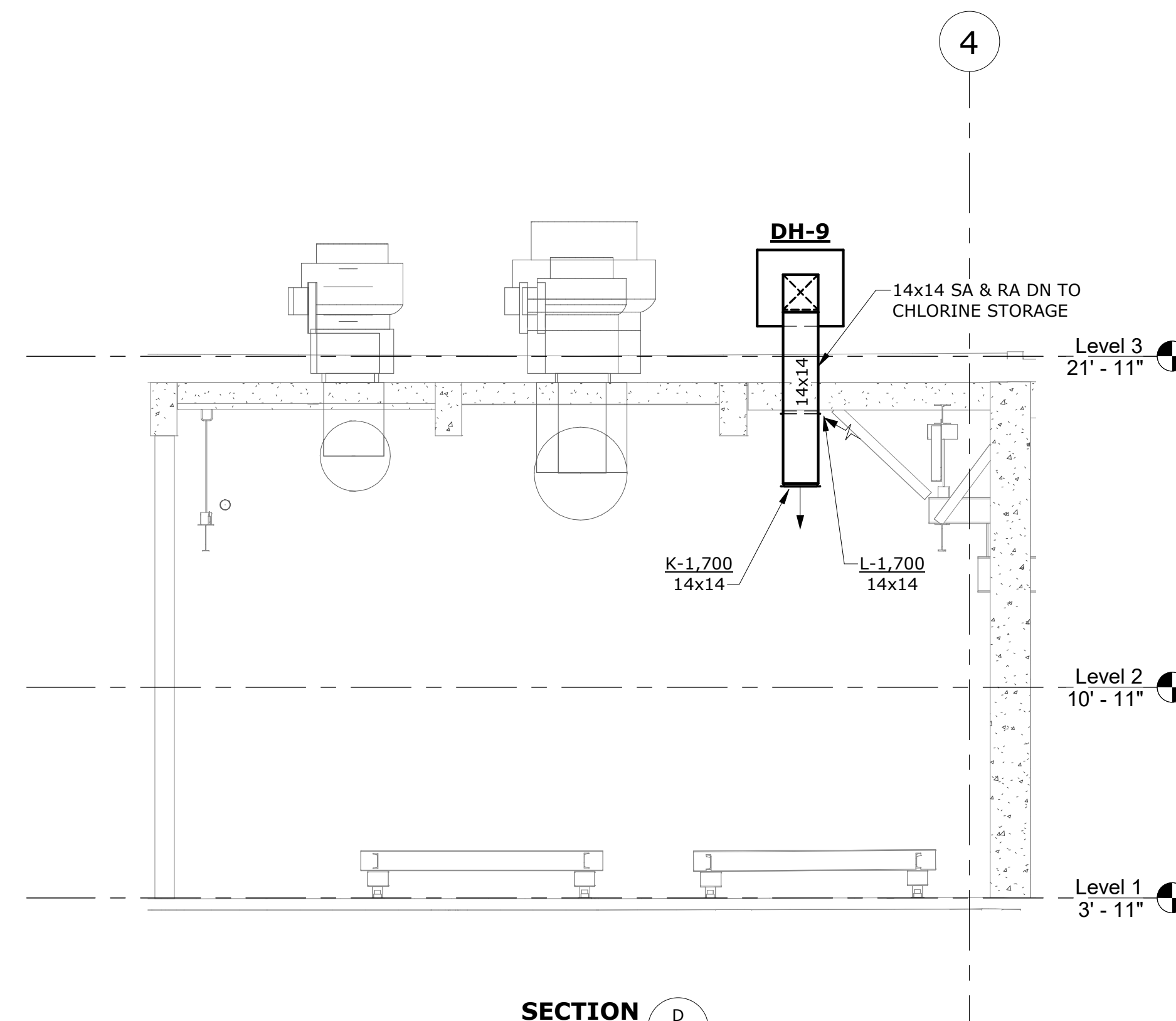
**SECTION F**  
1/4" = 1'-0" H-105



**SECTION A**  
1/4" = 1'-0" H-105



**SECTION C**  
1/4" = 1'-0" H-108



**SECTION D**  
1/4" = 1'-0" H-108

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

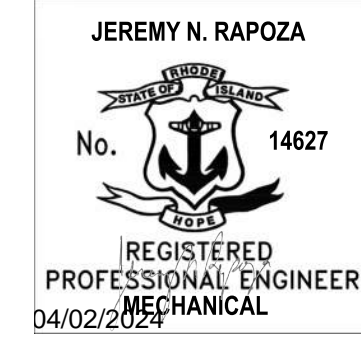
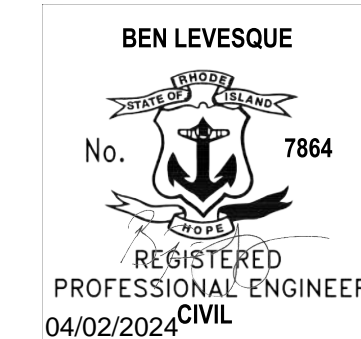
PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: RAK, OLR  
DESIGNED/CHECKED BY: JNR, SJP  
APPROVED BY: BRL

HVAC SECTIONS - 1

SCALE: AS SHOWN

**H-201**





**Dehumidification System Design**

Providence Water Supply Board

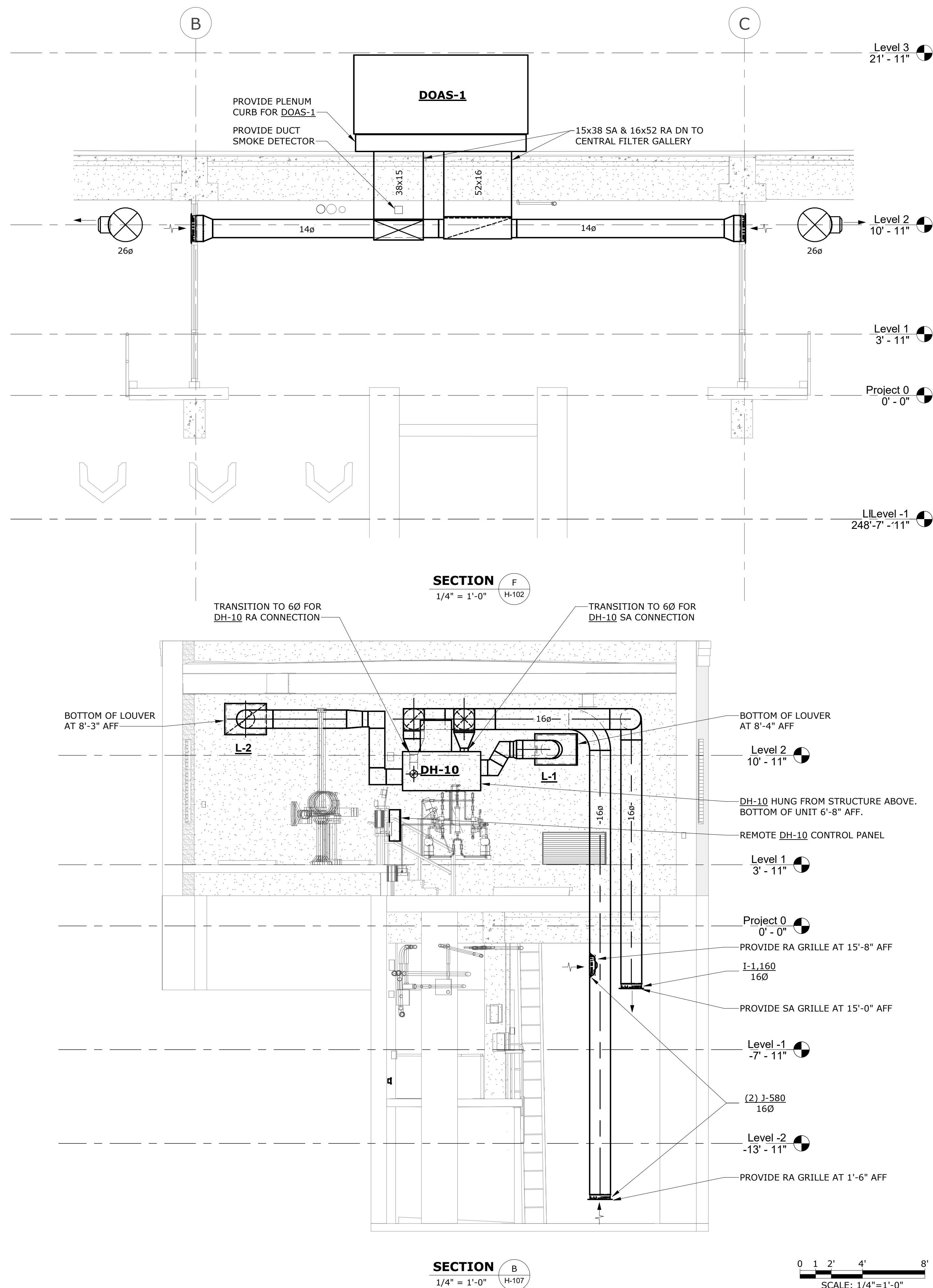
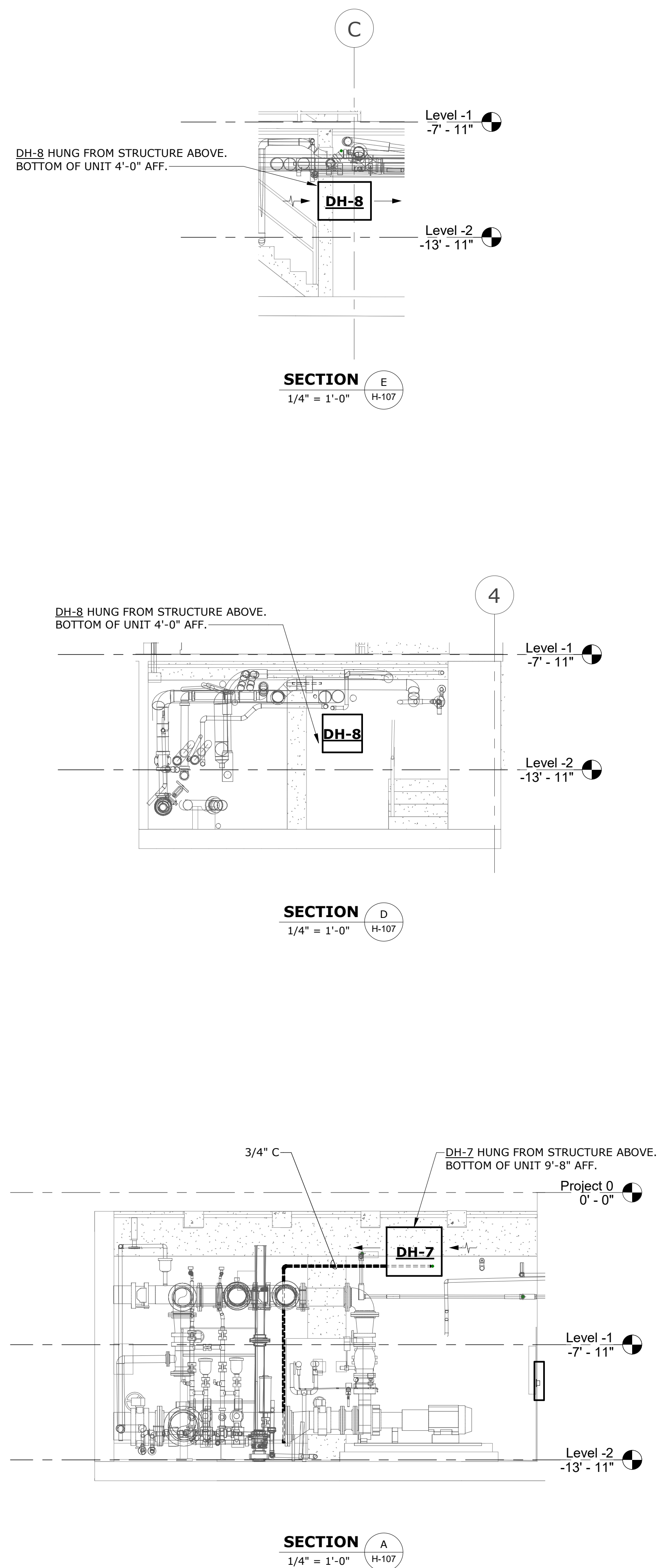
Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO:	P-0740-047	
DATE:	APRIL 2024	
FILE:	P-0740-047	
DRAWN BY:	RAK, OLR	
DESIGNED/CHECKED BY:	JNR, SJP	
APPROVED BY:	BRL	

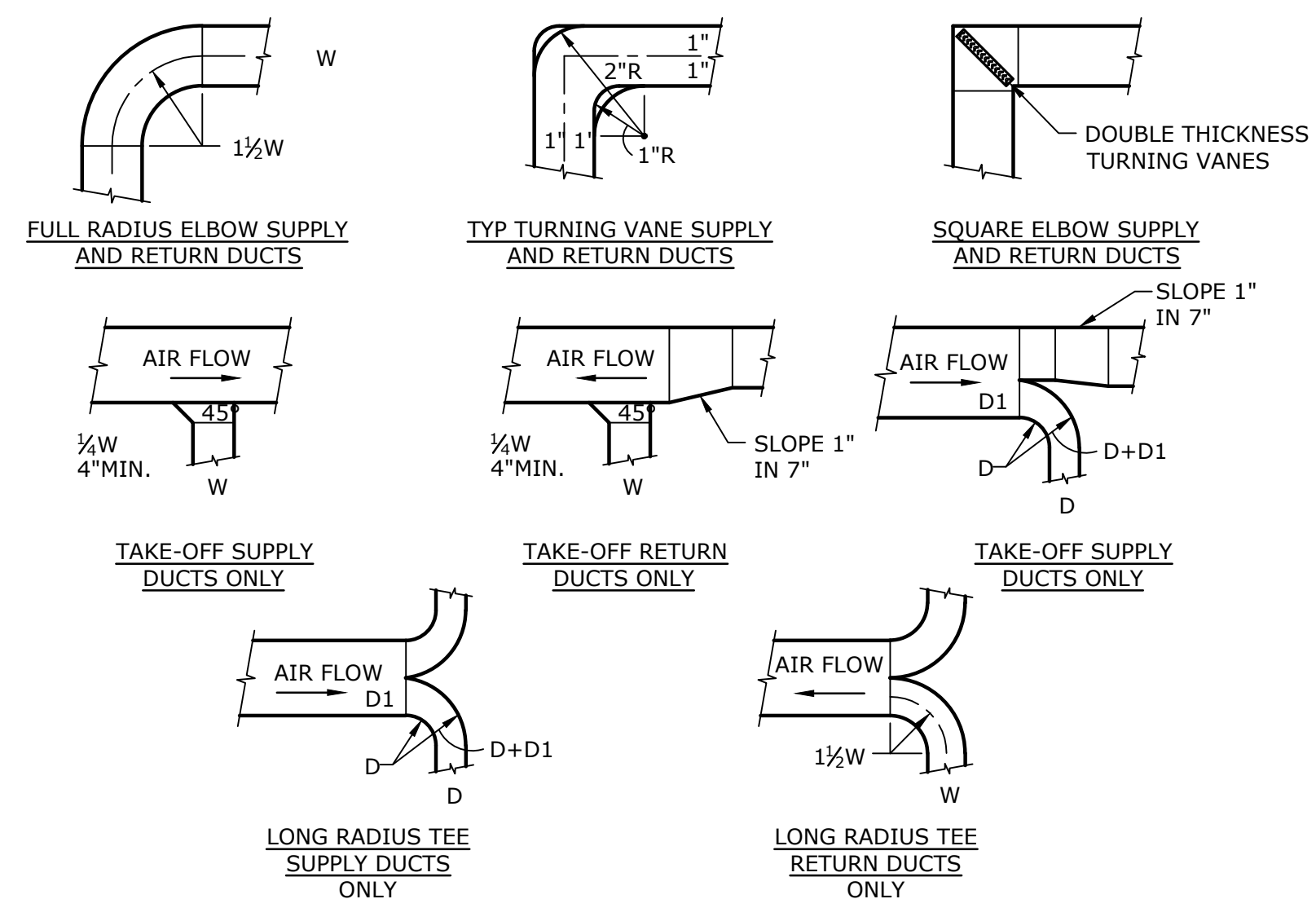
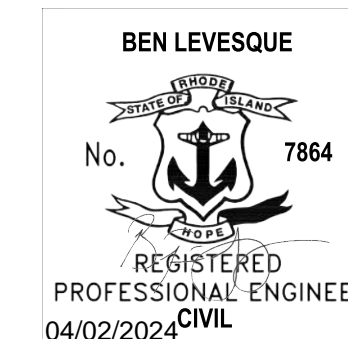
HVAC SECTIONS - 2

SCALE: AS SHOWN

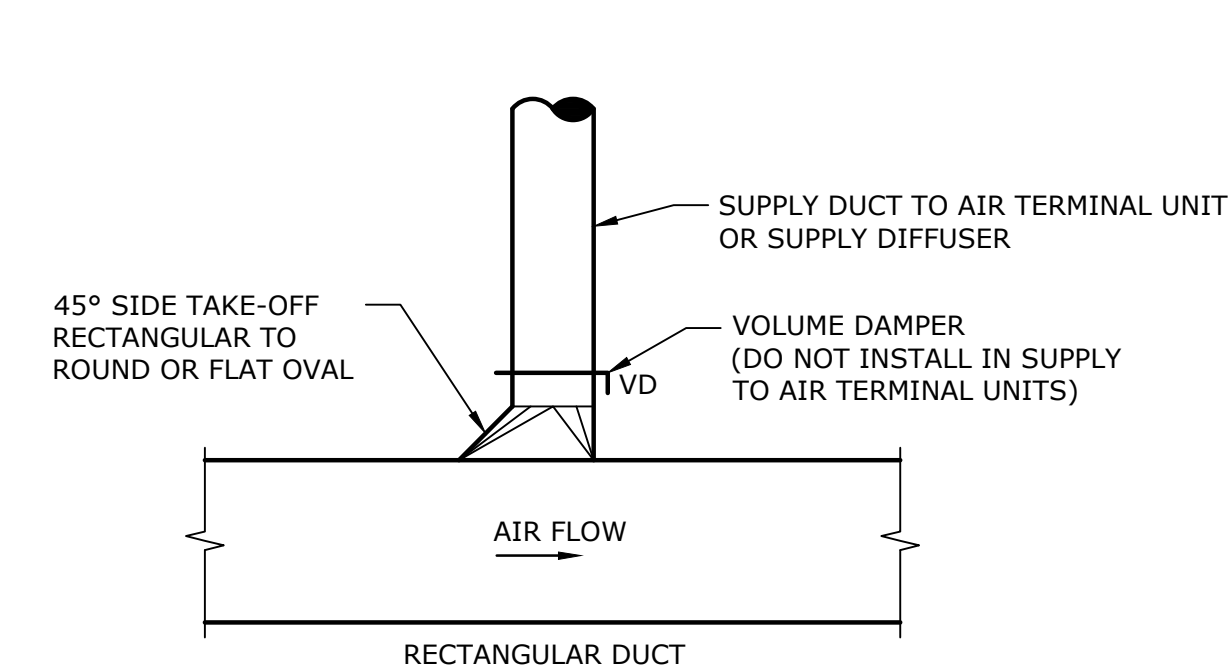
**H-202**



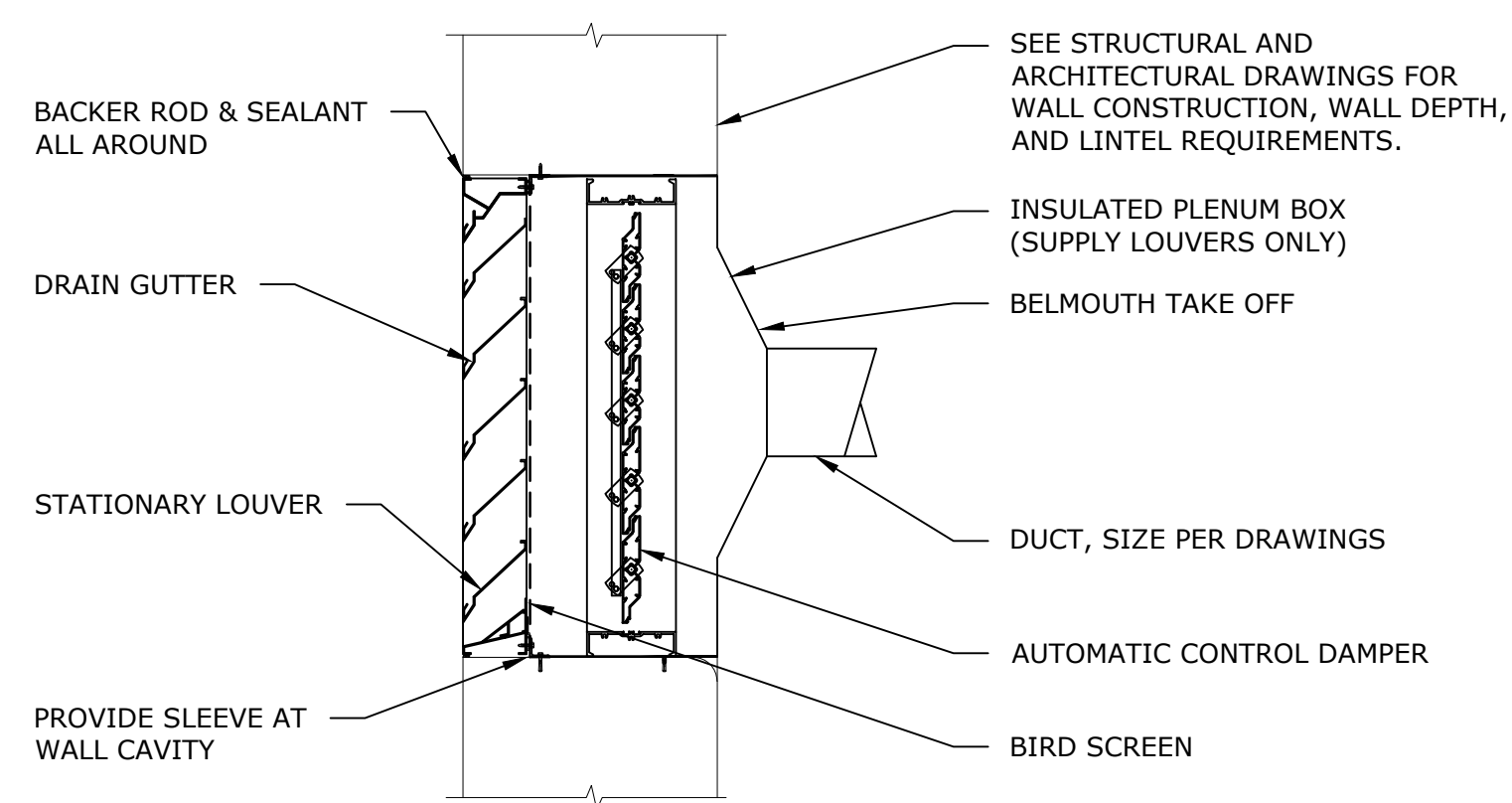
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 Tighe & Bond



**DUCT**  
NO SCALE



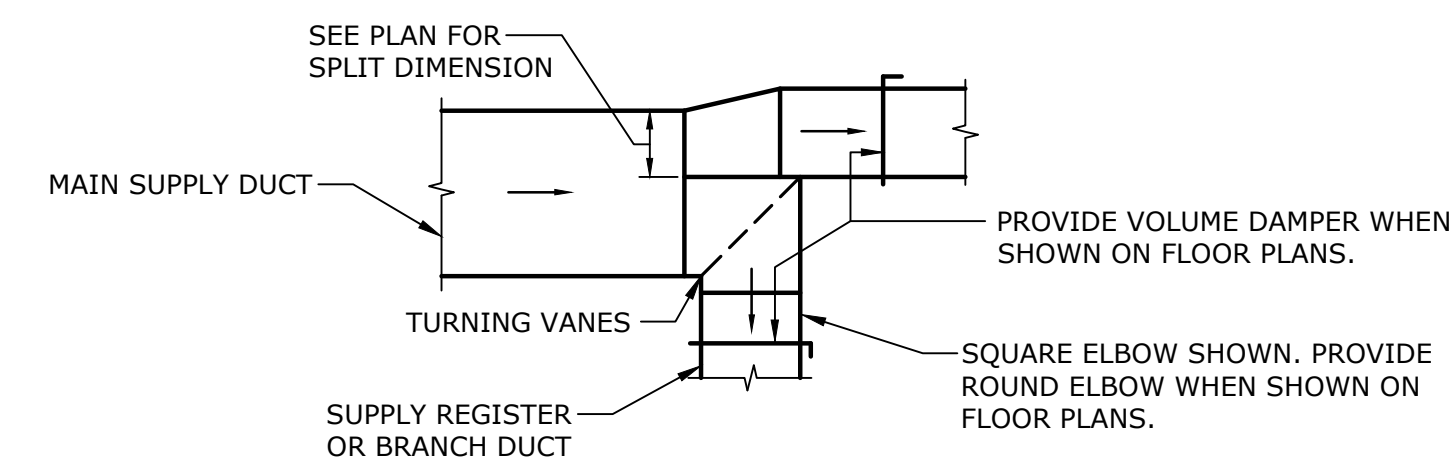
**45° SUPPLY AIR TAKEOFF**  
NO SCALE



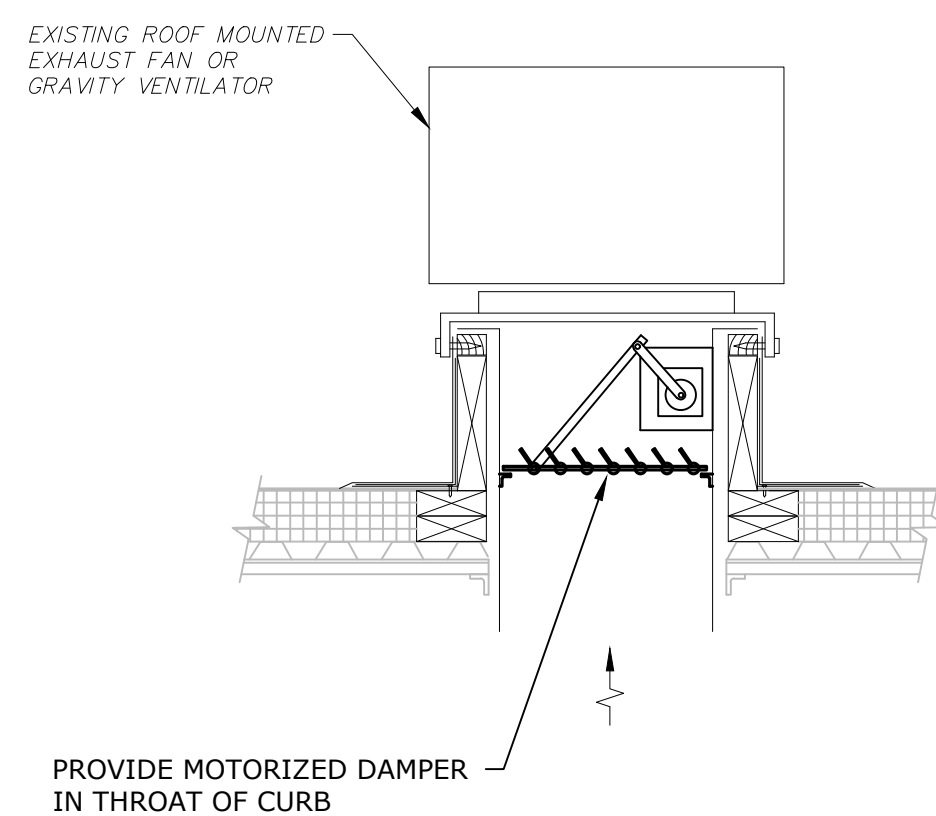
**NOTES:**

1. PROVIDE DUCT SLEEVE IN WALL CAVITY FROM LOUVER TO INTERIOR WALL.

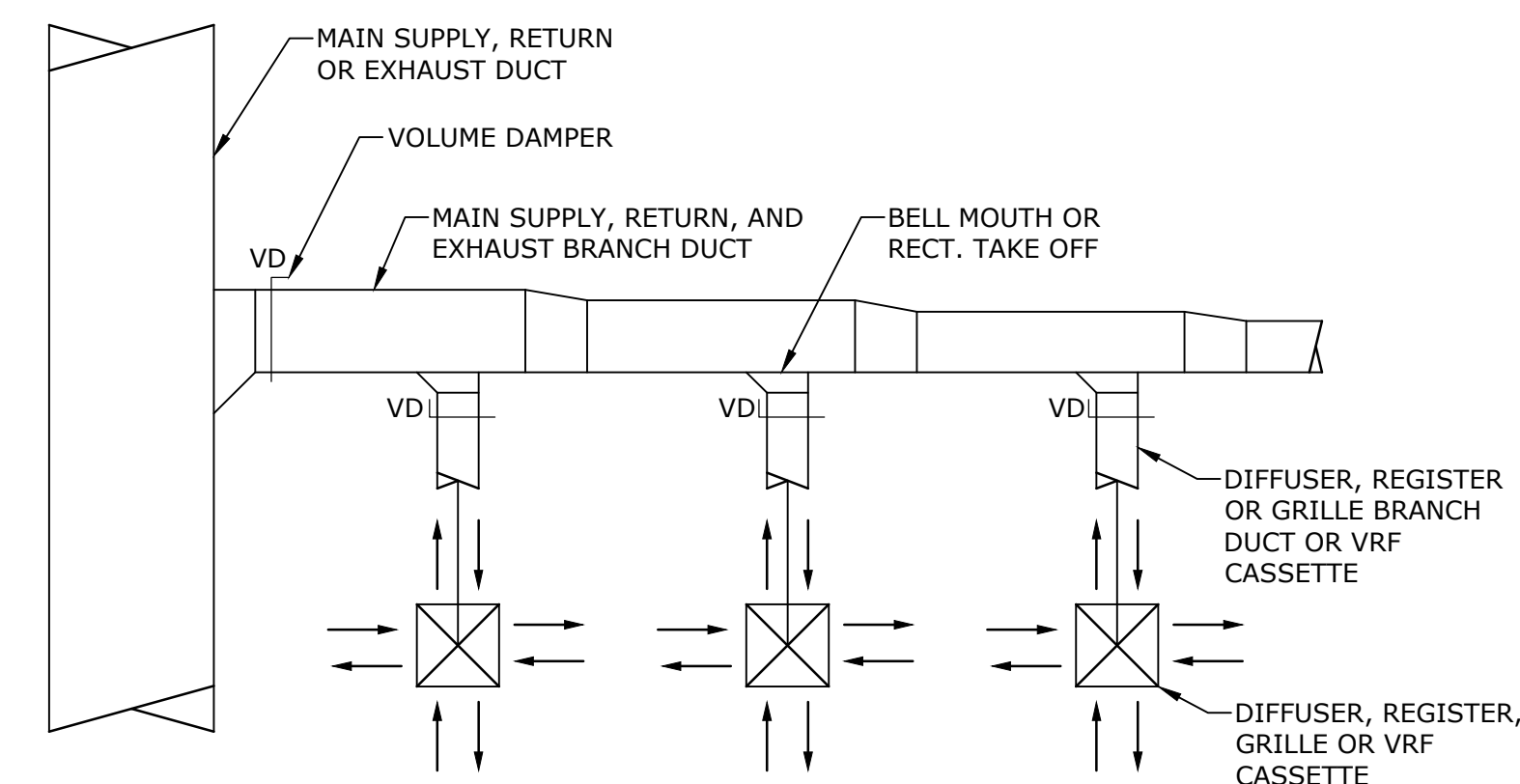
**LOUVER - DUCTED**  
NO SCALE



**AIR SUPPLY DUCTWORK TAKE OFF**  
NO SCALE



**MOTORIZED DAMPER IN EXISTING CURB**  
NO SCALE



**NOTES:**

1. PROVIDE VOLUME DAMPERS IN ALL MAIN SUPPLY, RETURN, AND EXHAUST BRANCH DUCTS AND DIFFUSER/REGISTER/GRILLE BRANCH DUCTS AS SHOWN ABOVE.
2. PROVIDE ADDITIONAL VOLUME DAMPERS AS SHOWN ON CONTRACT DOCUMENTS OR AS REQUIRED TO PROPERLY BALANCE THE SYSTEM.

**VOLUME DAMPER LOCATION**  
NO SCALE

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P0740-047

DATE: APRIL 2024

FILE: P0740-047-H-501.dwg

DRAWN BY: RAK, OLR

DESIGNED/CHECKED BY: JNR, SJP

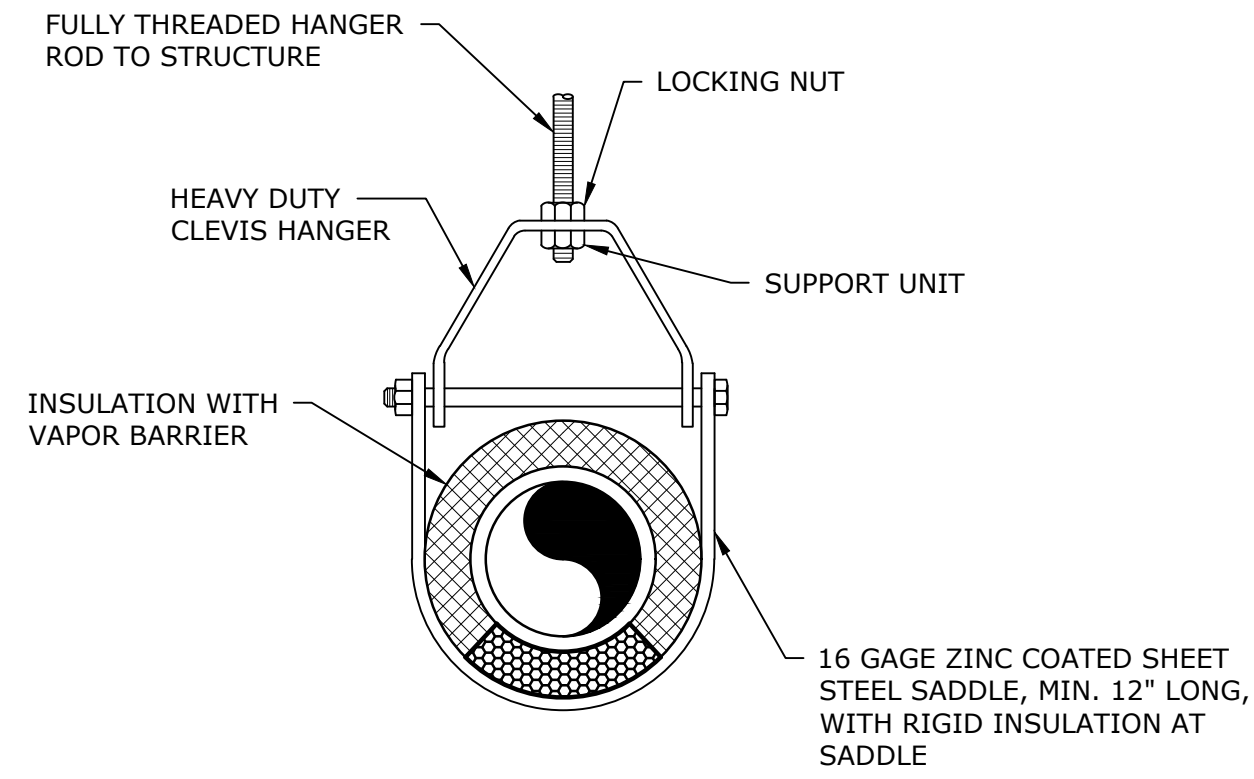
APPROVED BY: BRL

HVAC DETAILS - 1

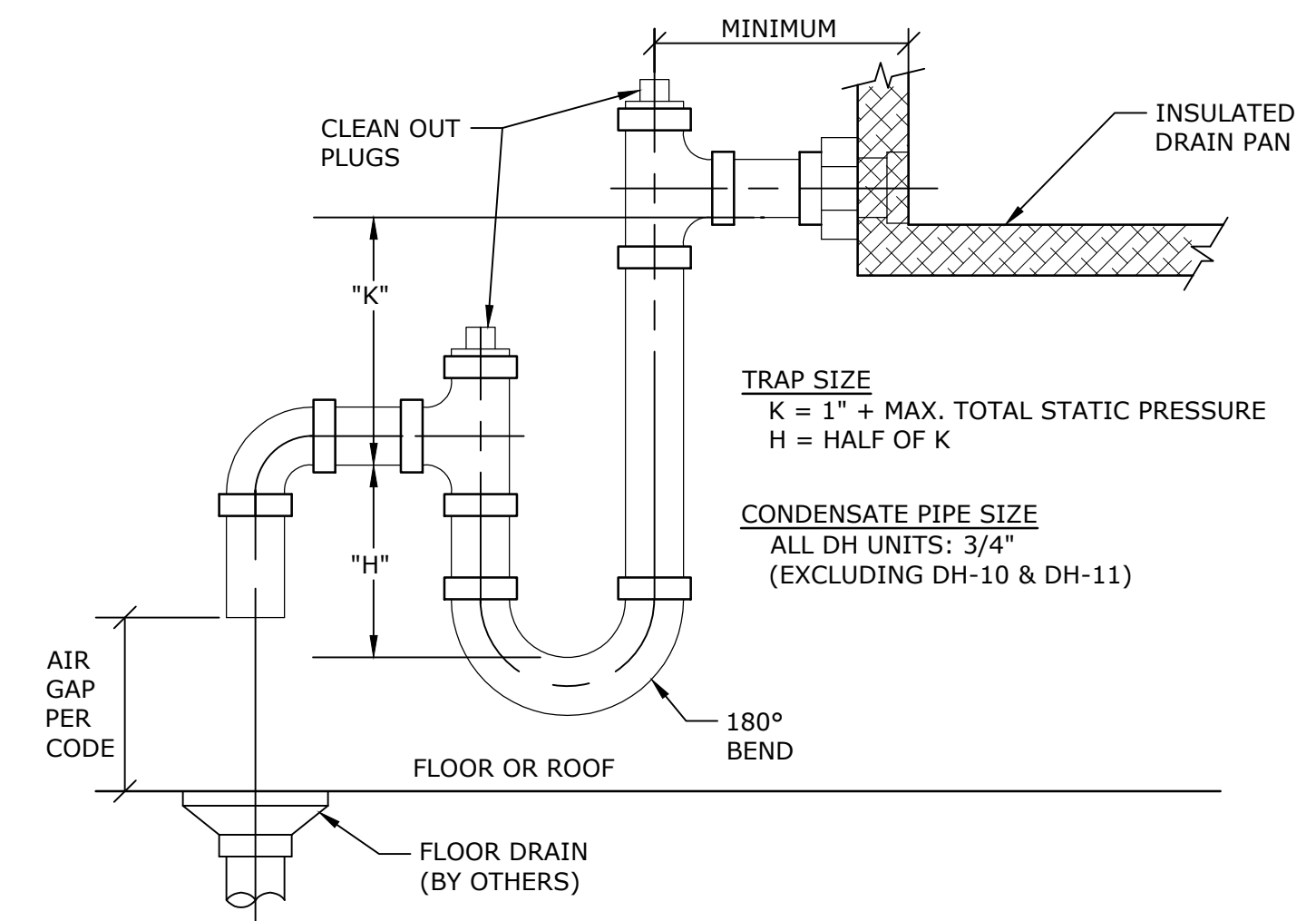
SCALE: NO SCALE

H-501





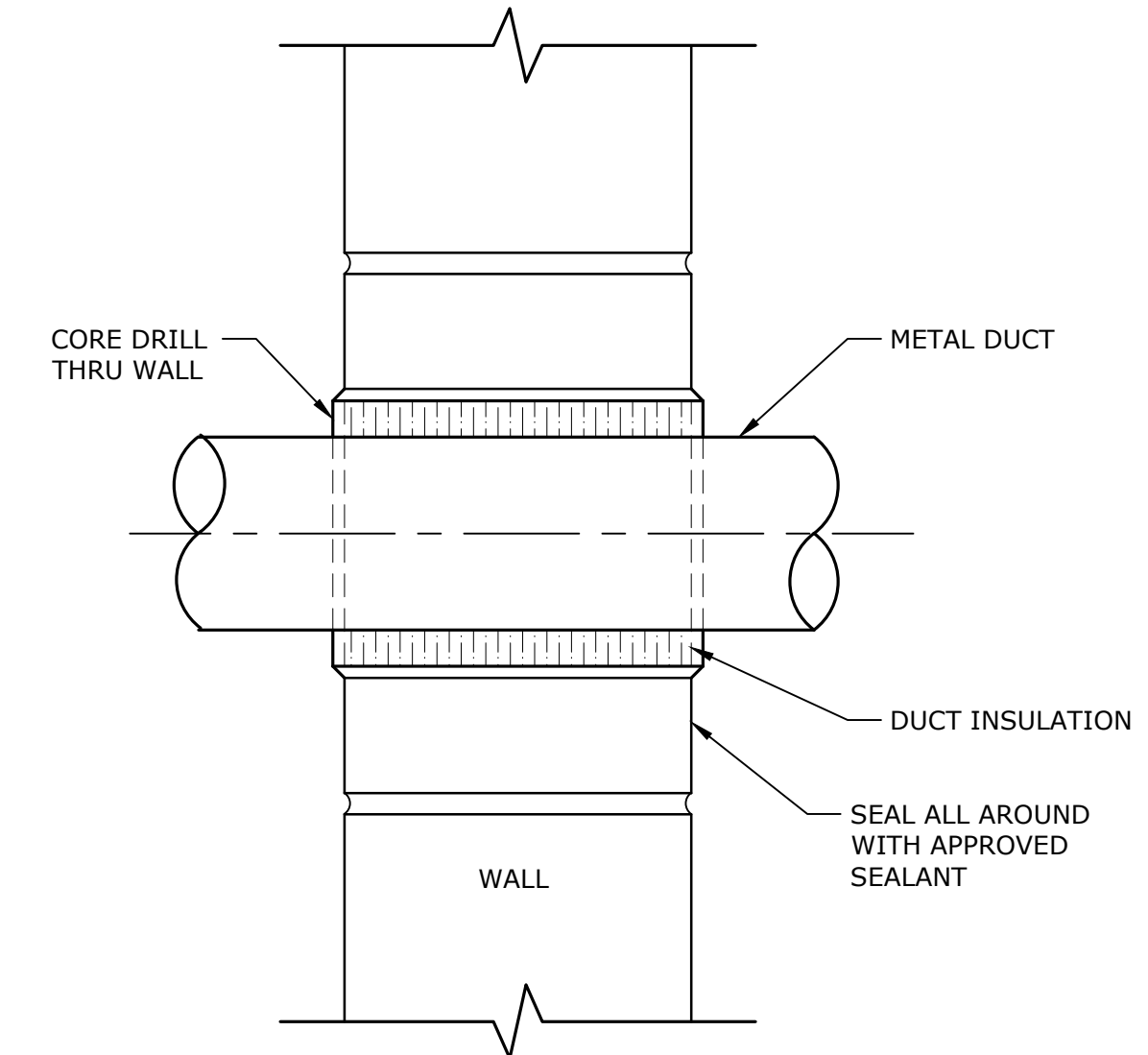
**PIPE HANGER**  
NO SCALE



**NOTES:**

1. VERIFY TRAP SIZE PER MANUFACTURER'S RECOMMENDATIONS.

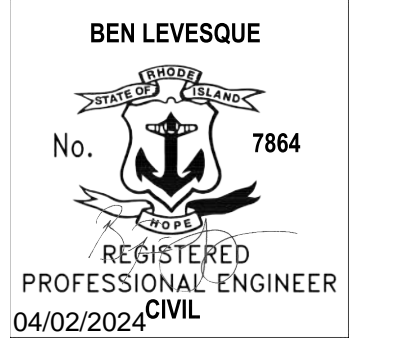
**TRAP (NEGATIVE PRESSURE)**  
NO SCALE



**NOTES:**

1. VERIFY LOCATION OF ANY REINFORCING BARS OR PRECAST TENSION CABLES PRIOR TO DRILLING.
2. SHEET METAL CONTRACTOR IS RESPONSIBLE FOR FOAMING AND SEALING VOID AFTER PIPE IS INSTALLED.

**DUCT PENETRATION AT WALL**  
NO SCALE



**Dehumidification System Design**

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Philip J. Holton Water Purification Plant  
Scituate, Rhode Island


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PROJECT NO:	P0740-047	
DATE:	APRIL 2024	
FILE:	P0740-047-H-502.dwg	
DRAWN BY:	RAK, OLR	
DESIGNED/CHECKED BY:	JNR, SJP	
APPROVED BY:	BRL	

HVAC DETAILS - 2

SCALE: NO SCALE

**H-502**



MAKE UP AIR UNIT SCHEDULE															
UNIT NO.	LOCATION	SERVING	MANUFACTURER	MODEL NO.	SUPPLY CFM	OUTDOOR CFM	SUPPLY FAN DATA							SPEED CONTROL	
							NUMBER OF FANS	TYPE	E.S.P. (IN. WC)	T.S.P. (IN. WC)	RPM	BHP	MHP		
MAU-1	WASHWATER UTILITY STRUCTURE ROOF	LOWER EFFLUENT PIPE GALLERY	ADDISON	PROH084B1	1,000	1,000	1	DIRECT	1.4	1.85	2,281	0.43	1	VFD	

MAKE UP AIR UNIT SCHEDULE																
UNIT NO.	ELECTRIC HEATING PERFORMANCE							HEAT PUMP HEATING PERFORMANCE							CONDENSER COIL DATA	
	KW	E.A.T. (°F)	L.A.T. (°F)	A.P.D. W.C.	VOLTS	PH	FLA	E.A.T. (°F)	L.A.T. (°F)	A.P.D. W.C.	MBH	COP	WATTS	ROWS	FPI	
	MAU-1	25	0	79	0.05	480	3	30.1	17	67.1	0.13	54.1	3.6	4,035	3	12

MAKE UP AIR UNIT SCHEDULE (CONTINUED)															
UNIT NO.	DX COOLING PERFORMANCE														
	TOTAL MBH	SENS. MBH	E.A.T. (°F)		L.A.T. (°F)		EER	EVAPORATOR COIL DATA			CONDENSER COIL DATA			AIR VELOCITY (FPM)	A.P.D. W.C.
			DB	WB	DB	WB		FACE AREA (SQFT)	ROWS	FPI	FACE AREA (SQFT)	ROWS	FPI		
MAU-1	84.1	32.5	80.2	75.6	63.0	55.3	13.4	4.72	6	12	13.5	3	12	211	0.24

MAKE UP AIR UNIT SCHEDULE (CONTINUED)															
UNIT NO.	SUPPLY PRE-FILTER DATA	DIMENSIONS, LxHxW (IN.)	WEIGHT (LBS)	ELECTRICAL				REMARKS							
				VOLTS	PH	FLA	SCCR (kA)								
MAU-1	2" MERV 8	130 x 66 x 64	1,956	460	3	44.4	65								

- NOTES:  
 1. REFER TO FLOOR PLANS FOR DUCT CONNECTION LOCATIONS.  
 2. PROVIDE SEACOAST COATING ON EXTERIOR AND CONDENSER COIL.  
 3. ROOF CURB TO BE PROVIDED. COORDINATE SIZE OF CURB WITH GENERAL CONTRACTOR.

DEDICATED OUTDOOR AIR SYSTEM SCHEDULE																									
UNIT NO.	LOCATION	SERVING	MANUFACTURER	MODEL NO.	SUPPLY CFM	OUTDOOR CFM	SUPPLY FAN DATA							ELECTRIC HEATING PERFORMANCE											
							NUMBER OF FANS	TYPE	E.S.P. (IN. WC)	T.S.P. (IN. WC)	RPM	BHP	MHP	SPEED CONTROL	KW	E.A.T. (°F)	L.A.T. (°F)	A.P.D. W.C.	VOLTS	PH	FLA				
DOAS-1	LOWER ROOF	CENTRAL FILTER GALLERY	ADDISON	PROH150C2	2,500	2,500	1	DIRECT	1.5	3.2	1,922	1.66	2	VFD	50	9	72.2	0.05	480	3	60.1				

DEDICATED OUTDOOR AIR SYSTEM SCHEDULE (CONTINUED)																												
UNIT NO.	COOLING PERFORMANCE															EXHAUST FAN DATA												
	E.A.T. (°F)	L.A.T. (°F)	A.P.D. W.C.	MBH	COP	WATTS	CONDENSER COIL DATA		TOTAL MBH	SENS. MBH	L.A.T. (°F)		EVAPORATOR COIL DATA			CONDENSER COIL DATA			AIR VELOCITY (FPM)	A.P.D. W.C.	NUMBER OF FANS	TYPE	E.S.P. (IN. WC)	T.S.P. (IN. WC)	RPM	BHP	MHP	SPEED CONTROL
							ROWS	FPI			DB	WB	FACE AREA (SQFT)	ROWS	FPI	FACE AREA (SQFT)	ROWS	FPI										
DOAS-1	39	75	0.13	97.7	3.3	7,567	3	12	165.1	79.2	83.6	63.1	12	6	12	27	3	12	208	0.23	1	DIRECT	1.5	2.9	2,290	1.65	2	VFD

DEDICATED OUTDOOR AIR SYSTEM SCHEDULE (CONTINUED)																									
UNIT NO.	ENTHALPY WHEEL PERFORMANCE															OUTDOOR AIR PRE-FILTER DATA	DIMENSIONS LxWxH (IN.)	WEIGHT (LBS)	ELECTRICAL				REMARKS		
	SUPPLY							RETURN											VOLTS	PH	MCA	SCCR (kA)			
	SUMMER			WINTER				SUMMER				WINTER													
	OA (DB/WB)	SA (DB/WB)	PRESSURE DROP (IN. WC)	OA (DB/WB)	SA (DB/WB)	PRESSURE DROP (IN. WC)	RA (DB/WB)	PRESSURE DROP (IN. WC)	RA (DB/WB)	PRESSURE DROP (IN. WC)	RA (DB/WB)	PRESSURE DROP (IN. WC)													
DOAS-1	80.2 / 75.6	80.1 / 71.5	1.20	9.0 / 8.0	39.0 / 32.1	1.30	80.0 / 68.1	1.25	60.0 / 46.0	1.25	2" MERV 8	195 x 64 x 70	3,629	460	3	93.5	65								

- NOTES:  
 1. REFER TO FLOOR PLANS FOR DUCT CONNECTION LOCATIONS.  
 2. PROVIDE SEACOAST COATING ON EXTERIOR AND CONDENSER COIL.  
 3. ROOF CURB TO BE PROVIDED. COORDINATE SIZE OF CURB WITH GENERAL CONTRACTOR.

LOUVER SCHEDULE												
UNIT NO.	LOCATION	SERVING	MANUFACTURER	MODEL NO.	FUNCTION	TYPE	SIZE W x H (IN)	CFM	FA VELOCITY (FPM)	FREE AREA (SQFT)	P.D. (IN W.G.)	REMARKS
L-1	INFLUENT CONTROL ROOM	DH-10	RUSKIN	ELF375DXD	SUPPLY	STATIONARY	32 x 24	1,160	485	2.39	0.046	
L-2	INFLUENT CONTROL ROOM	DH-10	RUSKIN	ELF375DXD	EXHAUST	STATIONARY	32 x 24	1,160	485	2.39	0.048	

- NOTES:  
 1. PROVIDE KYNAR FINISH AND BIRD SCREEN.  
 2. VERIFY COLOR OF LOUVERS WITH OWNER.

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant Scituate, Rhode Island

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PROJECT NO: P0740-047		
DATE: APRIL 2024		
FILE: P0740-047-H-601.dwg		
DRAWN BY: RAK, OLR		
DESIGNED/CHECKED BY: JNR, SJP		
APPROVED BY: BRL		

HVAC SCHEDULES - 1

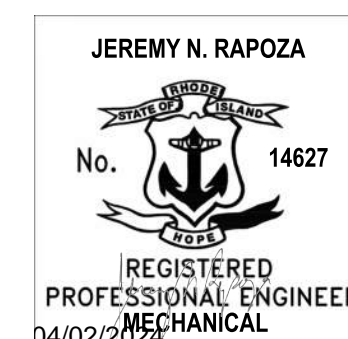
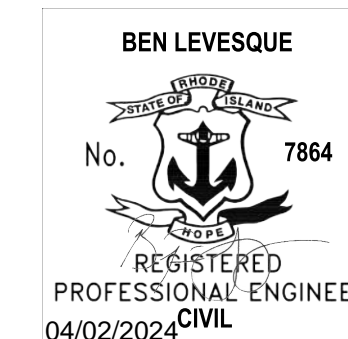
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**H-601**

DEHUMIDIFIER SCHEDULE															
UNIT NO.	LOCATION	SERVING	MANUFACTURER	MODEL NO.	INDOOR DESIGN CONDITIONS (°F/%RH)	WATER REMOVAL CAPACITY (LBS/HR)	INTEGRAL CONDENSATE PUMP	CFM	ELECTRICAL				DIMENSIONS, LxWxH (IN.)	WEIGHT (LBS)	REMARKS
									VOLTS	PHASE	FLA	SCCR (kA)			
DH-1	LOWER ROOF	WEST FILTER BED	DESERT AIRE	LW15BR4MDEUNNLL	75 / 57	61.7	-	6,900	460	3	28.2	65	64 x 53 x 53	2,050	
DH-2	LOWER ROOF	CENTRAL FILTER GALLERY	DESERT AIRE	LW15BR4MDEUNNLL	75 / 57	61.7	-	6,900	460	3	28.2	65	64 x 53 x 53	2,050	
DH-3	LOWER ROOF	CENTRAL FILTER GALLERY	DESERT AIRE	LW15BR4MDEUNNLL	75 / 57	61.7	-	6,900	460	3	28.2	65	64 x 53 x 53	2,050	
DH-4	LOWER ROOF	EAST FILTER BED	DESERT AIRE	LW15BR4MDEUNNLL	75 / 57	61.7	-	6,900	460	3	28.2	65	64 x 53 x 53	2,050	
DH-5	WASHWATER UTILITY STRUCTURE ROOF	WASHWATER UTILITY STRUCTURE	DESERT AIRE	LW08AR4KDENNNDL	75 / 57	24.7	-	4,300	460	3	14.7	65	72 x 50 x 40	1,300	
DH-6	WASHWATER UTILITY STRUCTURE ROOF	WASHWATER UTILITY STRUCTURE	DESERT AIRE	LW08AR4KDENNNDL	75 / 57	24.7	-	4,300	460	3	14.7	65	72 x 50 x 40	1,300	
DH-7	PUMP ROOM B004	PUMP ROOM B004	DESERT AIRE	LW03AN4KDENNNLL	65 / 58	9.6	-	1,700	460	3	5.8	65	46 x 34 x 30	800	
DH-8	LOWER PUMP ROOM	LOWER PUMP ROOM	QUEST	335	75 / 50	12.1	YES	900	208	1	7.9	5	33 x 25 x 24	215	
DH-9	UPPER ROOF	CHLORINE STORAGE	DESERT AIRE	LW03AR4KDENNNLL	75 / 60	9.6	-	1,700	460	3	5.8	65	46 x 34 x 30	800	

**NOTES:**

1. UNIT SHALL BE CAPABLE OF STATED WATER REMOVAL CAPACITY AT DESIGN INDOOR CONDITIONS INDICATED.



DESICCANT DEHUMIDIFIER SCHEDULE																					
UNIT NO.	LOCATION	SERVING	MANUFACTURER	MODEL NO.	CFM	SUMMER		WINTER		REACT FAN DATA					PROCESS FAN DATA						
						INDOOR CONDITIONS (°F/%RH)	WATER REMOVAL CAPACITY (LBS/HR)	INDOOR CONDITIONS (°F / %RH)	WATER REMOVAL CAPACITY (LBS/HR)	FAN SIZE & TYPE	E.S.P. (IN WC)	T.S.P. (IN WC)	RPM	MHP	SPEED CONTROL	FAN SIZE & TYPE	E.S.P. (IN WC)	T.S.P. (IN WC)	RPM	MHP	SPEED CONTROL
DH-10	INFLUENT CONTROL ROOM	LOWER INFLUENT ROOM	INNOVATIVE AIR	IAT-1000RE	1,160	65 / 53.6	40	65 / 25.3	5	SWSI FC 7	2.0	4.48	3,450	0.5	ECM	SWSI FC 7 11/16	2.0	3.69	3,450	1.5	ECM
DH-11	WASHWATER UTILITY STRUCTURE ROOF	LOWER EFFLUENT PIPE GALLERY	INNOVATIVE AIR	IAT-3000RE	2,100	65 / 53.6	61.6	65 / 25.3	30	SWSI FC 7 11/16	2.0	4.34	3,450	2	ECM	SWSI 10	2.0	3.55	3,500	3	ECM

**DESICCANT DEHUMIDIFIER SCHEDULE (CONTINUED)**

UNIT NO.	ELECTRIC REACT HEAT COIL						REACT FILTER			PROCESS FILTER				ELECTRICAL				DIMENSIONS, LxWxH (IN.)	WEIGHT (LBS)	REMARKS	
	OUTPUT (KW)	MBH	CFM	E.A.T. (°F)	L.A.T. (°F)	FLA	MERV	PD INITIAL (IN WC)	PD FINAL (IN WC)	FACE VELOCITY (FPM)	MERV	PD INITIAL (IN WC)	PD FINAL (IN WC)	FACE VELOCITY (FPM)	VOLTS	PHASE	FLA				SCCR (kA)
DH-10	26.9	91	386	65	285	32.39	8	0.31	0.62	386	8	0.31	0.62	580	460	3	39.79	65	77 x 36 x 61	850	
DH-11	48.7	166	699	65	285	58.65	8	0.31	0.62	393	8	0.31	0.62	394	460	3	69.51	65	90 x 52 x 70	1,700	

**NOTES:**

1. UNIT SHALL BE CAPABLE OF STATED WATER REMOVAL CAPACITY AT DESIGN INDOOR CONDITIONS INDICATED.

GRILLES, DIFFUSERS, & REGISTERS SCHEDULE					
TYPE	LOCATION	MANUFACTURER	MODEL	FUNCTION	REMARKS
A	CENTRAL FILTER GALLERY	TITUS	S-DL-SV	SUPPLY	LONG THROW, HIGH CAPACITY, SPLIT VANE, DUCT-MOUNTED
B	CENTRAL FILTER GALLERY	TITUS	350FL	RETURN	ALUMINUM, SINGLE DEFLECTION
C	CENTRAL FILTER GALLERY	TITUS	R-301F	RETURN	ALUMINUM, SINGLE DEFLECTION, ROUND
D	EFFLUENT PIPE GALLERY	TITUS	R-301F	RETURN	ALUMINUM, SINGLE DEFLECTION, ROUND
E	EFFLUENT PIPE GALLERY	TITUS	TND-AA	SUPPLY	ALUMINUM, DUCT-MOUNTED, EYEBALL-TYPE NOZZLE DIFFUSER
F	EFFLUENT PIPE GALLERY	TITUS	350FL	RETURN	ALUMINUM, SINGLE DEFLECTION
G	WASHWATER UTILITY STRUCTURE	TITUS	S-DL-SV	SUPPLY	LONG THROW, HIGH CAPACITY, SPLIT VANE, DUCT-MOUNTED
H	WASHWATER UTILITY STRUCTURE	TITUS	R-301F	RETURN	ALUMINUM, SINGLE DEFLECTION, ROUND
I	LOWER INFLUENT ROOM	TITUS	R-300F	SUPPLY	ALUMINUM, DOUBLE DEFLECTION, ROUND
J	LOWER INFLUENT ROOM	TITUS	R-301F	RETURN	ALUMINUM, SINGLE DEFLECTION, ROUND
K	CHLORINE STORAGE	TITUS	50F	SUPPLY	ALUMINUM, EGGCRATE GRILL, 1" x 1" x 1" CORE SIZES
L	CHLORINE STORAGE	TITUS	50F	RETURN	ALUMINUM, EGGCRATE GRILL, 1" x 1" x 1" CORE SIZES

**GENERAL NOTES:**

- ALL NECK SIZES ARE NOTED ON DRAWINGS.
- PROVIDE MANUFACTURER'S NECK ADAPTORS WHERE REQUIRED TO MAKE CONNECTIONS BETWEEN DIFFUSERS, REGISTERS, AND GRILLES AND BRANCH DUCTS. ADAPTORS SHALL BE EQUIVALENT DUCT SIZE TO THE ASSOCIATED BRANCH DUCT. FIELD FABRICATED DUCT TRANSITIONS OR ADAPTORS THAT ARE NOT EQUIVALENT TO BRANCH DUCT SIZES WILL NOT BE ACCEPTED.
- THROW PATTERNS ARE 4-WAY UNLESS NOTED WITH FLOW ARROWS ON FLOOR PLANS.
- PROVIDE COLOR AND FINISH PER DIRECTION OF ARCHITECT.
- PROVIDE FRAME/MOUNTING TYPE SUITABLE FOR CEILING CONSTRUCTION.
- ALL AIR INLETS AND OUTLETS SHALL HAVE A MEANS OF BALANCING. PROVIDE AIR INLETS AND OUTLETS WITH OPPOSED BLADE DAMPERS, AIR SCOOPS, OR APERTURE DAMPERS WHERE REQUIRED FOR BALANCING PURPOSES.

**Dehumidification System Design**

Providence Water Supply Board

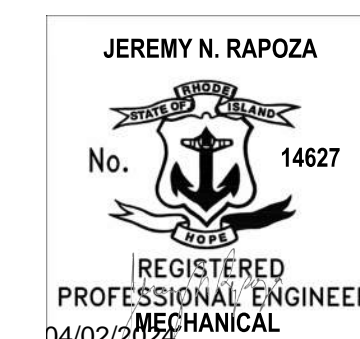
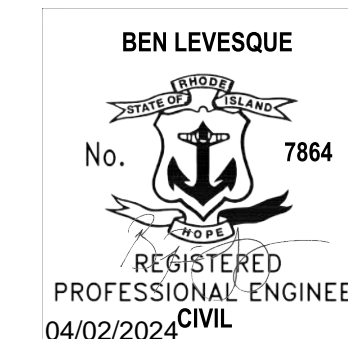
Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO: P0740-047		
DATE: APRIL 2024		
FILE: P0740-047-H-602.dwg		
DRAWN BY: RAK, OLR		
DESIGNED/CHECKED BY: JNR, SJP		
APPROVED BY: BRL		

HVAC SCHEDULES - 2

SCALE: NO SCALE

**H-602**



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS
PROJECT NO: P0740-047		
DATE: APRIL 2024		
FILE: P0740-047-H-700.dwg		
DRAWN BY: RAK, OLR		
DESIGNED/CHECKED BY: JNR, SJP		
APPROVED BY: BRL		

HVAC CONTROL DIAGRAMS - 1

SCALE: NO SCALE

**H-700**

**CONTROL SYMBOLS**

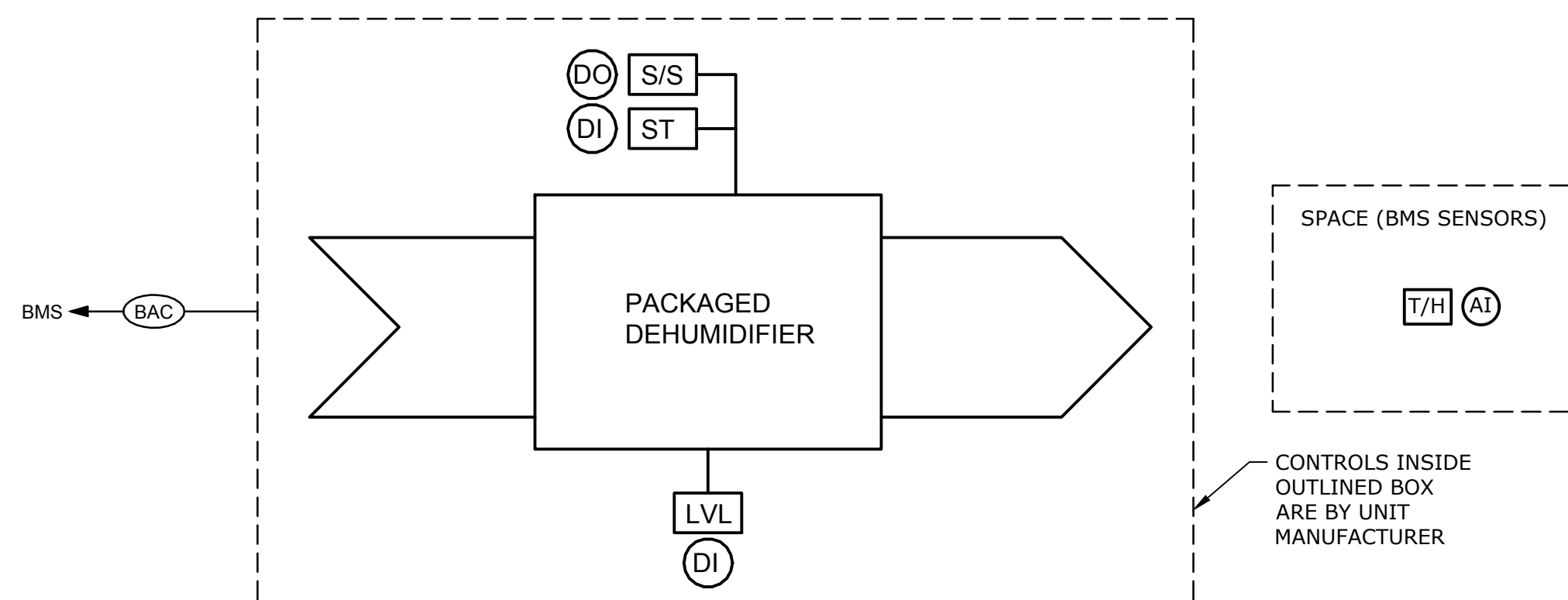
- 2-WAY CONTROL VALVE
- MOTORIZED CONTROL DAMPER
- DAMPER ACTUATOR
- DUCT SMOKE DETECTOR
- VARIABLE FREQUENCY DRIVE
- AIR FLOW STATION
- AVERAGING SENSOR
- LOW TEMP LIMIT SWITCH
- FREEZE
- FIRE ALARM ADDRESSABLE INTERFACE DEVICE
- SPACE SENSOR TRANSMITTER
- SENSOR/TRANSMITTER
- LOW LIMIT INDICATION
- HIGH LIMIT INDICATION

**INTERFACE**

- AI ANALOG INPUT
- AO ANALOG OUTPUT
- BAC BACNET INTERFACE
- DI DIGITAL INPUT
- DO DIGITAL OUTPUT
- HDW HARDWIRE THRU WAY

**CONTROL ABBREVIATIONS**

- AFS AIR FLOW STATION
- BMS CENTRAL BUILDING MANAGEMENT SYSTEM
- C COMMON
- CS CURRENT SENSOR
- CO CARBON MONOXIDE
- CO2 CARBON DIOXIDE LEVEL
- DA DAMPER ACTUATOR
- DC DOOR WINDOW CONTACT
- DEW DEW POINT
- DH DEHUMIDIFIER
- DP DIFFERENTIAL PRESSURE SWITCH
- EA EXHAUST AIR
- ES END SWITCH
- F FAULT
- FS FLOW SWITCH
- H HUMIDITY (RELATIVE)
- LVL LEVEL
- MA MIXED AIR
- OA OUTSIDE AIR
- P PRESSURE
- PN POSITION
- RA RETURN AIR
- REF REFRIGERANT
- SA SUPPLY AIR
- SP STATIC PRESSURE
- SPD SPEED
- S/S START/STOP
- ST STATUS
- T TEMPERATURE
- T/H COMBINATION TEMPERATURE/HUMIDITY SENSOR
- VFD VARIABLE FREQUENCY DRIVE

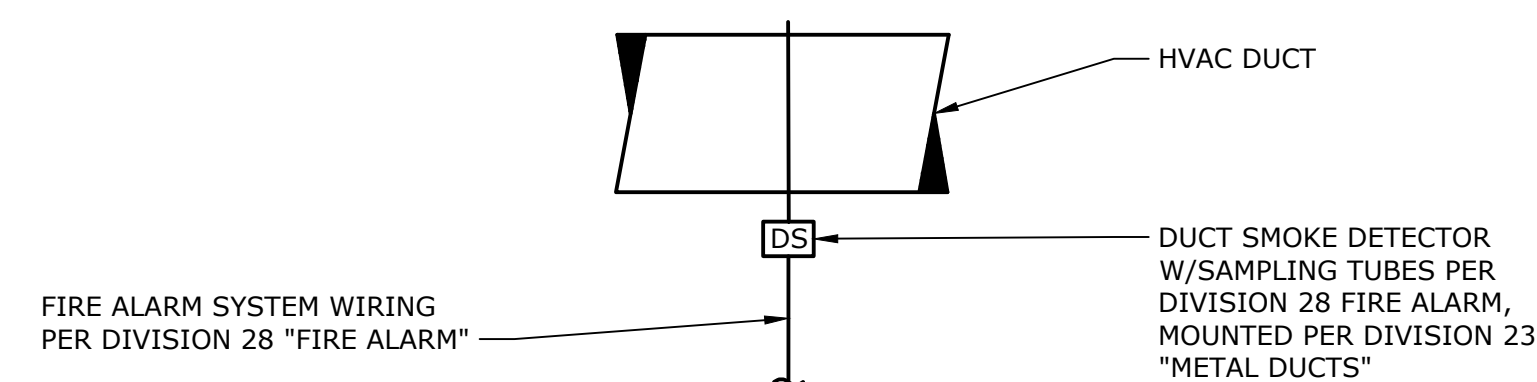


**DEHUMIDIFIER:**

1. **GENERAL:**
  - 1.1. PACKAGED DX DEHUMIDIFICATION AIR HANDLING UNIT WITH RECIRCULATING SUPPLY FAN, DX COOLING AND REHEAT AND FILTRATION SERVING DUCT DISTRIBUTION TO CENTRAL FILTER GALLERY AND THE FILTER BEDS.
  - 1.2. CONTROLS SHOWN ON DIAGRAM AND INCLUDED IN SEQUENCE OF OPERATIONS SHALL BE PROVIDED BY DESICCANT DEHUMIDIFIER MANUFACTURER TO PROVIDE COMPLETE CONTROLS WITH BACNET INTERFACE TO BMS.
2. **SEQUENCE OF OPERATION**
  - 2.1. THE DEHUMIDIFIER FAN SHALL BE NORMALLY OFF
  - 2.2. IF THE SPACE HUMIDITY (AS DETERMINED BY HUMIDISTAT) RISES ABOVE 60% THE DEHUMIDIFIER FAN AND COMPRESSOR SHALL TURN ON.
  - 2.3. INTERLOCK DEHUMIDIFIER OPERATION WITH THE UNIT MOUNTED CONDENSATE DRAIN PAN.
3. **ALARMS VIA BACNET**
  - 3.1. ALARM CONDITION
  - 3.2. DEHUMIDIFIER STATUS DOES NOT MATCH COMMAND
  - 3.3. DRAIN PAN OVERFLOW
4. **GRAPHICS VIA BACNET**
  - 4.1. COMMAND ON/OFF
  - 4.2. STATUS ON/OFF
5. **GRAPHICS VIA BMS**
  - 5.1. SPACE TEMPERATURE
  - 5.2. SPACE HUMIDITY RH%
  - 5.3. SPACE DEWPOINT
  - 5.4. OA TEMPERATURE, RH%, AND DEWPOINT

**SPACE SENSOR/CONTROL DEVICES**

NOT TO SCALE  
(APPLICABLE TO DH-1, 2, 3, 4, 5, 6, 7, 8, AND 9)

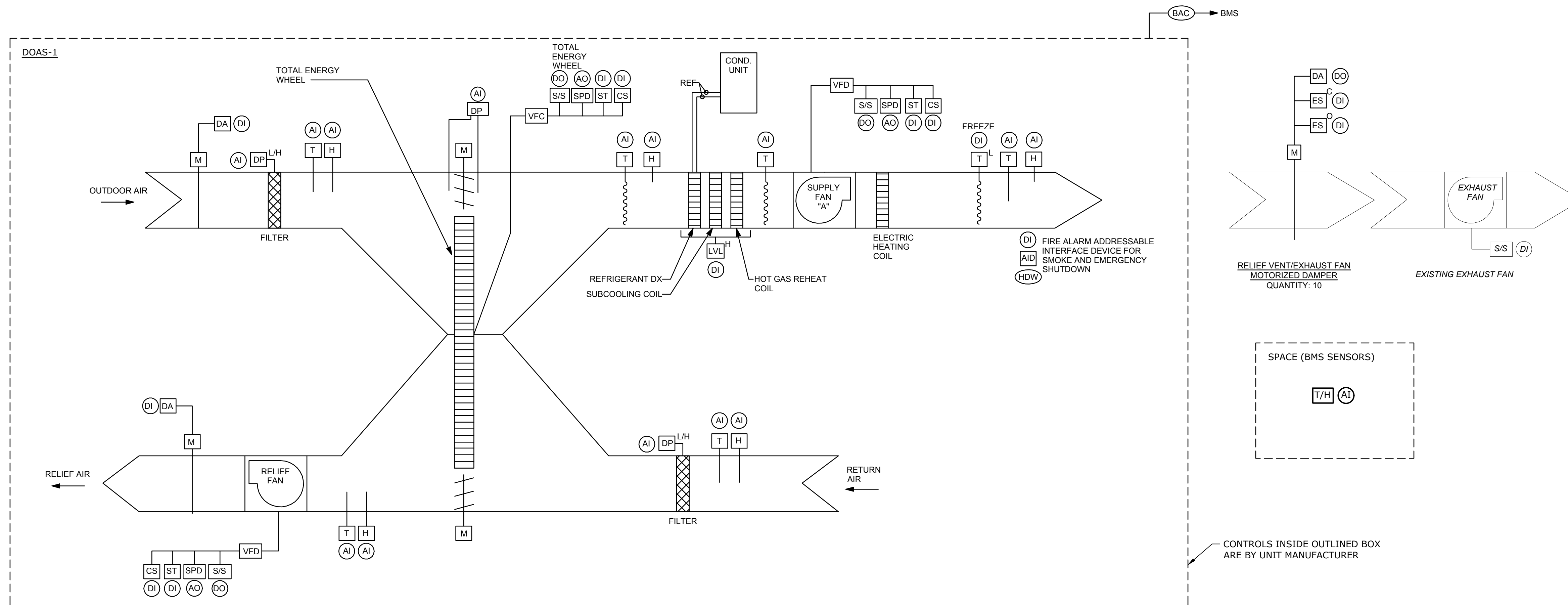


**TYPICAL DUCT SMOKE DETECTOR DETAIL**

NOT TO SCALE

**NOTES:**

APPLY THIS DETAIL TO THE SYSTEM DIAGRAMS ON THIS DRAWING FOR A COMPLETE SYSTEM



**DOAS-1 CONTROL WITH ENERGY RECOVERY SCHEMATIC**  
NOT TO SCALE

**DOAS CONTROL**

**1. GENERAL**

- 1.1. CONSTANT VOLUME AIR HANDLING UNIT WITH SUPPLY AND RELIEF/EXHAUST FANS, ELECTRIC HEATING AND DX COOLING AND HEAT PUMP HEATING COILS, ECONOMIZER DAMPER CONTROL, ENERGY RECOVERY WHEEL, AND FILTRATION SERVING DUCT DISTRIBUTION TO THE CENTRAL FILTER GALLERY AND FILTER BEDS. INTENT IS TO OPERATE 24/7/365, HOWEVER CONTROL SEQUENCES SHALL BE PROGRAMMED FOR THE POSSIBILITY OF CYCLING OFF DURING UNOCCUPIED PERIODS. UNIT PROVIDES VENTILATION TO FILTER GALLERY AND FILTER BEDS. UNIT ALSO SUPPLEMENTS LOCAL DEHUMIDIFIERS BY DELIVERING AIR AT A LOW DEWPOINT. CONTROLS BE PROVIDED BY MANUFACTURER SHALL COMMUNICATE WITH BMS VIA BACNET INTERFACE.
- 1.2. BMS SHALL PERFORM THE FOLLOWING:
  - 1.3.1. ADJUST SETPOINTS.
  - 1.4. MANUFACTURER SHALL COMMUNICATE VIA BACNET THE FOLLOWING:
    - 1.4.1. SUPPLY FAN START, STOP, AND OPERATION.
    - 1.4.2. OUTDOOR-AIR DAMPER POSITION, SUPPLY AND ROOM AIR TEMPERATURE AND HUMIDITY.
    - 1.4.3. MONITORING OCCUPIED AND UNOCCUPIED OPERATIONS.
    - 1.4.4. MONITORING CONSTANT AND VARIABLE MOTOR LOADS.
    - 1.4.5. MONITORING VARIABLE-FREQUENCY DRIVE OPERATION.
    - 1.4.6. MONITORING COOLING/DEHUMIDIFICATION MODE.
    - 1.4.7. MONITORING ECONOMIZER CYCLES.

**2. OCCUPIED/UNOCCUPIED (OCC/UNOC) MODE: (BMS)**

- 2.1. OCC/UNOC SCHEDULES SHALL BE ESTABLISHED VIA PROGRAMMED HEAD END SCHEDULES AS COORDINATED WITH AND DIRECTED BY OWNER
- 2.2. WHENEVER ANY ZONE IS OVERRIDDEN TO OCCUPIED MODE THE ASSOCIATED AIR HANDLER SHALL BE INDEXED TO OCCUPIED MODE.
- 2.3. IN UNOCCUPIED MODE SUPPLY AND RETURN FANS SHALL BE DISABLED AND UNIT SHALL CYCLE TO MAINTAIN BUILDING SETBACK ZONE TEMPERATURES

**3. SUPPLY AIR TEMPERATURE AND DEW POINT CONTROL: (BMS)**

- 3.1. THE DESIGN INTENT IS TO MINIMIZE THE USE OF MECHANICAL COOLING AND HEATING WHILE PROVIDING DRY AIR WITH DRY BULB TEMPERATURES ANYWHERE BETWEEN 53°F AND 75°F (ADJ.)
- 3.2. DISCHARGE AIR TEMPERATURE (DAT) RESET: THE DOAS DAT SHALL BE ALLOWED TO RESET BASED ON THE FOLLOWING SCHEDULE:
  - 3.2.1. COOLING MODE SETPOINT: OAT = 75 °F & ABOVE => DAT = 55 °F
  - 3.2.2. HEATING MODE SETPOINT: OAT = 55 °F & BELOW => DAT = 70 °F
  - 3.2.3. ECONOMIZER MODE SETPOINT
  - 3.2.4. DEHUMIDIFICATION MODE SETPOINT: SEE DEHUMIDIFICATION MODE SEQUENCE FOR TEMPERATURE SETPOINTS DURING DEHUMIDIFICATION MODE.
- 3.3. WHEN OAT BETWEEN 55 AND 75 °F, CONTROL TO LEAVING AIR DEWPOINT OF 53°F. THERE WILL BE NO DRY BULB DISCHARGE AIR TEMPERATURE SET POINT AS IT WILL BE ALLOWED TO FLOAT BETWEEN 55°F AND 75°F.

**4. ECONOMIZER AND INTERLOCK WITH EXISTING EXHAUST FANS AND GRAVITY INTAKES: (BMS)**

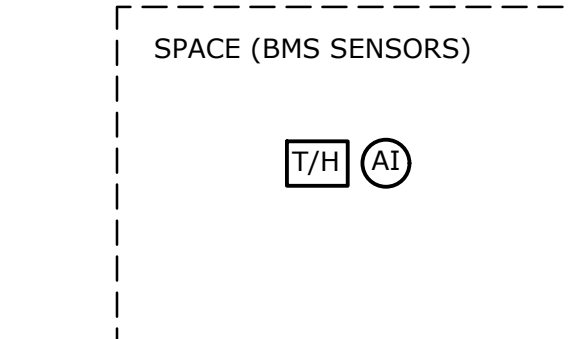
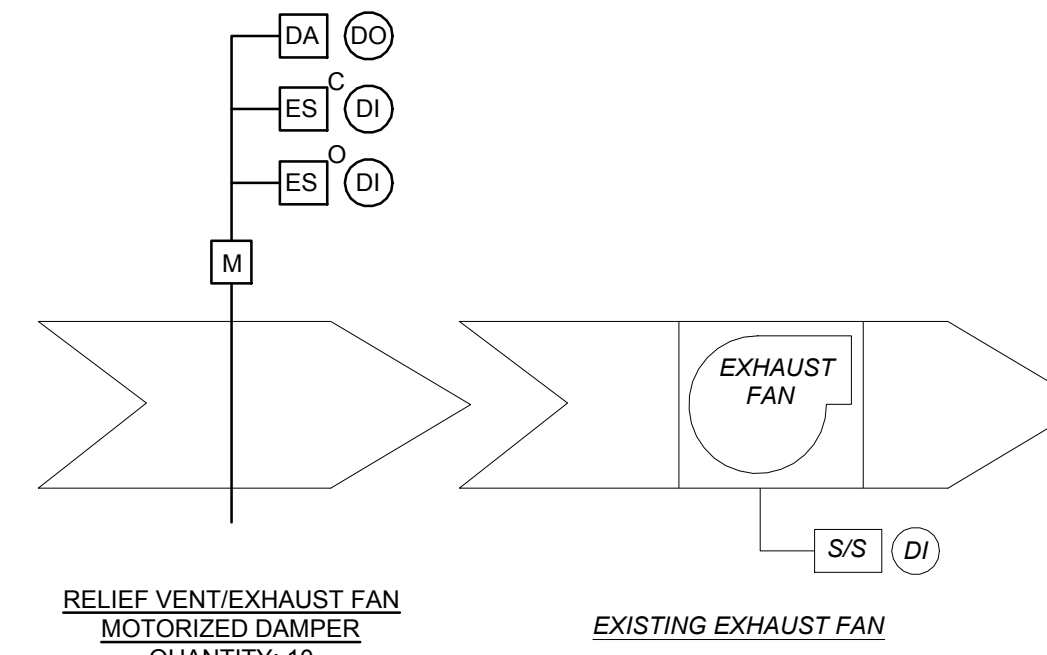
- 4.1. DESIGN INTENT: EXISTING EXHAUST FANS AND GRAVITY INTAKES IN THE FILTER BEDS SHALL OPERATE ONLY DURING MILD AND DRY WEATHER OR FOR PURGING/FLUSHING THE SPACE WITH OUTSIDE AIR. EXISTING EXHAUST FANS AND GRAVITY INTAKES ARE LOCATED IN FILTER BEDS AND WASHWATER UTILITY STRUCTURE SPACES ONLY.
- 4.2. EXISTING EXHAUST FAN AND GRAVITY INTAKE DISABLED MODE:
  - 4.2.1. MOTORIZED DAMPERS SHALL BE CLOSED AND EXHAUST FANS SHALL BE DISABLED.
  - 4.2.1.1. FILTER BED SPACES: DEHUMIDIFICATION SHALL BE PROVIDED BY LOCAL DEHUMIDIFIERS DH-2 AND DH-3 AND VENTILATION IS PROVIDED BY DOAS-1.
  - 4.2.1.2. WASHWATER UTILITY STRUCTURE SPACE: DEHUMIDIFICATION SHALL BE PROVIDED BY LOCAL DEHUMIDIFIERS DH-5 AND 6.
  - 4.2.2. WHEN OA IS ANY OF THE FOLLOWING:
    - 4.2.2.1. BELOW 50 °F (ADJ.) OR ABOVE 80°F DRY BULB TEMPERATURES, OR ABOVE 55 °F DEWPOINT.
    - 4.2.3. EXISTING EXHAUST FAN AND GRAVITY INTAKE ENABLED MODE:
      - 4.2.3.1. LOCAL DEHUMIDIFICATION UNITS SHALL CONTINUE TO OPERATE PER THEIR OWN CONTROLS AND RUN AS NEEDED TO SUPPLEMENT ECONOMIZER OPERATION. MOTORIZED DAMPERS SHALL BE OPEN AND EXISTING EXHAUST FANS SHALL BE ENABLED WHEN OA IS ANY OF THE FOLLOWING:
        - 4.2.3.1.1. ABOVE 50 °F (ADJ.) OR BELOW 80°F DRY BULB TEMPERATURES, AND BELOW 55 °F DEWPOINT.
      - 4.2.4. PURGE/FLUSH MODE:
        - 4.2.4.1. THE SPACE SHALL BE ABLE TO BE MANUALLY INDEXED TO PURGE MODE AT BMS WORKSTATION.
        - 4.2.4.2. LOCAL DEHUMIDIFICATION UNITS SHALL CONTINUE TO OPERATE PER THEIR OWN CONTROLS AND RUN AS NEEDED TO MEET SPACE HUMIDITY SETPOINT. MOTORIZED DAMPERS SHALL BE OPEN AND EXISTING EXHAUST FANS SHALL BE ENABLED TO PURGE/FLUSH THE SPACE REGARDLESS OF OA CONDITIONS.

**THE FOLLOWING SEQUENCES SHALL BE PROVIDED BY THE MANUFACTURER:**

5. **DISABLED CONDITION:**
  - 5.1. WHENEVER THE UNIT IS DISABLED FANS SHALL BE OFF. THE OUTSIDE AIR AND RELIEF AIR DAMPERS SHALL BE CLOSED. THE DX CIRCUIT SHALL BE DISABLED WHEN THE UNIT IS OFF.
6. **RESTART/START COMMAND:**
  - 6.1. WHEN THE SYSTEM IS STARTED OR RESET, DAMPERS SHALL OPEN AND, SUBJECT TO END SWITCHES ON THE DAMPER CLOSED POSITIONS THE FANS SHALL BE SENT A START COMMAND. SUPPLY AND RETURN FANS SHALL RAMP UP OVER 240 SECONDS (ADJ) AND HEATING/COOLING COIL CONTROL COME UNDER NORMAL CONTROL. ONCE FANS AND COILS ARE UNDER STABLE CONTROL AT SET POINT, MINIMUM OUTSIDE AIR AND RELIEF AIR DAMPERS SHALL COME UNDER CONTROL OVER 240 SECONDS SUBJECT TO MORNING WARM UP/COOL DOWN AND VENTILATION PURGE MODE SEQUENCES.
7. **STOP/SHUT-DOWN COMMAND:**
  - 7.1. UNIT SHUTDOWN SHALL OCCUR UNDER THE CONDITIONS INDICATED BELOW:
    - 7.1.1. THE SUPPLY AND RELIEF/EXHAUST FAN VARIABLE FREQUENCY CONTROLLERS SHALL RAMP DOWN TO MINIMUM SPEED IN 120 SECONDS (ADJ) AND COMMAND OFF. ALL EMERGENCY COMMANDS SHALL BE A HARD WIRE INTERLOCK THAT IMMEDIATELY DISCONNECTS POWER TO THE SUPPLY AND RETURN FANS AND IS ALARMED AT OPERATOR WORKSTATION. ONCE COMMANDED TO SHUTDOWN, THE UNIT SHALL GO TO DISABLED MODE. EACH EMERGENCY CONDITION SHUTDOWN REQUIRES A MANUAL RESET TO CLEAR ALARM AND ALLOW START OF UNIT, SUBJECT TO OPTIMUM/DEMAND LIMITING CONTROL SEQUENCE
    - 7.1.2. EMERGENCY SHUTDOWN CONDITION AS COMMANDED FROM BUILDING FIRE ALARM SYSTEM FOR BOTH ALARM CONDITION IN ACCORDANCE WITH AHJ AND OWNER REQUIREMENTS AND FOR A MANUAL EMERGENCY SHUTDOWN COMMAND
    - 7.1.3. EMERGENCY FREEZE CONDITION
    - 7.1.4. EMERGENCY HIGH LEVEL CONDENSATE CONDITION
    - 7.1.5. MANUAL COMMAND FROM THE OPERATOR'S WORKSTATION

**8. SUPPLY AND EXHAUST FAN CONTROL:**

- 8.1. SUPPLY AND EXHAUST FAN RAMP UP AT THE SAME RATE TO MAXIMUM CFM VALUES. COORDINATE CFM, DOAS SUPPLY AND EXHAUST FAN SPEED VALUES WITH ATC AND TAB CONTRACTOR.
- 8.2. THE OUTSIDE AIR DAMPER WILL OPEN, AND THE UNIT WILL START AFTER A 30 SEC. (ADJ.) DELAY. THE CONTROL SEQUENCE WILL BE ENABLED. THE SUPPLY AND EXHAUST FANS WILL RUN CONTINUOUSLY DURING OCCUPIED PERIODS. EXHAUST FAN WILL CONTROL TO MAINTAIN A FIXED CFM OFFSET FROM SUPPLY.
9. **ENERGY RECOVERY WHEEL (ERW):**
  - 9.1. AFTER THE SF TURNS ON, THE ERW IS ENABLED.
  - 9.2. THE ERW BY-PASS DAMPER WILL OPEN WHEN THE ERW IS OFF AND IT WILL CLOSE WHEN THE ERW IS ON.
  - 9.3. ERW WITH ON/OFF DEFROST:
    - 9.3.1. WHEN THE OAT IS 3°F (ADJ) OR MORE ABOVE OR BELOW THE RAT, THE ERW WILL BE ON. IT WILL BE OFF IF THE OAT IS LESS THAN 3°F (ADJ) ABOVE OR BELOW THE RAT OR IF THE WHEEL EXHAUST AIR TEMPERATURE (WEXAT) IS BELOW 25°F (ADJ) TO ALLOW FOR WHEEL DEFROSTING. WHEN THE WEXAT RISES ABOVE 35°F (ADJ), THE WHEEL WILL TURN BACK ON.
10. **COOLING MODE:**
  - 10.1. REVERSING VALVE IS "OFF" IN COOLING MODE.
  - 10.2. COOLING MODE OPERATION SHALL BE CONTROLLED BY PACKAGED SYSTEM TO MEET DISCHARGE AIR SETPOINT, MANAGE COMPRESSOR OIL RETURN, AND PREVENT COMPRESSOR SHORT CYCLING.
  - 10.3. HOT GAS REHEAT (HGRH) - MODULATING (SEE DEHUMIDIFICATION MODE).
11. **DEHUMIDIFICATION MODE: SPACE DEHUMIDIFICATION SETPOINT SHALL BE 55% RH, WITH A 5% DEADBAND.**
  - 11.1. REVERSING VALVE IS "OFF" IN DEHUMIDIFICATION MODE.
  - 11.2. DEHUMIDIFICATION MODE SHALL BE CONTROLLED BY PACKAGED SYSTEM TO CONTROL HOT GAS REHEAT TO MEET DISCHARGE AIR SETPOINT.
  - 11.3. HOT GAS REHEAT (HGRH) - MODULATING:
    - 11.3.1. WHEN THE SAT IS 1°F (ADJ) OR MORE BELOW THE SAT DEHUMIDIFICATION SETPOINT (70°F, ADJ), HGRH TURNS ON AND MODULATES BASED UPON THE SAT DEHUMIDIFICATION SETPOINT.
    - 11.3.2. WHEN SAT IS 2°F (ADJ) OR MORE ABOVE THE SAT DEHUMIDIFICATION SETPOINT, HGRH TURNS OFF.
    - 11.3.3. IF THE HGRH IS UNABLE TO MAINTAIN THE SAT DEHUMIDIFICATION SETPOINT, THE COMPRESSOR MODULATION WILL BE INCREASED TO PROVIDE MORE CAPACITY FOR REHEAT.
  - 11.4. SWITCHABLE SUB-COOLING:
    - 11.4.1. WHEN EITHER OF THE COMPRESSORS ARE ENABLED, THE SUB-COOLING COIL IS ENABLED.
    - 11.4.2. WHEN BOTH OF THE COMPRESSORS ARE DISABLED, THE SUB-COOLING COIL IS DISABLED.
12. **HEAT PUMP MODE:**
  - 12.1. REVERSING VALVE IS "ON" IN HEATING MODE.
  - 12.2. HEAT PUMP OPERATION SHALL BE CONTROLLED BY PACKAGED SYSTEM TO MEET DISCHARGE AIR SETPOINT, MANAGE DEFROST MODE, AND MANAGE COMPRESSOR OIL RETURN.
13. **AUXILIARY HEATING MODE:**
  - 13.1. AFTER BOTH HEAT PUMPS HAVE BEEN ENABLED, WHEN THE SAT IS 2°F (ADJ) OR MORE BELOW THE SAT HEATING SETPOINT (70°F, ADJ), AND AFTER A 10-MINUTE (ADJ) DELAY PERIOD, AUXILIARY HEATING WILL BE ENABLED. WHEN THE SAT IS ABOVE THE SAT HEATING SETPOINT, AUXILIARY HEATING WILL BE DISABLED.
  - 13.2. MODULATED HEAT:
    - 13.2.1. SCR ELECTRIC HEAT: ON DEMAND FOR HEATING, THE MANUFACTURER SUPPLIED CONTROLLER MODULATES THE ELECTRIC HEATING SCR BASED UPON THE SAT HEATING SETPOINT (70°F, ADJ).
  - 13.3. EMERGENCY HEATING MODE:
    - 13.3.1. THE COMPRESSORS ARE "OFF" IN EMERGENCY HEATING MODE.
    - 13.3.2. EMERGENCY HEATING MODE IS SELECTABLE USING THE EQUIPMENT INTERFACE OR BMS (DEFAULT IS "OFF"). EMERGENCY HEATING MODE WILL AUTOMATICALLY BE TURNED ON IF UNIT IS IN HEATING MODE AND BOTH HEAT PUMP COMPRESSORS FAIL OR ARE DISABLED DUE TO EITHER THE OUTSIDE AIR TEMPERATURE (OAT) GOING BELOW THE COMPRESSOR DISABLE SETPOINT OF 20°F (ADJ) OR THE SF-VSC MODULATING BELOW 85% (ADJ). MODULATED EMERGENCY SCR ELECTRIC HEAT: ON DEMAND FOR EMERGENCY HEATING, THE MANUFACTURER SUPPLIED CONTROLLER MODULATES THE ELECTRIC HEATING SCR BASED UPON THE SAT HEATING SETPOINT (70°F, ADJ).



CONTROLS INSIDE OUTLINED BOX ARE BY UNIT MANUFACTURER

**14. ALARMS:**

- 14.1. CAUTIONARY ALARM WHEN UNOCCUPIED MODE IS OVERRIDDEN
- 14.2. UNIT STOPPED CONDITION
- 14.3. SUPPLY FAN STOPPED CONDITION
- 14.4. SUPPLY FAN FAULT/FAILURE CONDITION
- 14.5. RELIEF FAN STOPPED CONDITION
- 14.6. RELIEF FAN FAULT/FAILURE CONDITION
- 14.7. SUPPLY SMOKE CONDITION
- 14.8. FREEZE CONDITION
- 14.9. RETURN/EXHAUST HUMIDIFICATION HIGH/LOW CONDITIONS
- 14.10. LOW/HIGH OUTSIDE AIR FLOWS
- 14.11. LOW/HIGH UNIT DISCHARGE AIR TEMPERATURES
- 14.12. LOW/HIGH FILTER BANK PRESSURES
- 14.13. RELIEF/OUTDOOR AIR DAMPERS FAILURE CONDITION
- 14.14. WHEEL MOTOR FAILURE
15. **GRAPHICS VIA BACNET**
  - 15.1. ALARM CONDITIONS
  - 15.2. OCCUPIED/UNOCCUPIED MODE
  - 15.3. SUPPLY FAN STATUS
  - 15.4. SUPPLY FAN SPEED
  - 15.5. SUPPLY FAN AIR FLOW (CALCULATED)
  - 15.6. SUPPLY SYSTEM STATIC PRESSURES
  - 15.7. DISCHARGE AIR TEMPERATURE
  - 15.8. ELECTRICAL HEATING SCR COMMAND PERCENTAGE
  - 15.9. ELECTRIC HEATING COIL DISCHARGE AIR TEMPERATURE
  - 15.10. DX COMPRESSOR COMMAND (PER COMPRESSOR)
  - 15.11. DX COIL DISCHARGE AIR TEMPERATURE
  - 15.12. CONDENSING UNIT FAN SPEED (PER FAN)
  - 15.13. EXHAUST FAN STATUS
  - 15.14. EXHAUST FAN SPEED
  - 15.15. EXHAUST FAN AIR FLOW (CALCULATED)
  - 15.16. RETURN HUMIDITY
  - 15.17. RETURN TEMPERATURE
  - 15.18. RETURN ENTHALPY
  - 15.19. RELIEF/WHEEL BYPASS OA DAMPER COMMAND PERCENTAGES
  - 15.20. RELIEF/WHEEL BYPASS OA DAMPER AIR FLOWS
  - 15.21. FILTER DIFFERENTIAL PRESSURE
  - 15.22. ENERGY WHEEL SPEED COMMAND PERCENTAGE
  - 15.23. ENERGY WHEEL STATUS
  - 15.24. ENERGY WHEEL HX DISCHARGE AIR TEMPERATURE
16. **GRAPHIC VIA BMS**
  - 16.1. SPACE TEMPERATURE
  - 16.2. SPACE HUMIDITY RH%
  - 16.3. DPACE DEWPOINT
  - 16.4. DISCHARGE AIR TEMPERATURE BASE SET POINT (DEWPOINT AND RELATIVE HUMIDITY SETPOINT)
  - 16.5. DISCHARGE AIR TEMPERATURE RESET SET POINT
  - 16.6. OUTSIDE AIR TEMPERATURE (GLOBAL)
  - 16.7. OUTSIDE AIR HUMIDITY (GLOBAL)
  - 16.8. OUTSIDE AIR ENTHALPY (GLOBAL)

**Dehumidification System Design**

**Providence Water Supply Board**

**Philip J. Holton Water Purification Plant Scituate, Rhode Island**

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P0740-047

DATE: APRIL 2024

FILE: P0740-047-H-701.dwg

DRAWN BY: RAK, OLR

DESIGNED/CHECKED BY: JNR, SJP

APPROVED BY: BRL

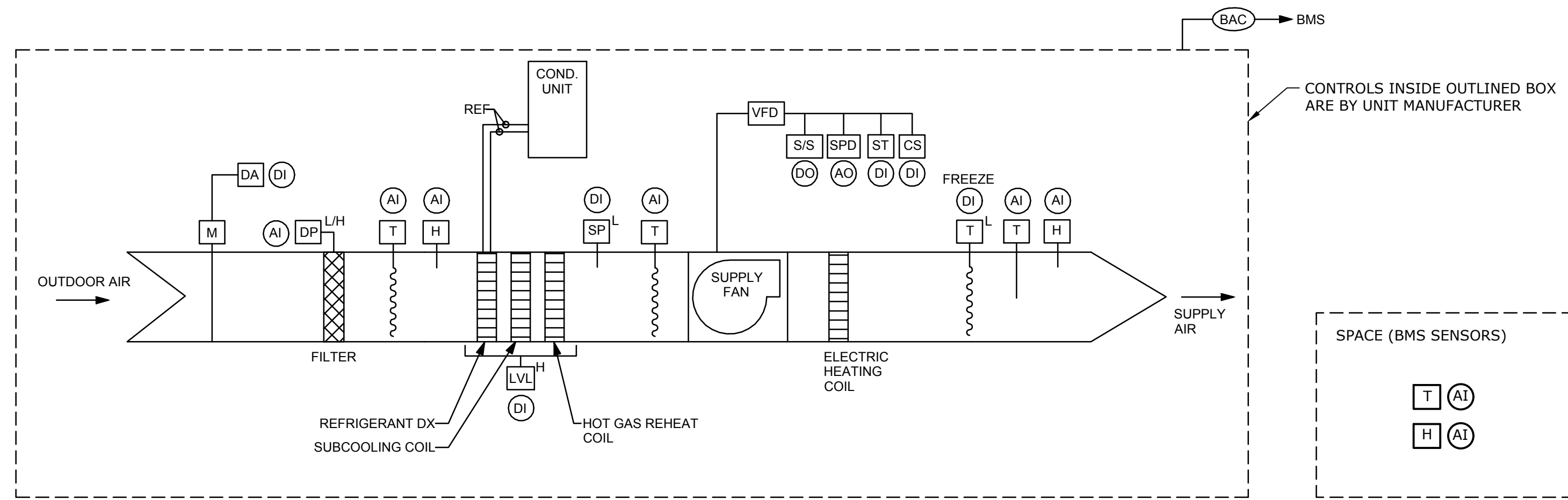
**HVAC CONTROL DIAGRAMS - 2**

SCALE: NO SCALE

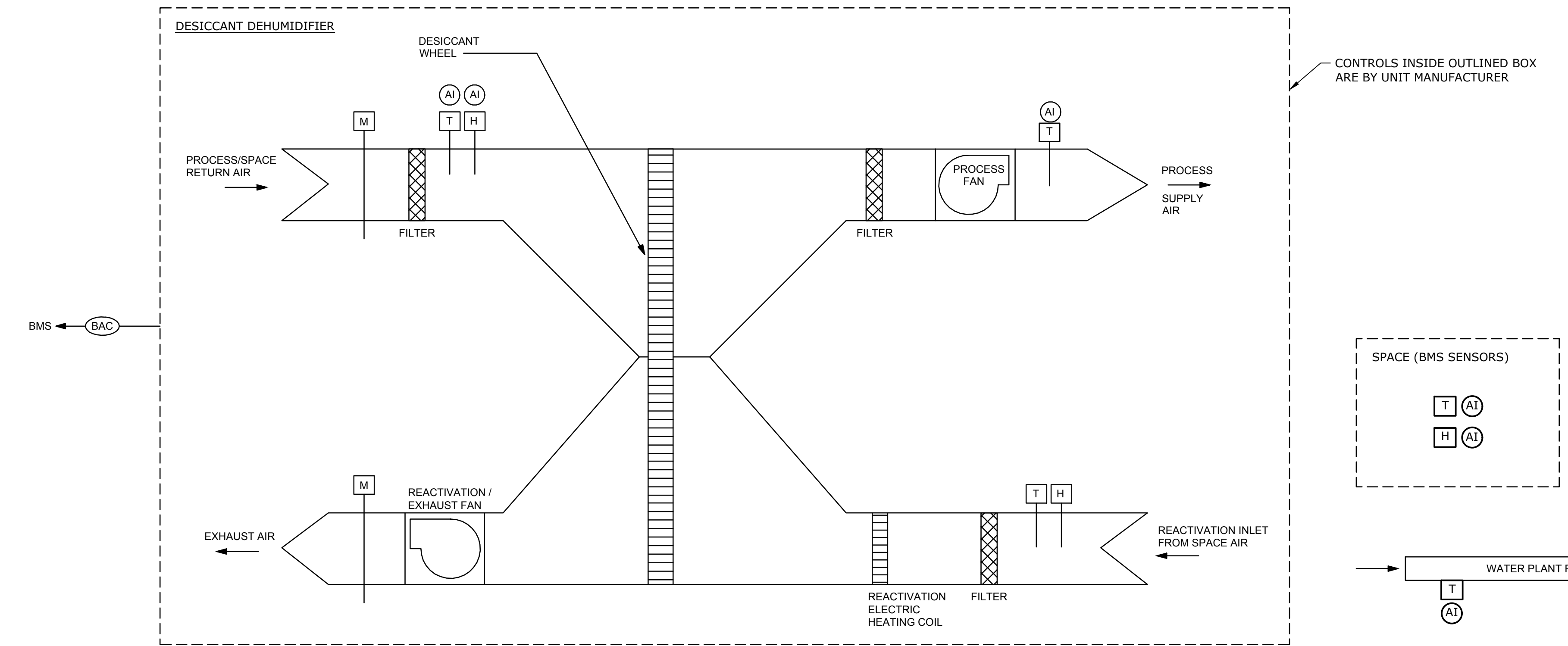
**H-701**

**MAU CONTROL**

1. **GENERAL:**
  - 1.1. CONSTANT VOLUME AIR HANDLING UNIT WITH SUPPLY FAN, DX COOLING AND HEAT PUMP HEATING COILS, ECONOMIZER DAMPER CONTROL, AND FILTRATION SERVING DUCT DISTRIBUTION TO PROVIDE VENTILATION AND MAKEUP AIR FOR THE DESICCANT REACTIVATION EXHAUST AIR STREAM FOR THE EFFLUENT PIPE UTILITY GALLERY. UNIT ALSO SUPPLEMENTS LOCAL DEHUMIDIFIER BY DELIVERING AIR AT A LOW DEWPOINT. INTENT IS TO OPERATE 24/7/365, HOWEVER CONTROL SEQUENCES SHALL BE PROGRAMMED FOR THE POSSIBILITY OF CYCLING OFF DURING UNOCCUPIED PERIODS WHEN DESICCANT DEHUMIDIFIER IS OFF.
  - 1.2. CONTROLS PROVIDED BY MANUFACTURER SHALL COMMUNICATE WITH BMS VIA BACNET INTERFACE.
  - 1.3. BMS SHALL PERFORM THE FOLLOWING:
    - 1.3.1. ADJUST SETPOINTS
  - 1.4. MANUFACTURER SHALL COMMUNICATE VIA BACNET THE FOLLOWING:
    - 1.4.1. SUPPLY FAN START, STOP, AND OPERATION
    - 1.4.2. OUTDOOR-AIR DAMPER POSITION, SUPPLY AND ROOM AIR TEMPERATURE AND HUMIDITY.
    - 1.4.3. MONITORING OCCUPIED AND UNOCCUPIED OPERATIONS.
    - 1.4.4. MONITORING CONSTANT AND VARIABLE MOTOR LOADS.
    - 1.4.5. MONITORING VARIABLE-FREQUENCY DRIVE OPERATION.
    - 1.4.6. MONITORING COOLING/DEHUMIDIFICATION MODE.
    - 1.4.7. MONITORING ECONOMIZER CYCLES.
2. **OCCUPIED/UNOCCUPIED (OCC/UNOC) MODE: (BMS)**
  - 2.1. OCC/UNOC SCHEDULES SHALL BE ESTABLISHED VIA PROGRAMMED HEAD END SCHEDULES AS COORDINATED WITH AND DIRECTED BY OWNER
  - 2.2. WHENEVER ANY ZONE IS OVERRIDDEN TO OCCUPIED MODE THE ASSOCIATED AIR HANDLER SHALL BE INDEXED TO OCCUPIED MODE.
  - 2.3. IN UNOCCUPIED MODE SUPPLY AND RETURN FANS SHALL BE DISABLED AND UNIT SHALL CYCLE TO MAINTAIN BUILDING SETBACK ZONE TEMPERATURES
3. **SUPPLY AIR TEMPERATURE AND DEW POINT CONTROL: (BMS)**
  - 3.1. THE DESIGN INTENT IS TO MINIMIZE THE USE OF MECHANICAL COOLING AND HEATING WHILE PROVIDING DRY AIR WITH DRY BULB TEMPERATURES ANYWHERE BETWEEN 53°F AND 75°F (ADJ.)
  - 3.2. DISCHARGE AIR TEMPERATURE (DAT) RESET: THE DOAS DAT SHALL BE ALLOWED TO RESET BASED ON THE FOLLOWING SCHEDULE:
    - 3.2.1. COOLING MODE SETPOINT: OAT = 75 °F & ABOVE => DAT = 55 °F
    - 3.2.2. HEATING MODE SETPOINT: OAT = 55 °F & BELOW => DAT = 70 °F
    - 3.2.3. ECONOMIZER MODE SETPOINT
    - 3.2.4. DEHUMIDIFICATION MODE SETPOINT: SEE DEHUMIDIFICATION MODE SEQUENCE FOR TEMPERATURE SETPOINTS DURING DEHUMIDIFICATION MODE.
  - 3.3. 55 AND 75 °F, CONTROL TO LEAVING AIR DEWPOINT OF 53°F. THERE WILL BE NO DRY BULB DISCHARGE AIR TEMPERATURE SET POINT AS IT WILL BE ALLOWED TO FLOAT BETWEEN 55°F AND 75°F.
4. **DISABLED CONDITION:**
  - 4.1. WHENEVER THE UNIT IS DISABLED FANS SHALL BE OFF, THE OUTSIDE AIR AND RELIEF AIR DAMPERS SHALL BE CLOSED. THE HEATING COIL VALVE SHALL MODULATE TO MAINTAIN AN INTERNAL CASE TEMPERATURE OF 50°F (ADJ.) AT THE HEATING COIL DISCHARGE AIR TEMPERATURE SENSOR. THE DX CIRCUIT SHALL BE DISABLED WHEN THE UNIT IS OFF.
5. **RESTART/START COMMAND:**
  - 5.1. WHEN THE SYSTEM IS STARTED OR RESET, DAMPERS SHALL OPEN AND, SUBJECT TO END SWITCHES ON THE DAMPER CLOSED POSITIONS THE FANS SHALL BE SENT A START COMMAND. SUPPLY AND RETURN FANS SHALL RAMP UP OVER 240 SECONDS (ADJ) AND HEATING/COOLING COIL CONTROL COME UNDER NORMAL CONTROL. ONCE FANS AND COILS ARE UNDER STABLE CONTROL AT SET POINT, MINIMUM OUTSIDE AIR AND RELIEF AIR DAMPERS SHALL COME UNDER CONTROL OVER 240 SECONDS SUBJECT TO MORNING WARM UP/COOL DOWN AND VENTILATION PURGE MODE SEQUENCES.
6. **STOP/SHUT-DOWN COMMAND:**
  - 6.1. UNIT SHUTDOWN SHALL OCCUR UNDER THE CONDITIONS INDICATED BELOW:
    - 6.1.1. THE SUPPLY AND RELIEF/EXHAUST FAN VARIABLE FREQUENCY CONTROLLERS SHALL RAMP DOWN TO MINIMUM SPEED IN 120 SECONDS (ADJ) AND COMMAND OFF. ALL EMERGENCY COMMANDS SHALL BE A HARD WIRE INTERLOCK THAT IMMEDIATELY DISCONNECTS POWER TO THE SUPPLY AND RETURN FANS AND IS ALARMED AT OPERATOR WORKSTATION. ONCE COMMANDED TO SHUTDOWN, THE UNIT SHALL GO TO DISABLED MODE. EACH EMERGENCY CONDITION SHUTDOWN REQUIRES A MANUAL RESET TO CLEAR ALARM AND ALLOW START OF UNIT. SUBJECT TO OPTIMUM/DEMAND LIMITING CONTROL SEQUENCE
    - 6.1.2. EMERGENCY SHUTDOWN CONDITION AS COMMANDED FROM BUILDING FIRE ALARM SYSTEM FOR BOTH ALARM CONDITION IN ACCORDANCE WITH AHJ AND OWNER REQUIREMENTS AND FOR A MANUAL EMERGENCY SHUTDOWN COMMAND
    - 6.1.3. EMERGENCY FREEZE CONDITION
    - 6.1.4. EMERGENCY HIGH LEVEL CONDENSATE CONDITION
    - 6.1.5. MANUAL COMMAND FROM THE OPERATOR'S WORKSTATION
7. **SUPPLY AND EXHAUST FAN CONTROL:**
  - 7.1. SUPPLY AND EXHAUST FAN RAMP UP AT THE SAME RATE TO MAXIMUM CFM VALUES. COORDINATE CFM, DOAS SUPPLY AND EXHAUST FAN SPEED VALUES WITH ATC AND TAB CONTRACTOR.
  - 7.2. THE OUTSIDE AIR DAMPER WILL OPEN, AND THE UNIT WILL START AFTER A 30 SEC. (ADJ.) DELAY. THE CONTROL SEQUENCE WILL BE ENABLED. THE SUPPLY AND EXHAUST FANS WILL RUN CONTINUOUSLY DURING OCCUPIED PERIODS, EXHAUST FAN WILL CONTROL TO MAINTAIN A FIXED CFM OFFSET FROM SUPPLY.
8. **COOLING MODE:**
  - 8.1. REVERSING VALVE IS "OFF" IN COOLING MODE.
  - 8.2. COOLING MODE OPERATION SHALL BE CONTROLLED BY PACKAGED SYSTEM TO MEET DISCHARGE AIR SETPOINT, MANAGE COMPRESSOR OIL RETURN, AND PREVENT COMPRESSOR SHORT CYCLING.
  - 8.3. HOT GAS REHEAT (HGRH) - MODULATING (SEE DEHUMIDIFICATION MODE):
9. **DEHUMIDIFICATION MODE: SPACE DEHUMIDIFICATION SETPOINT SHALL BE 55% RH, WITH A 5% DEADBAND.**
  - 9.1. REVERSING VALVE IS "OFF" IN DEHUMIDIFICATION MODE.
  - 9.2. DEHUMIDIFICATION MODE SHALL BE CONTROLLED BY PACKAGED SYSTEM TO CONTROL HOT GAS REHEAT TO MEET DISCHARGE AIR SETPOINT.
  - 9.3. HOT GAS REHEAT (HGRH) - MODULATING:
    - 9.3.1. WHEN THE SAT IS 1°F (ADJ) OR MORE BELOW THE SAT DEHUMIDIFICATION SETPOINT (70°F, ADJ), HGRH TURNS ON AND MODULATES BASED UPON THE SAT DEHUMIDIFICATION SETPOINT.
    - 9.3.2. WHEN SAT IS 2°F (ADJ) OR MORE ABOVE THE SAT DEHUMIDIFICATION SETPOINT, HGRH TURNS OFF.
    - 9.3.3. IF THE HGRH IS UNABLE TO MAINTAIN THE SAT DEHUMIDIFICATION SETPOINT, THE COMPRESSOR MODULATION WILL BE INCREASED TO PROVIDE MORE CAPACITY FOR REHEAT.
  - 9.4. SWITCHABLE SUB-COOLING:
    - 9.4.1. WHEN EITHER OF THE COMPRESSORS ARE ENABLED, THE SUB-COOLING COIL IS ENABLED.
    - 9.4.2. WHEN BOTH OF THE COMPRESSORS ARE DISABLED, THE SUB-COOLING COIL IS DISABLED.
10. **HEAT PUMP MODE:**
  - 10.1. REVERSING VALVE IS "ON" IN HEATING MODE.
  - 10.2. HEAT PUMP OPERATION SHALL BE CONTROLLED BY PACKAGED SYSTEM TO MEET DISCHARGE AIR SETPOINT, MANAGE DEFROST MODE, AND MANAGE COMPRESSOR OIL RETURN.
11. **AUXILIARY HEATING MODE:**
  - 11.1. AFTER BOTH HEAT PUMPS HAVE BEEN ENABLED, WHEN THE SAT IS 2°F (ADJ) OR MORE BELOW THE SAT HEATING SET POINT (70°F, ADJ), AND AFTER A 10-MINUTE (ADJ) DELAY PERIOD, AUXILIARY HEATING WILL BE ENABLED. WHEN THE SAT IS ABOVE THE SAT HEATING SETPOINT, AUXILIARY HEATING WILL BE DISABLED.
  - 11.2. MODULATED HEAT:
    - 11.2.1. SCR ELECTRIC HEAT: ON DEMAND FOR HEATING, THE MANUFACTURER SUPPLIED CONTROLLER MODULATES THE ELECTRIC HEATING SCR BASED UPON THE SAT HEATING SETPOINT (70°F, ADJ).
  - 11.3. EMERGENCY HEATING MODE:
    - 11.3.1. THE COMPRESSORS ARE "OFF" IN EMERGENCY HEATING MODE.
    - 11.3.2. EMERGENCY HEATING MODE IS SELECTABLE USING THE EQUIPMENT INTERFACE OR BMS (DEFAULT IS "OFF"). EMERGENCY HEATING MODE WILL AUTOMATICALLY BE TURNED ON IF UNIT IS IN HEATING MODE AND BOTH HEAT PUMP COMPRESSORS FAIL OR ARE DISABLED DUE TO EITHER THE OUTSIDE AIR TEMPERATURE (OAT) GOING BELOW THE COMPRESSOR DISABLE SETPOINT OF 26°F (ADJ) OR THE SF-VSC MODULATING BELOW 85% (ADJ).
    - 11.3.3. MODULATED EMERGENCY SCR ELECTRIC HEAT: ON DEMAND FOR EMERGENCY HEATING, THE MANUFACTURER SUPPLIED CONTROLLER MODULATES THE ELECTRIC HEATING SCR BASED UPON THE SAT HEATING SETPOINT (70°F, ADJ).
12. **ALARMS:**
  - 12.1. CAUTIONARY ALARM WHEN UNOCCUPIED MODE IS OVERRIDDEN
  - 12.2. UNIT STOPPED CONDITION
  - 12.3. SUPPLY FAN STOPPED CONDITION
  - 12.4. SUPPLY FAN FAULT/FAILURE CONDITION
  - 12.5. RELIEF FAN STOPPED CONDITION
  - 12.6. RELIEF FAN FAULT/FAILURE CONDITION
  - 12.7. SUPPLY SMOKE CONDITION
  - 12.8. FREEZE CONDITION
  - 12.9. RETURN/EXHAUST HUMIDIFICATION HIGH/LOW CONDITIONS
  - 12.10. LOW/HIGH OUTSIDE AIR FLOWS
  - 12.11. LOW/HIGH UNIT DISCHARGE AIR TEMPERATURES
  - 12.12. LOW/HIGH FILTER BANK PRESSURES
  - 12.13. RELIEF/OUTDOOR AIR DAMPERS FAILURE CONDITION
  - 12.14. WHEEL MOTOR FAILURE
13. **GRAPHICS VIA BACNET:**
  - 13.1. ALARM CONDITIONS
  - 13.2. OCCUPIED/UNOCCUPIED MODE
  - 13.3. SUPPLY FAN STATUS
  - 13.4. SUPPLY FAN SPEED
  - 13.5. SUPPLY FAN AIR FLOW
  - 13.6. SUPPLY SYSTEM STATIC PRESSURES
  - 13.7. DISCHARGE AIR TEMPERATURE
  - 13.8. ELECTRIC HEATING SCR COMMAND PERCENTAGE
  - 13.9. ELECTRIC HEATING COIL DISCHARGE AIR TEMPERATURE
  - 13.10. DX COMPRESSOR COMMAND (PER COMPRESSOR)
  - 13.11. DX COIL DISCHARGE AIR TEMPERATURE
  - 13.12. CONDENSING UNIT FAN SPEED (PER FAN)
  - 13.13. EXHAUST FAN STATUS
  - 13.14. EXHAUST FAN SPEED
  - 13.15. EXHAUST FAN AIR FLOW
  - 13.16. RETURN HUMIDITY
  - 13.17. RETURN TEMPERATURE
  - 13.18. RETURN ENTHALPY
  - 13.19. FILTER DIFFERENTIAL PRESSURE
14. **GRAPHICS VIA BMS:**
  - 14.1. SPACE TEMPERATURE
  - 14.2. SPACE HUMIDITY RH%
  - 14.3. SPACE DEWPOINT
  - 14.4. DISCHARGE AIR TEMPERATURE BASE SET POINT (DEWPOINT AND RELATIVE HUMIDITY SETPOINT)
  - 14.5. DISCHARGE AIR TEMPERATURE RESET SET POINT
  - 14.6. OUTSIDE AIR TEMPERATURE (GLOBAL)
  - 14.7. OUTSIDE AIR HUMIDITY (GLOBAL)
  - 14.8. OUTSIDE AIR ENTHALPY (GLOBAL)



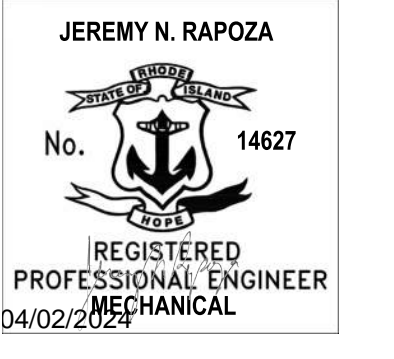
**MAU-1 CONTROL SCHEMATIC**  
NOT TO SCALE



**DESICCANT DEHUMIDIFICATION CONTROL SCHEMATIC**  
NOT TO SCALE

**DESICCANT DEHUMIDIFIER CONTROLS**

1. **GENERAL:**
  - 1.1. PACKAGED DESICCANT DEHUMIDIFICATION AIR HANDLING UNIT WITH PROCESS AND REACTIVATION/EXHAUST FANS, REACTIVATION ELECTRIC HEATING AND ELECTRIC POST HEATING DESICCANT DEHUMIDIFICATION WHEEL, AND FILTRATION SERVING DUCT DISTRIBUTION TO THE EFFLUENT PIPE GALLERY AND THE INFLUENT PIPE ROOM.
  - 1.2. CONTROLS SHOWN ON DIAGRAM AND INCLUDED IN SEQUENCE OF OPERATIONS SHALL BE PROVIDED BY DESICCANT DEHUMIDIFIER MANUFACTURER TO PROVIDE COMPLETE CONTROLS WITH BACNET INTERFACE TO BMS
2. **COOLING / DEHUMIDIFICATION MODE:**
  - 2.1. THE MAXIMUM ALLOWABLE DEWPOINT SHALL BE THE LESSER OF:
    - 2.2.1. THE BULK PLANT WATER TEMPERATURE LESS THE PLANT WATER-SPACE DEWPOINT OFFSET.
    - 2.2.2. THE EQUIVALENT DEWPOINT BASED ON THE MAXIMUM ALLOWABLE RELATIVE HUMIDITY SETPOINT.
  - 2.3. THE BMS SHALL RESET THE TARGET SPACE DEWPOINT TEMPERATURE VIA A CASCADING LOOP ALGORITHM BASED ON ROOM TEMPERATURE AND DEWPOINT TO MAINTAIN ROOM HUMIDITY SETPOINT.
3. **ALARMS VIA BACNET:**
  - 4.1. ALARM CONDITION
  - 4.2. DEHUMIDIFIER STATUS DOES NOT MATCH COMMAND
  - 4.3. DRAIN PAN OVERFLOW
5. **GRAPHICS VIA BACNET:**
  - 5.1. COMMAND ON/OFF
  - 5.2. STATUS ON/OFF
6. **GRAPHICS VIA BMS:**
  - 6.1. SPACE TEMPERATURE
  - 6.2. SPACE HUMIDITY RH%
  - 6.3. SPACE DEWPOINT
  - 6.4. OA TEMPERATURE, RH%, AND DEWPOINT



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
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DRAWN BY:	RAK, OLR	
DESIGNED/CHECKED BY:	JNR, SJP	
APPROVED BY:	BRL	

HVAC CONTROL DIAGRAMS - 3

SCALE: NO SCALE

H-702

Last Saved: 8/11/2023 7:25pm By: JKR/npj  
 Plotted On: Apr 01, 2024 7:25pm By: JKR/npj  
 Figure 8: HVAC Upgrades Holton Water Works Drawings AutoCAD Sheet P0740-047-H-702.dwg  
 Tighe & Bond, Inc. 100 Water Street, Providence, RI 02903

**DEMOLITION LEGEND**

- "X" EXISTING DEVICE TO BE REMOVED. SEE GENERAL DEMO NOTES FOR ADDITIONAL INFORMATION.
- "RR" EXISTING DEVICE TO BE REMOVED, RELOCATED AND REUSED. SEE GENERAL DEMO NOTES FOR ADDITIONAL INFORMATION.
- "R" EXISTING DEVICE TO REMAIN ACTIVE AS-IS. SEE GENERAL DEMO NOTES FOR ADDITIONAL INFORMATION.
- "RL" EXISTING DEVICE TO BE REMOVED, RELOCATED, AND REINSTALLED. PLACE EQUIPMENT IN OPERATIONAL ORDER. SEE GENERAL DEMOLITION NOTES FOR ADDITIONAL INFORMATION.
- "NL" NEW LOCATION OF EXISTING RELOCATED DEVICE. PROVIDE ALL MOUNTING PROVISIONS, CONDUIT, AND WIRING TO PLACE RELOCATED DEVICE IN OPERATIONAL ORDER IN NEW LOCATION. ELECTRICAL CONTRACTOR SHALL INTERCEPT, EXTEND, AND RECONNECT EXISTING EQUIPMENT, DEVICE CABLING, AND CONDUCTORS TO NEW LOCATION PER DRAWING. COORDINATE EACH SYSTEM CABLE AND CONDUCTOR TYPE AND REQUIRED CONNECTIONS FOR THE RELOCATION. PROVIDE TESTING TO ENSURE A COMPLETE AND OPERATIONAL SYSTEM AT EACH RELOCATION. SEE GENERAL DEMOLITION NOTES FOR ADDITIONAL INFORMATION.

EQUIPMENT, STRUCTURES, PIPING AND/OR CONDUIT TO BE DEMOLISHED.

**GENERAL SYMBOLS**

- BOLD LINES AND TEXT INDICATE PROPOSED WORK
- LIGHT LINES AND ITALICIZED TEXT INDICATE APPROXIMATE EXISTING CONDITIONS

**RACEWAYS AND WIRING**

- L4A1-1,3 HOMERUN TO EQUIPMENT. "L4A1" INDICATES EQUIPMENT ID, "1,3" INDICATES PANELBOARD CIRCUIT NUMBERS, (20A, 1P, UNLESS INDICATED OTHERWISE) SEE DRAWINGS FOR QUANTITY AND SIZE OF WIRE AND CONDUIT. MINIMUM 2#12, #12G, IN 3/4"C IF NOT INDICATED OR SCHEDULED OTHERWISE. DASHED LINES INDICATE IN OR UNDER SLAB.
- CONDUIT, CONCEALED IN CONSTRUCTION IN FINISHED AREAS, EXPOSED IN UNFINISHED AREAS
- CONDUIT TURNING UP
- CONDUIT TURNING DOWN

**NOTES:**

1. GREEN GROUND CONDUCTOR NOT INDICATED BUT SHALL BE INCLUDED IN EACH RACEWAY. SIZE SHALL BE #12AWG UNLESS INDICATED OTHERWISE.
2. HOMERUNS TO PANELBOARDS SHALL HAVE A MAXIMUM OF THREE (3) PHASE CONDUCTORS (ONE PER PHASE), (3) NEUTRALS AND (3) GROUND CONDUCTORS IN EACH CONDUIT. DERATE CONDUCTORS AS REQUIRED PER CODE.

**BRANCH CIRCUIT WIRING NOTES**

1. WIRING IS SHOWN ON DRAWINGS ONLY FOR SPECIFIC ROUTES OR SPECIAL CONDITIONS.
2. WIRING AND CONDUIT SHALL BE REQUIRED BETWEEN ALL OUTLETS INDICATED WITH CIRCUIT NUMBERS AND PANEL DESIGNATIONS.
3. ALL SWITCH CONTROLS SHALL BE FURNISHED WITH WIRING AND CONDUIT AS REQUIRED.
4. ALTHOUGH ALL BRANCH CIRCUIT WIRING AND CONDUIT IS NOT SHOWN, IT IS THE INTENT OF THESE DOCUMENTS THAT A COMPLETE BRANCH CIRCUIT WIRING SYSTEM BE INSTALLED.
5. A GREEN GROUNDING CONDUCTOR SHALL BE RUN WITH ALL CIRCUITS. VERIFY CONDUIT SIZE TO ENSURE IT CAN ACCOMMODATE ALL PHASE, NEUTRAL AND GROUND CONDUCTORS.
6. ALL BRANCH CIRCUITS SHALL HAVE INDIVIDUAL NEUTRALS AND GROUNDS. BRANCH CIRCUITS SHALL NOT SHARE NEUTRALS OR GROUNDS.

**LIGHTING FIXTURES**

- LIGHTING FIXTURE, SURFACE, RECESSED OR PENDANT MOUNTED
- VAPOR TIGHT LUMINAIRE

**RECEPTACLES**

MOUNTED AT 18" AFF UNLESS OTHERWISE NOTED.  
 NUMBERS/LETTERS SHOWN BESIDE RECEPTACLES SHALL INDICATE THE FOLLOWING:  
 "GFI" INDICATES INTEGRAL GROUND FAULT INTERRUPTER.  
 "2" (NUMBER OR PANELBOARD NAME AND NUMBER) INDICATES POWER CIRCUIT NUMBER.  
 "WP" INDICATES WEATHERPROOF

DUPLEX RECEPTACLE

**POWER DISTRIBUTION EQUIPMENT**

- PANELBOARD, SURFACE MOUNTED
- MOTOR, "2" INDICATES HORSEPOWER
- NON-FUSED DISCONNECT SWITCH, SIZE AS REQUIRED.
- FUSED DISCONNECT SWITCH, SIZE OF SWITCH AND FUSE AS REQUIRED.
- DRY-TYPE DISTRIBUTION TRANSFORMER

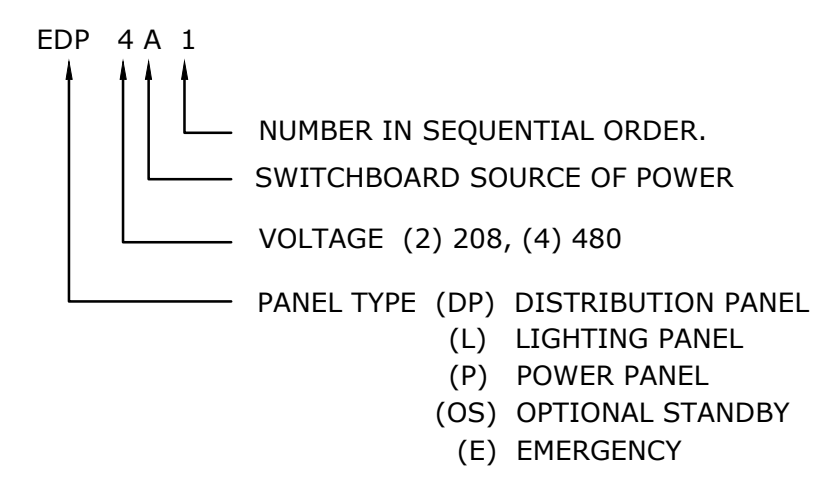
**MISCELLANEOUS**

- JUNCTION BOX, SIZED PER NEC
- JUNCTION BOX WITH SINGLE POINT ELECTRICAL CONNECTION TO EQUIPMENT.
- JUNCTION BOX WITH CONNECTION TO BUILDING MANAGEMENT SYSTEM.
- PULLBOX

**FIRE ALARM**

- DUCT MOUNTED SMOKE DETECTOR
- REMOTE ALARM INDICATOR AND TEST SWITCH FOR DUCT SMOKE DETECTOR WITH NAMEPLATE LABELED ACCORDINGLY. LOCATED TEST STATION 48" AFF ON WALL. FIELD COORDINATE LOCATION WITH CM PRIOR TO ROUGH IN.

**ELECTRICAL PANELBOARD KEY**

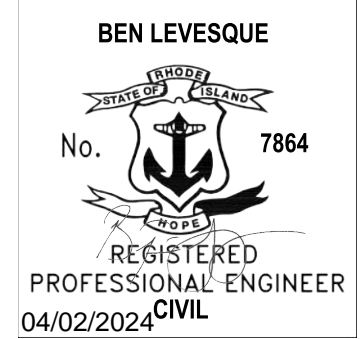


**ABBREVIATIONS**

#	WIRE SIZE OR IDENTIFICATION NUMBER	MC	MECHANICAL CONTRACTOR
A	AMPERES	MCB	MAIN CIRCUIT BREAKER
AF	AMPERE FRAME (CIRCUIT BREAKER RATING)	MCC	MOTOR CONTROL CENTER
AFG	ABOVE FINISHED FLOOR	MISC	MISCELLANEOUS
AFG	ABOVE FINISHED GRADE	MFR	MANUFACTURER
AIC	AMPERE INTERRUPTING CAPACITY	MLO	MAIN LUGS ONLY
AL	ALUMINUM	NC, NC	NORMALLY CLOSED
ARCH	ARCHITECT	NEC	NATIONAL ELECTRICAL CODE
AS	AMPERE SENSOR (CIRCUIT BREAKER RATING)	NIC	NOT IN CONTRACT
AT	AMPERE TRIP (CIRCUIT BREAKER RATING)	NL	NIGHT LIGHT
ATS	AUTOMATIC TRANSFER SWITCH	NO	NORMALLY OPEN
AWG	AMERICAN WIRE GAUGE	NTS	NOT TO SCALE
BLDG	BUILDING	OL	OVERLOAD
C	CONDUIT	P	POLE
CB	CIRCUIT BREAKER	PH, Ø	PHASE
CT	CURRENT TRANSFORMER	PLC	PROGRAMMABLE LOGIC CONTROLLER
CAT	CATALOG	PVC	POLYVINYL CHLORIDE
CIR, CKT	CIRCUIT	PT	POTENTIAL TRANSFORMER
CP	CONTROL PANEL	PVC	POLYVINYL CHLORIDE
CPT	CONTROL POWER TRANSFORMER 480 VOLTS - 120/240 VOLTS, UNLESS OTHERWISE INDICATED	R	RECESSED
COL	COLUMN	RGS	RIGID GALVANIZED STEEL CONDUIT
Δ	DELTA	RVNR	REDUCED-VOLTAGE NON-REVERSING
CU	COPPER	S	SURFACE
DISC SW, DS	DISCONNECT SWITCH	SCCR, SCR	SHORT CIRCUIT CURRENT INTERRUPTING RATING
DWG	DRAWING	SCH 40	SCHEDULE 40 PVC CONDUIT
E	WIRED ON EMERGENCY CIRCUIT	SP	SPARE
EC	ELECTRICAL CONTRACTOR	SPD	SURGE PROTECTION DEVICE
EM	EMERGENCY	SS	STAINLESS STEEL
EXP	EXPLOSION PROOF	SW	SWITCH
F	FLUSH	TEL	TELEPHONE
FU	FUSE	TSP	TWISTED SHIELDED PAIR CABLE
FT	FEET	TYP	TYPICAL
FVNR	FULL VOLTAGE NON-REVERSING	UG	UNDERGROUND
FVR	FULL VOLTAGE REVERSING	UPS	UNINTERRUPTABLE POWER SUPPLY
G	GROUND	V	VOLT
GC	GENERAL CONTRACTOR	VFD	VARIABLE FREQUENCY DRIVE (ALSO REFERED TO AS ADJUSTABLE FREQUENCY DRIVE)
GFI, GFCI	GROUND FAULT CIRCUIT INTERRUPTER	Y	WYE
ID	IDENTIFICATION	W	WATT, WIRE
KCMIL, MCM	ONE THOUSAND CIRCULAR MILS	WTF	WATER TREATMENT FACILITY
KVA	KILOVOLT-AMPERES	WWTF	WASTEWATER TREATMENT FACILITY
KVAR	KILOVOLT-AMPERES REACTIVE	WP	WEATHERPROOF
KW	KILOWATTS	XFMR	TRANSFORMER
LSIG	LONG/SHORT TIME, INSTANTANEOUS AND GROUND FAULT SETTINGS (FOR CIRCUIT BREAKER)		

**AREA CLASSIFICATIONS**

- INDICATES THAT ALL ELECTRICAL MATERIALS AND EQUIPMENT INSTALLED IN THE ROOM OR DEMARCATED AREA SHALL BE NEMA 12 CONSTRUCTION SUITABLE FOR USE IN A DAMP LOCATION (UNLESS NOTED OTHERWISE).
- INDICATES THAT ALL ELECTRICAL MATERIALS AND EQUIPMENT INSTALLED IN THE ROOM OR DEMARCATED AREA SHALL BE OF WATERTIGHT OR NEMA 4 CONSTRUCTION SUITABLE FOR USE IN A WET LOCATION
- INDICATES THAT ALL ELECTRICAL EQUIPMENT AND INSTALLATION MATERIALS AND METHODS WITHIN THE ROOM OR DEMARCATED AREA SHALL CONFORM TO THE NATIONAL ELECTRICAL CODE REQUIREMENTS FOR THE HAZARDOUS AREA CLASSIFICATION INDICATED (ARTICLE 501 FOR CLASS I AREA, ARTICLE 502 FOR CLASS II AREA, ARTICLE 503 FOR CLASS III AREA)
- INDICATES THAT ALL ELECTRICAL MATERIALS INSTALLED IN THE ROOM OR DEMARCATED AREA SHALL BE OF CORROSION RESISTANT, AND WATERTIGHT OR NEMA 4X CONSTRUCTION SUITABLE FOR USE IN A WET LOCATION AND RESISTANT TO THE CHEMICALS OR CORROSIVE ENVIRONMENT WITHIN THE AREA.
- INDICATES THAT ALL ELECTRICAL MATERIALS AND EQUIPMENT INSTALLED IN THE ROOM OR DEMARCATED AREA MAY BE NEMA 1 CONSTRUCTION SUITABLE FOR USE IN A DRY LOCATION (UNLESS NOTED OTHERWISE).



**Dehumidification System Design**

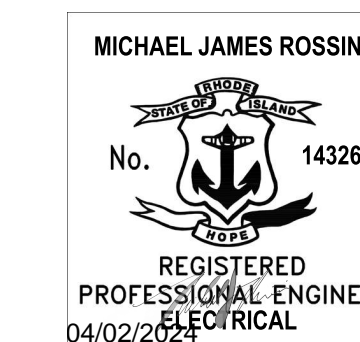
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Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO: P0740-047		
DATE: APRIL 2024		
FILE: P0740-047-E-001.dwg		
DRAWN BY: RAK, HDA		
DESIGNED/CHECKED BY: MB, MR		
APPROVED BY: BRL		

**ELECTRICAL LEGEND**

SCALE: NO SCALE



**GENERAL DEMOLITION NOTES**

- DISCONNECT AND REMOVE EXISTING ELECTRICAL JUNCTION BOXES, BRANCH CIRCUITS, FEEDERS, RACEWAYS, DEVICES, ETC., AS REQUIRED TO ACCOMPLISH THE NEW WORK AS SHOWN OR REASONABLY IMPLIED. COORDINATE WITH STRUCTURAL, MECHANICAL, AND ELECTRICAL WORK TO DETERMINE THE EXTENT OF THE DEMOLITION WORK REQUIRED.
- EXISTING BRANCH CIRCUITS NO LONGER SERVING ANY EQUIPMENT OR DEVICES SHALL BE PULLED BACK TO AND DISCONNECTED FROM THE PANEL OF ORIGIN. RE-LABEL EXISTING CIRCUIT BREAKERS AS SPARE AND PROVIDE A NEW LABEL/NAMEPLATE OR TYPE-WRITTEN PANEL DIRECTORY.
- BRANCH CIRCUITS SERVING EXISTING DEVICES TO REMAIN AND EXISTING DEVICES TO BE REMOVED SHALL BE MAINTAINED AND RECONNECTED AS REQUIRED AFTER REMOVAL OF THE EXISTING DEVICES, AS NECESSARY TO ACCOMMODATE THE ALTERATIONS.
- COORDINATE WITH THE OWNER FOR THE DISCONNECTION AND REMOVAL OF TELECOMMUNICATIONS, PROCESS, PAGING, FIRE ALARM, AND SECURITY SYSTEM DEVICES, EQUIPMENT, AND CABLING.
- DISCONNECT AND REMOVE EXISTING FIRE ALARM DEVICES TO ACCOMMODATE ALTERATIONS. MAINTAIN CONTINUITY OF ALL FIRE ALARM INITIATION AND INDICATING CIRCUITS SERVING OTHER AREAS. PROVIDE ADDITIONAL CONDUIT AND WIRING AS REQUIRED.
- REMOVE ALL WIRING/CABLING NO LONGER IN USE FROM EXISTING RACEWAYS/CONDUITS. RACEWAYS/CONDUITS NO LONGER IN USE THAT ARE EMBEDDED IN FLOOR SLABS SHALL BE CUT BACK AS REQUIRED AND CAPPED. SURFACE-MOUNTED RACEWAYS/CONDUITS NO LONGER IN USE SHALL BE REMOVED.
- PROVIDE BLANK STAINLESS STEEL COVER PLATES FOR ALL JUNCTION/DEVICE BOXES NO LONGER IN USE THAT ARE EMBEDDED IN FLOOR SLABS OR MASONRY WALLS. ALL COVER PLATES SHALL BE PAINTED TO MATCH EXISTING CONDITIONS.
- REFER TO SPECIFICATIONS FOR ADDITIONAL DEMOLITION CRITERIA.
- THE EXISTENCE OF UTILITIES AND APPURTENANCES AS SHOWN ON THESE DRAWINGS ARE FOR REFERENCE ONLY. THOROUGHLY INVESTIGATE THE EXACT SIZE, TYPE, LOCATION AND ELEVATION PRIOR TO THE START OF CONSTRUCTION. FIELD MEASURE TO VERIFY EXISTING AND CONTRACT INTERFACE DIMENSIONS, LOCATIONS, AND OTHER CONDITIONS. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGE WHICH MIGHT BE OCCASIONED BY FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UTILITIES.
- ASSUME MATERIALS TO BE DEMOLISHED ARE POSITIVE FOR HAZARDOUS MATERIALS AND DISPOSE OF AS NECESSARY IN ACCORDANCE WITH APPLICABLE REGULATIONS. REFER TO SPECIFICATIONS FOR MORE DETAILS.
- OWNER RETAINS RIGHT OF FIRST REFUSAL FOR ALL ITEMS TO BE REMOVED OR DEMOLISHED. TAKE REASONABLE CARE TO AVOID DAMAGE TO ITEMS TO BE RETAINED BY OWNER. NO ADDITIONAL CHARGE WILL BE ALLOWED FOR REMOVAL OF SALVAGEABLE ITEMS.
- FOR ITEMS BEING DEMOLISHED, REMOVE EXISTING SUPPORTS AND MOUNTING HARDWARE. FILL OPENINGS FROM ANCHOR HOLES AND CONDUIT/PIPE PENETRATIONS (UNLESS CONDUIT IS TO BE REUSED) WITH NON-SHRINK GROUT AND PAINT TO MATCH WALL OR FLOOR.
- PATCH HOLES IN CONCRETE FROM OLD EQUIPMENT SUPPORTS, CONDUITS, PENETRATIONS, ETC. WITH NON-SHRINK GROUT. PAINT TO MATCH SURROUNDING SURFACE.
- VOIDS CREATED BY THE REMOVAL OF CONDUIT/WIRE IN FLOORS OR WALLS ABOVE OR BELOW CEILINGS SHALL BE PATCHED AND SEALED WITH MATERIALS MATCHING THE EXISTING CONSTRUCTION.
- PROPERLY DISPOSE OF DEMOLISHED EQUIPMENT IN COMPLIANCE WITH CODES, REGULATIONS, AND STATE STANDARDS.

**GENERAL NOTES**

- FOR SYMBOLS AND ABBREVIATIONS, REFER TO DRAWING E-001.
- BOLD TEXT AND LINES INDICATE PROPOSED WORK, LIGHT TEXT AND LINES INDICATE APPROXIMATE EXISTING CONDITIONS.
- PROVIDE TEMPORARY POWER AND EQUIPMENT AS REQUIRED TO KEEP SYSTEMS OPERATIONAL, SEE 16050 FOR SEQUENCING AND SCHEDULING.
- FOR ELECTRICAL DETAILS, REFER TO DETAIL DRAWINGS.
- COORDINATE WITH PROCESS MECHANICAL DRAWINGS AND VENDOR DRAWINGS FOR COORDINATION OF EQUIPMENT LOCATIONS AND POWER REQUIREMENTS.
- ALL CONDUIT SHALL BE INSTALLED ATTACHED TO THE TOP OF STEEL (TOP CHORD OF JOIST/GIRDER).
- COORDINATE ALL DEVICE LOCATIONS WITH GC AND/OR OWNER PRIOR TO ROUGH-IN.
- COORDINATE ALL REQUIRED OPENINGS/PENETRATIONS THROUGH WALLS, FLOORS, AND CEILING WITH OTHER TRADES AND APPROVED EQUIPMENT SUBMITTALS.
- ALL PIPES OR OTHER UTILITIES DAMAGED DURING THE CONTRACTOR'S OPERATIONS SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO REPAIR OR REPLACE AT NO COST TO THE OWNER.
- SUPPORT ALL UTILITIES AND STRUCTURES DURING CONSTRUCTION AND MAKE REPAIRS IF DAMAGED.
- PREVENT DUST FROM BECOMING A NUISANCE OR HAZARD. CONTROL DUST DURING AND AFTER CONSTRUCTION.

**GENERAL POWER NOTES**

- ALL RECEPTACLES IN MECHANICAL ROOMS, ELECTRIC ROOMS, MECHANICAL & ELECTRICAL CLOSETS SHALL BE GFI TYPE.
- ALL RECEPTACLES ON ROOF AND EXTERIOR OF THE BUILDING SHALL BE WEATHER RESISTANT GFCI AND SHALL HAVE "IN-USE COVERS".
- DEVICE TYPES SHALL BE SUITABLE FOR THE SPECIFIC AREA CLASSIFICATION SHOWN.

**GENERAL FIRE ALARM NOTES**

- ALL FIRE ALARM DEVICE TYPES SHALL MEET THE SPECIFICATIONS AND AREA CLASSIFICATION REQUIREMENTS.
- ALL FIRE ALARM WIRING SHALL BE INSTALLED IN CONDUIT.

**ELECTRICAL FASTENING NOTES:**

- EQUIPMENT SHALL BE FASTENED USING THE FOLLOWING MEANS BASED ON THE TYPE OF WALL OR SURFACE:
  - FOR MOUNTING TO CONCRETE (CMU OR PRECAST), USE CRACKED-CONCRETE RATED EXPANDING SHEATH CONCRETE ANCHORS.
  - FOR MOUNTING TO METAL COLUMNS, METAL EQUIPMENT FRAME, OR METAL MOUNTING PLATES, USE STAINLESS STEEL STUD WELD WITH STAINLESS STEEL ACORN NUT.
- REFER TO DIVISION 16 SPECIFICATIONS FOR ADDITIONAL INFORMATION.
- FASTENERS AND MATERIALS SHALL BE OF THE MATERIAL TYPE SPECIFIED FOR THE AREA, UNLESS SPECIFIED OTHERWISE ON THE DRAWINGS OR DETAILS.

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO: P0740-047		
DATE: APRIL 2024		
FILE: P0740-047-E-002.dwg		
DRAWN BY: RAK, HDA		
DESIGNED/CHECKED BY: MB, MR		
APPROVED BY: BRL		

**ELECTRICAL GENERAL NOTES**

SCALE: NO SCALE

**E-002**



**BEN LEVESQUE**  
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 04/02/2024

**MICHAEL JAMES ROSSINI**  
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 REGISTERED PROFESSIONAL ENGINEER  
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 04/02/2024

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

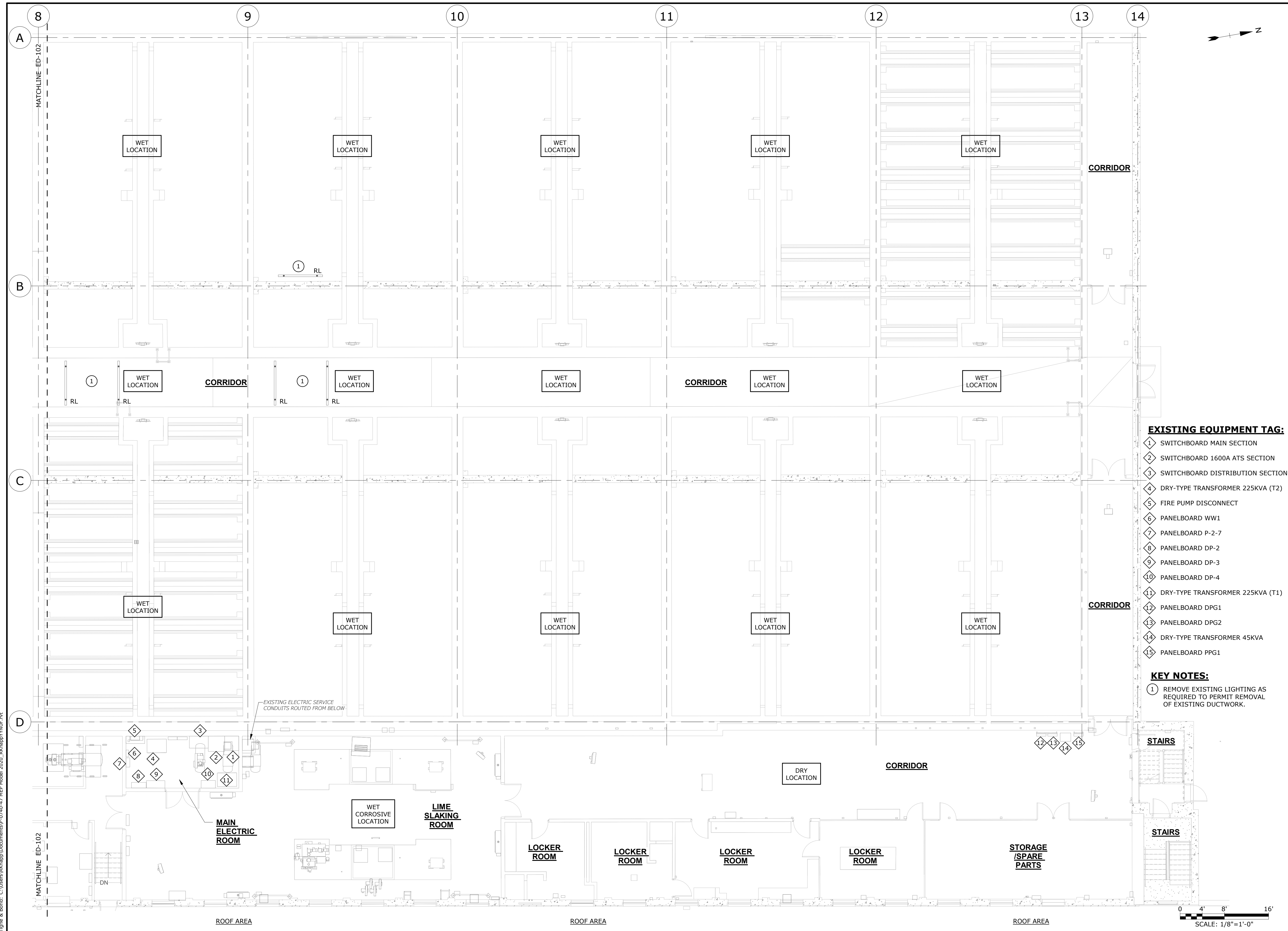
MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, HDA  
 DESIGNED/CHECKED BY: MB, MR  
 APPROVED BY: BRL

ELECTRICAL DEMOLITION - CENTRAL FILTER GALLERY - NORTH

SCALE: AS SHOWN

**ED-101**



**EXISTING EQUIPMENT TAG:**

- 1 SWITCHBOARD MAIN SECTION
- 2 SWITCHBOARD 1600A ATS SECTION
- 3 SWITCHBOARD DISTRIBUTION SECTION
- 4 DRY-TYPE TRANSFORMER 225KVA (T2)
- 5 FIRE PUMP DISCONNECT
- 6 PANELBOARD WW1
- 7 PANELBOARD P-2-7
- 8 PANELBOARD DP-2
- 9 PANELBOARD DP-3
- 10 PANELBOARD DP-4
- 11 DRY-TYPE TRANSFORMER 225KVA (T1)
- 12 PANELBOARD DPG1
- 13 PANELBOARD DPG2
- 14 DRY-TYPE TRANSFORMER 45KVA
- 15 PANELBOARD PPG1

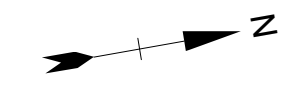
**KEY NOTES:**

- 1 REMOVE EXISTING LIGHTING AS REQUIRED TO PERMIT REMOVAL OF EXISTING DUCTWORK.

EXISTING ELECTRIC SERVICE  
 CONDUITS ROUTED FROM BELOW



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**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

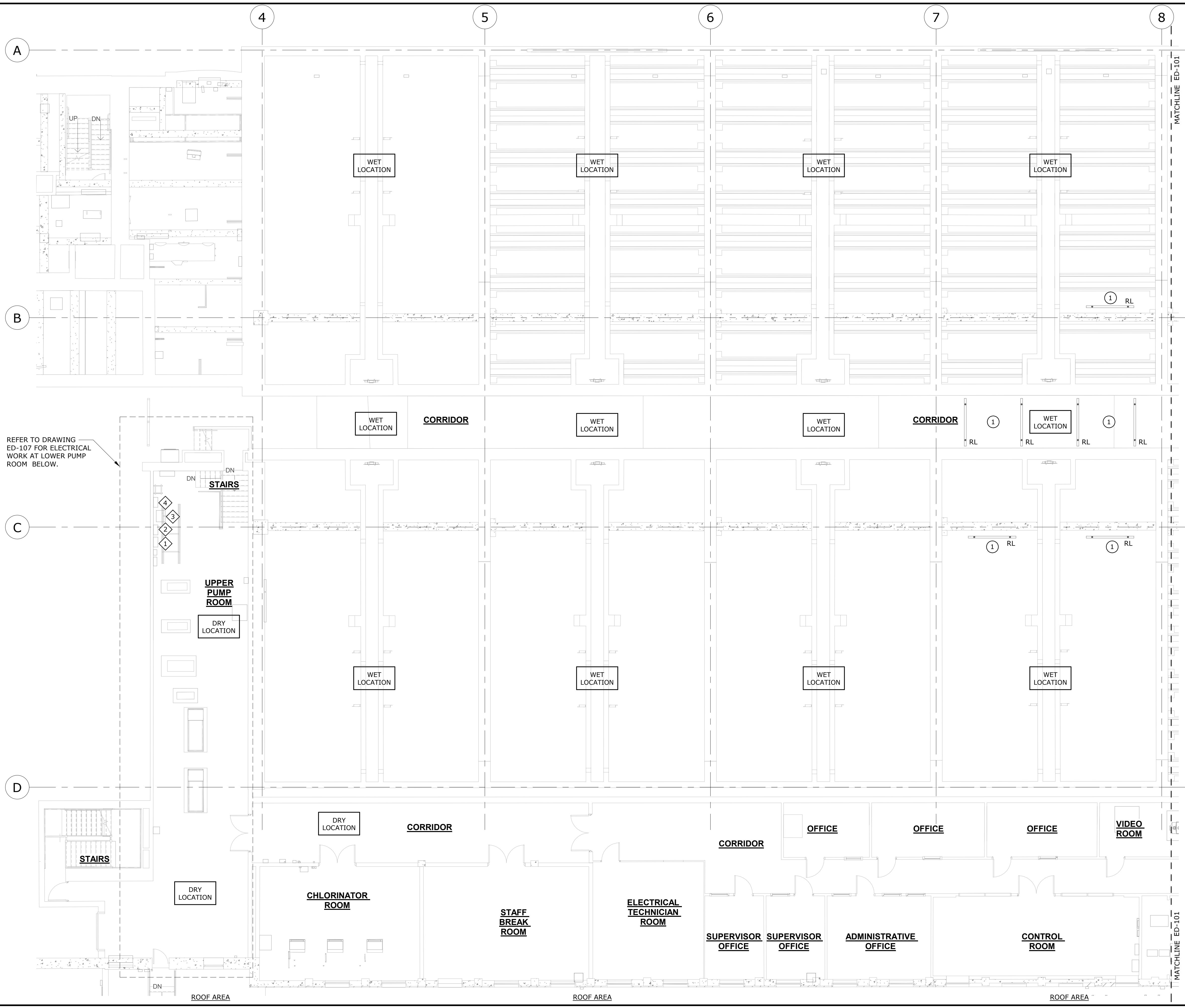
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0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, HDA  
 DESIGNED/CHECKED BY: MB, MR  
 APPROVED BY: BRL

ELECTRICAL DEMOLITION - CENTRAL FILTER GALLERY - SOUTH

SCALE: AS SHOWN

**ED-102**



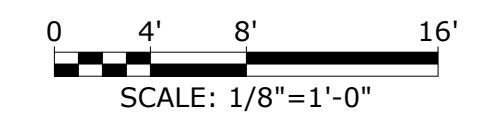
REFER TO DRAWING ED-107 FOR ELECTRICAL WORK AT LOWER PUMP ROOM BELOW.

**EXISTING EQUIPMENT TAG:**

- 1 PANELBOARD DPF1
- 2 PANELBOARD DPF2
- 3 DRY-TYPE TRANSFORMER 45KVA
- 4 PANELBOARD PPF1

**KEY NOTES:**

- 1 REMOVE EXISTING LIGHTING AS REQUIRED TO PERMIT REMOVAL OF EXISTING DUCTWORK.



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Dehumidification System Design

Providence Water Supply Board

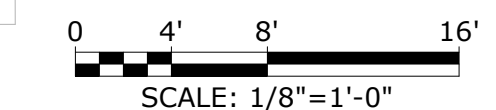
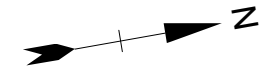
Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

ELECTRICAL DEMOLITION - ROOF PLAN - NORTH

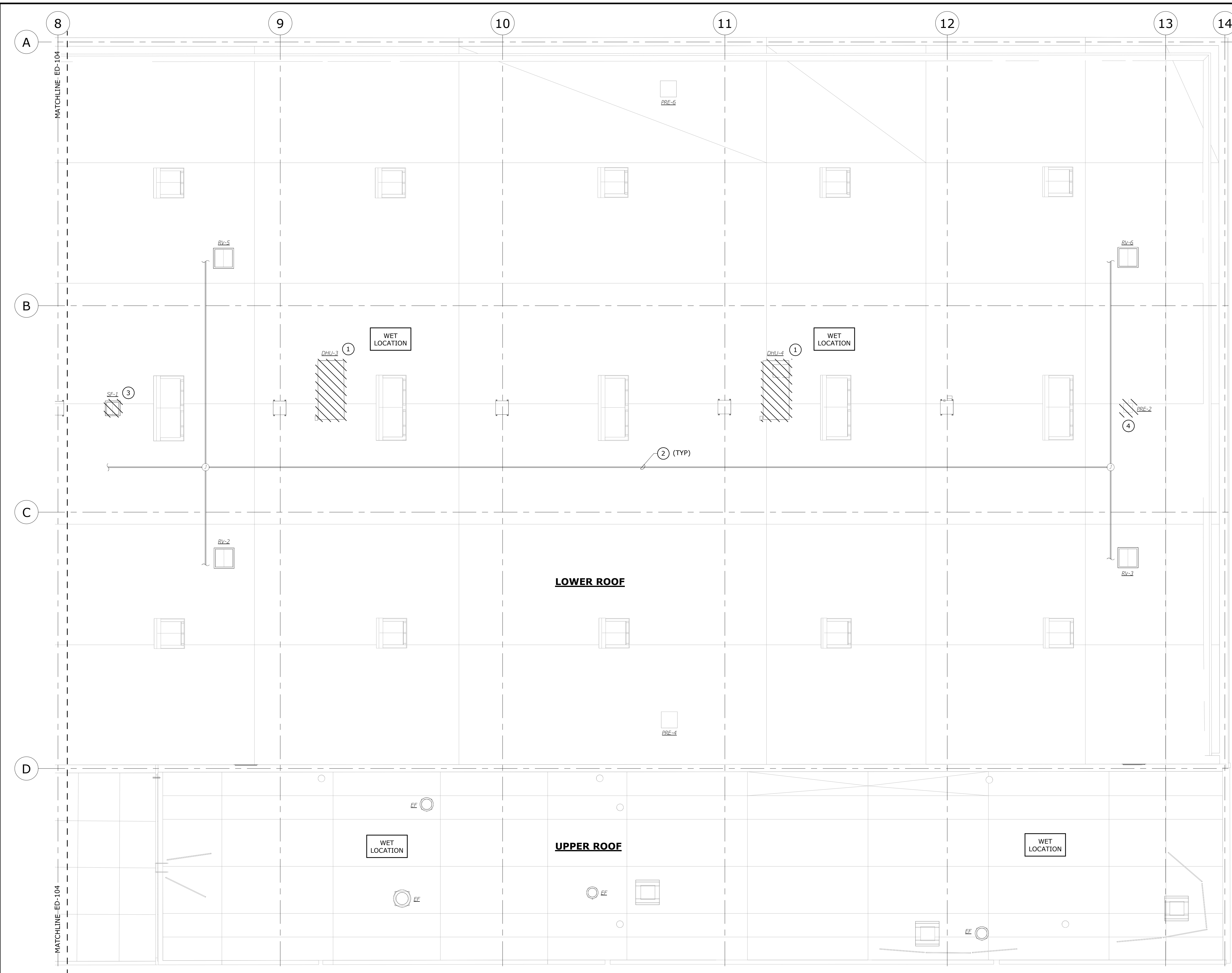
SCALE: AS SHOWN

ED-103



KEY NOTES:

- ① DISCONNECT EXISTING DEHUMIDIFIER AND PREPARE CONDUIT AND CONNECTION TO RECEIVE NEW DEHUMIDIFIER.
- ② EXISTING CONDUIT USING PREMANUFACTURED RUBBER CONDUIT SLEEPER SUPPORTS TO REMAIN; SHOWN FOR COORDINATION PURPOSES.
- ③ DEMOLISH EXISTING GRAVITY VENTILATOR INTAKE AND SUPPLY FAN.
- ④ DEMOLISH EXISTING EXHAUST FAN.



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**Dehumidification System Design**

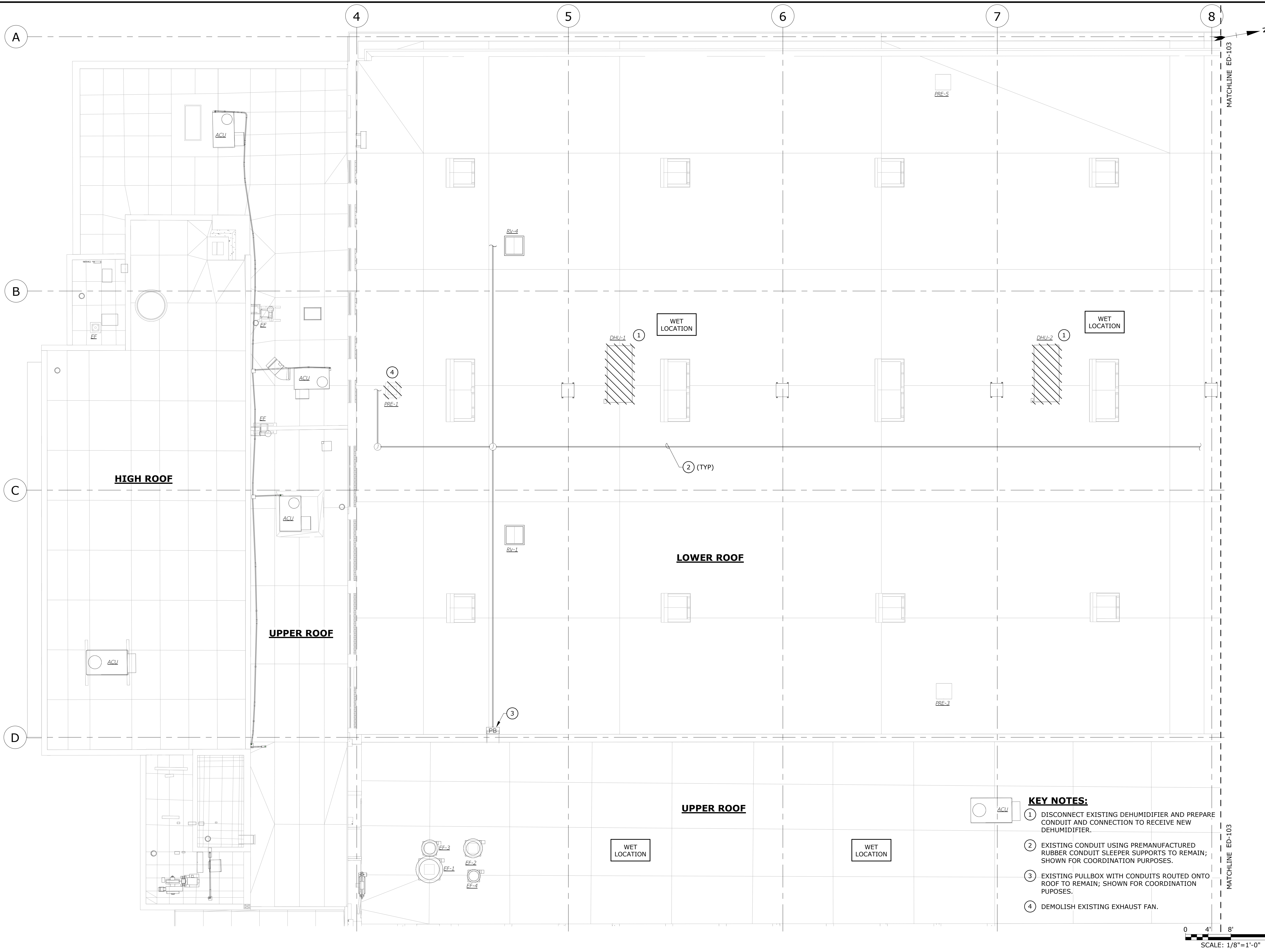
Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

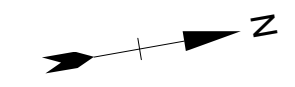
MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

ELECTRICAL DEMOLITION - ROOF PLAN - SOUTH

SCALE: AS SHOWN

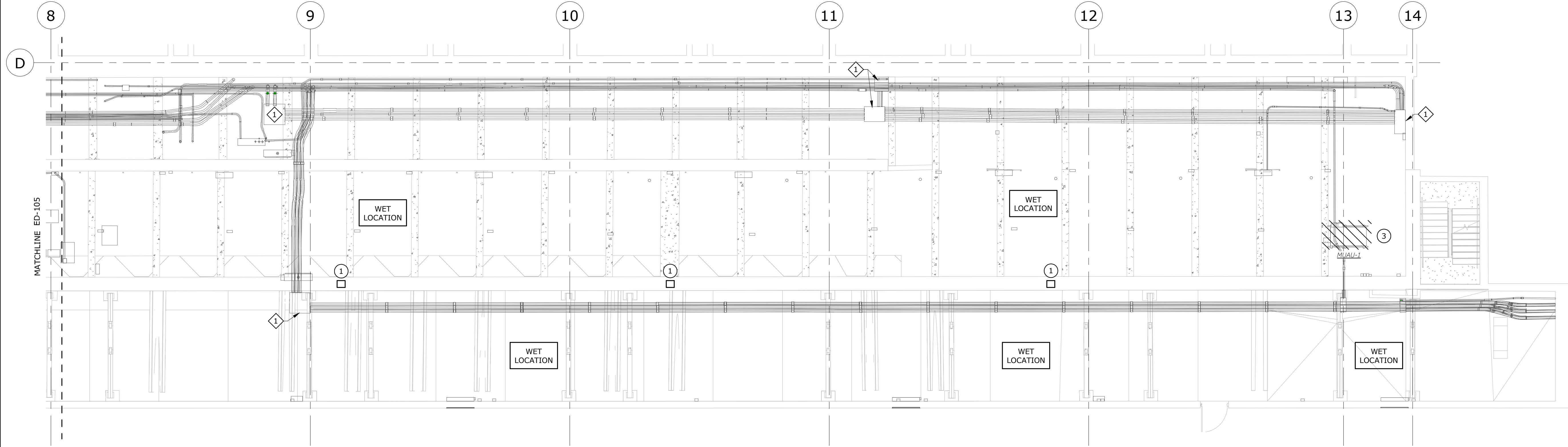


- KEY NOTES:**
- 1 DISCONNECT EXISTING DEHUMIDIFIER AND PREPARE CONDUIT AND CONNECTION TO RECEIVE NEW DEHUMIDIFIER.
  - 2 EXISTING CONDUIT USING PREMANUFACTURED RUBBER CONDUIT SLEEPER SUPPORTS TO REMAIN; SHOWN FOR COORDINATION PURPOSES.
  - 3 EXISTING PULLBOX WITH CONDUITS ROUTED ONTO ROOF TO REMAIN; SHOWN FOR COORDINATION PURPOSES.
  - 4 DEMOLISH EXISTING EXHAUST FAN.

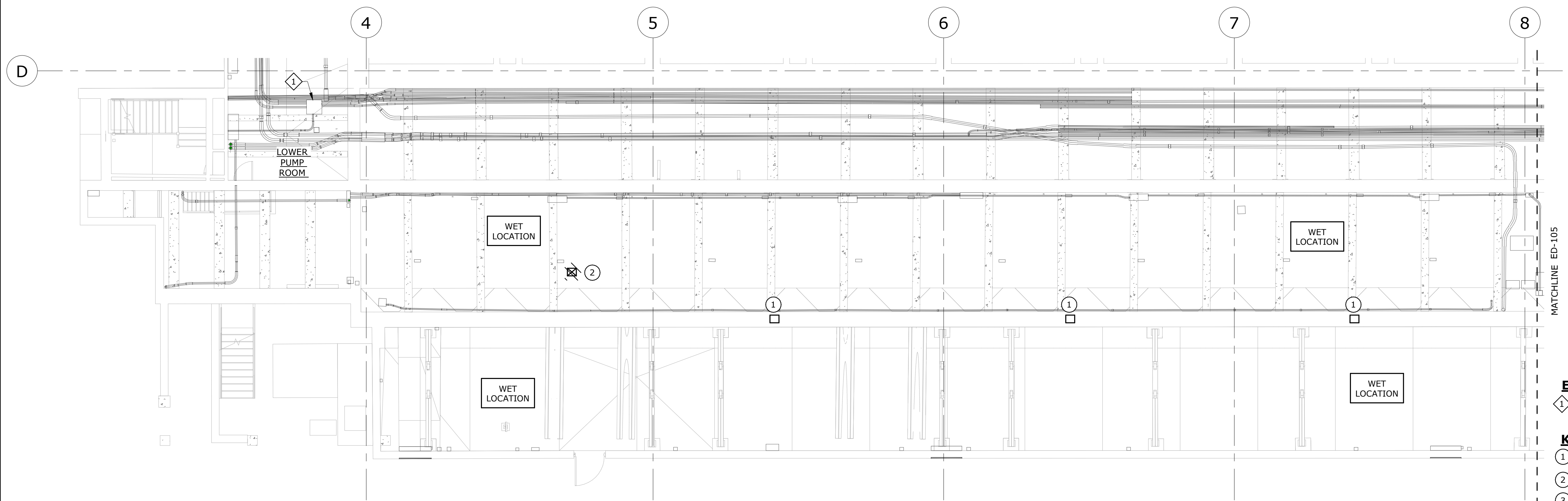


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 04/02/2024



**ELECTRICAL DEMOLITION - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - NORTH**



**ELECTRICAL DEMOLITION - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - SOUTH**

**EXISTING EQUIPMENT TAG:**  
 ① PULLBOX AND FEEDERS

**KEY NOTES:**  
 ① EXISTING DEHUMIDIFIER TO REMAIN.  
 ② DEMOLISH EXISTING EXHAUST FAN.  
 ③ DEMOLISH EXISTING MAKEUP AIR UNIT.

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, HDA  
 DESIGNED/CHECKED BY: MB, MR  
 APPROVED BY: BRL

ELECTRICAL DEMOLITION - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN

SCALE: AS SHOWN



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 By: RAK, HDA  
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 Tighe & Bond

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 04/02/2024

**Dehumidification System Design**

Providence Water Supply Board

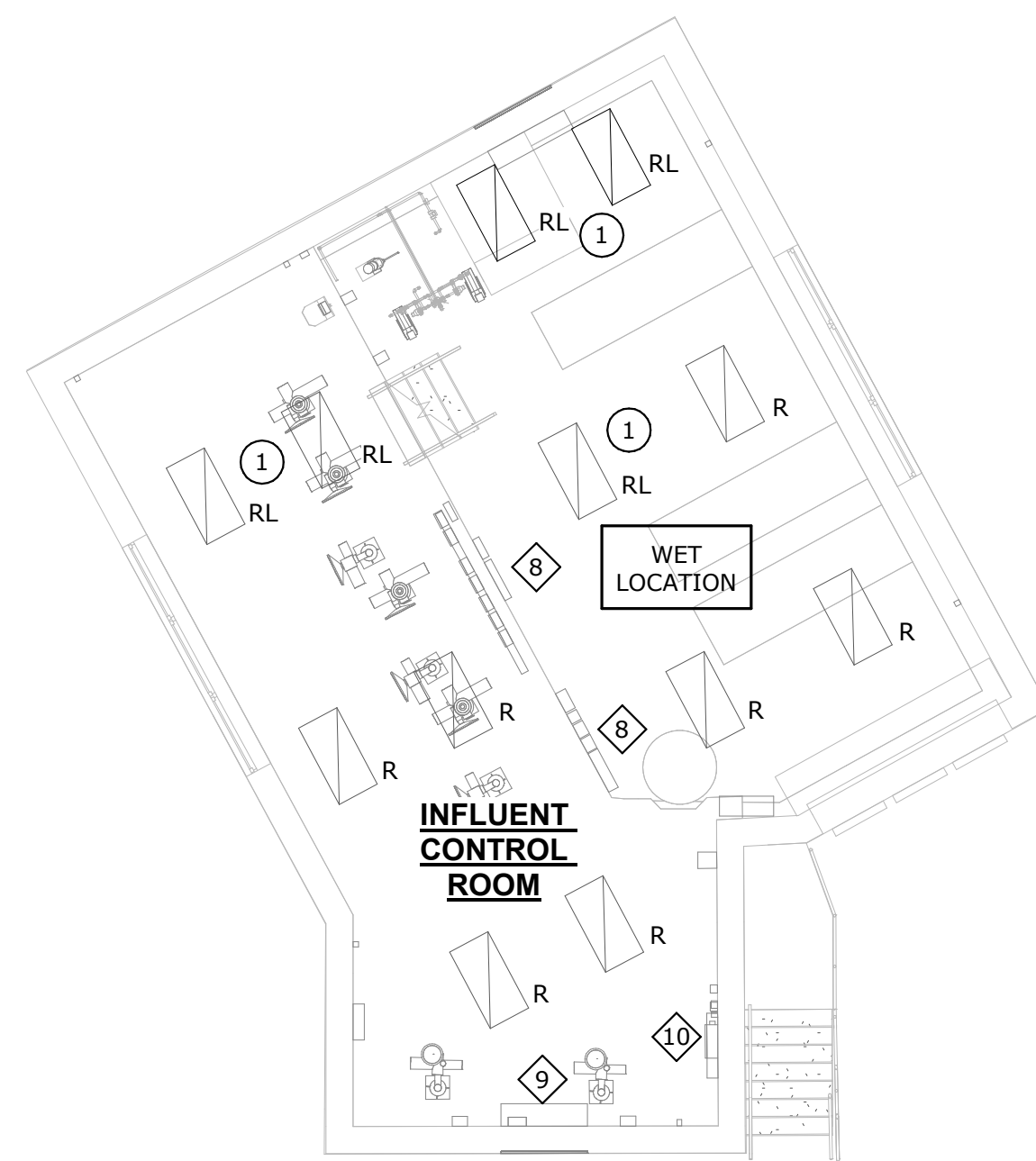
Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

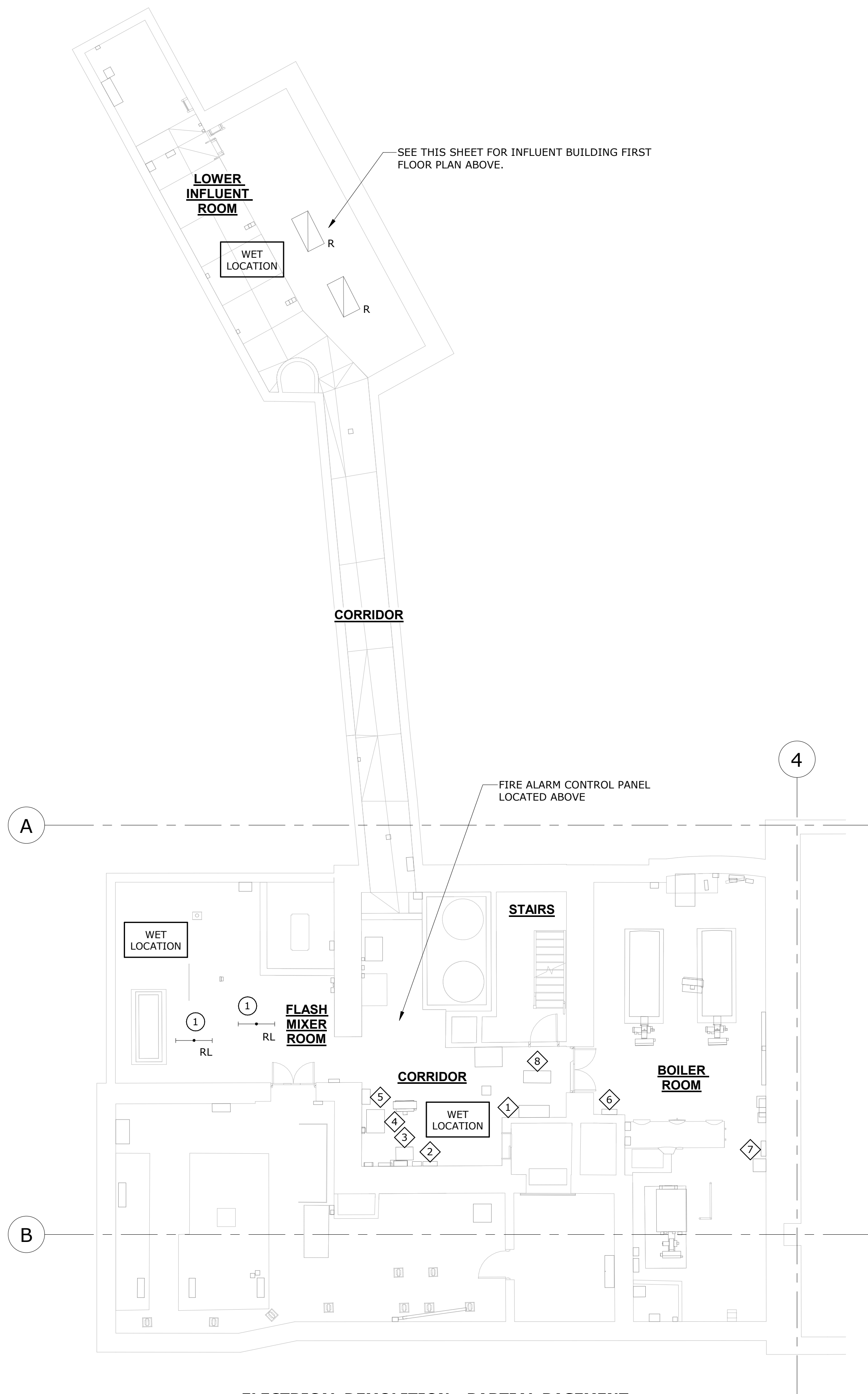
ELECTRICAL DEMOLITION - PARTIAL BASEMENT AND LOWER PUMP RM

SCALE: AS SHOWN

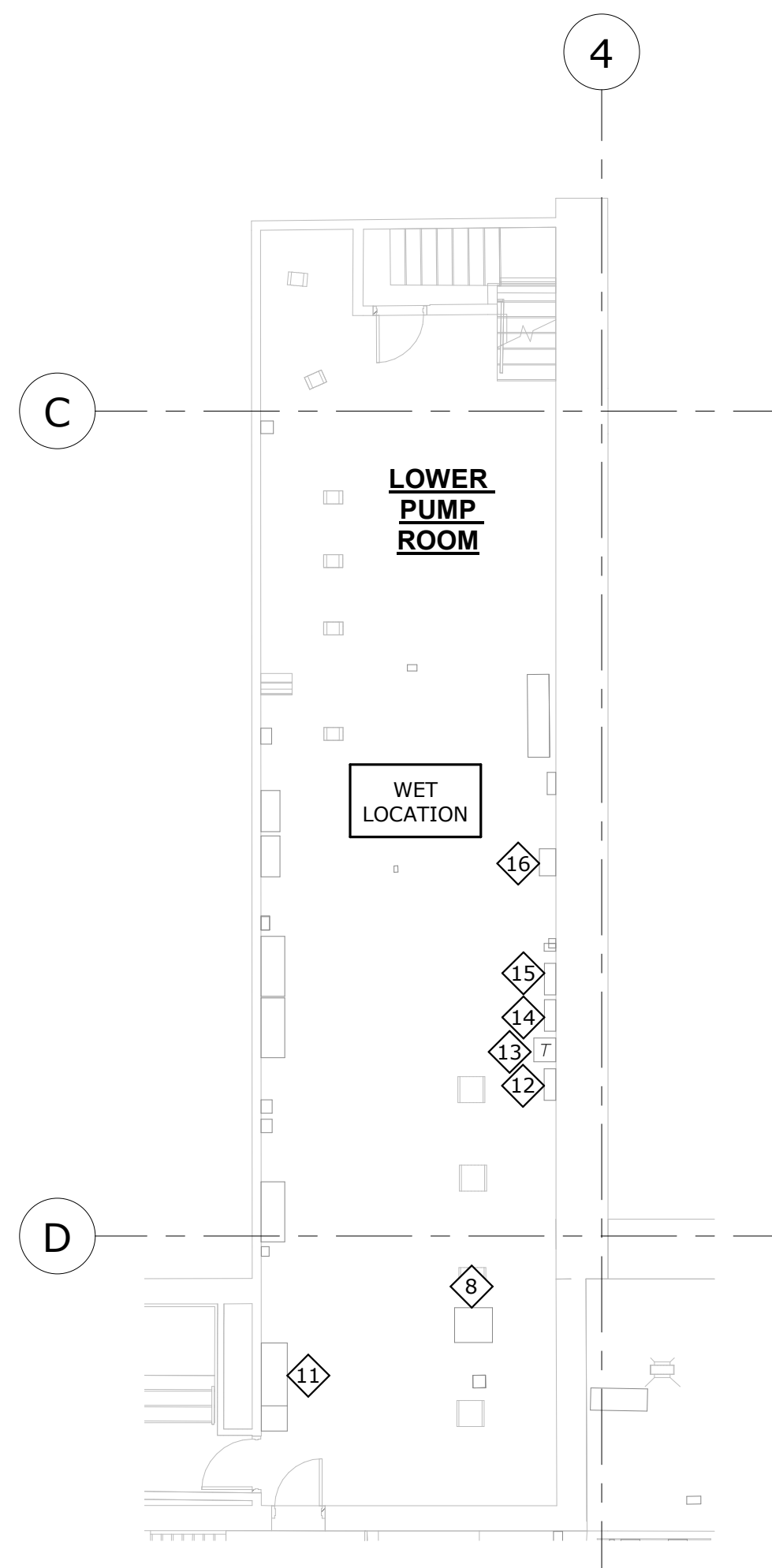
**ED-106**



**ELECTRICAL DEMOLITION - INFLUENT BUILDING PLAN FIRST FLOOR**



**ELECTRICAL DEMOLITION - PARTIAL BASEMENT**



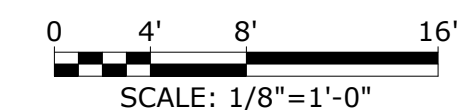
**ELECTRICAL DEMOLITION - LOWER PUMP RM EFFLUENT GALLERY**

**KEY NOTES:**

- ① REMOVE EXISTING LIGHTING TO PREPARE AREA TO RECEIVE NEW DEHUMIDIFIER.

**EXISTING EQUIPMENT TAG:**

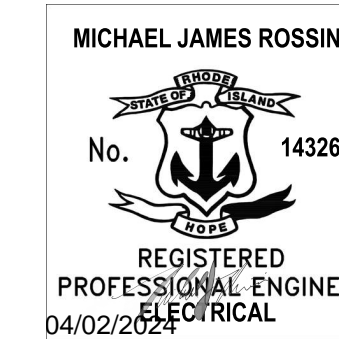
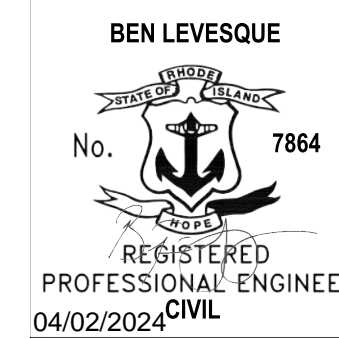
- ① PANELBOARD DP-9
- ② PANELBOARD R-9-3
- ③ DRY-TYPE TRANSFORMER 30KVA
- ④ DRY-TYPE TRANSFORMER 75KVA
- ⑤ PANELBOARD P-9-2
- ⑥ PANELBOARD P-9-1
- ⑦ PANELBOARD BR
- ⑧ PULLBOX AND FEEDERS
- ⑨ PANELBOARD P-9-1-1
- ⑩ LIGHTING CONTROL PANEL
- ⑪ PANELBOARD DP-3
- ⑫ PANELBOARD P-3-2
- ⑬ TRANSFORMER - 225KVA
- ⑭ PANELBOARD P-3-1A
- ⑮ PANELBOARD L
- ⑯ PANELBOARD WW1





**EXISTING EQUIPMENT TAG:**

- 1 SWITCHBOARD MAIN SECTION
- 2 SWITCHBOARD 1600A ATS SECTION
- 3 SWITCHBOARD DISTRIBUTION SECTION
- 4 DRY-TYPE TRANSFORMER 225KVA (T2)
- 5 FIRE PUMP DISCONNECT
- 6 PANELBOARD WW1
- 7 PANELBOARD P-2-7
- 8 PANELBOARD DP-2
- 9 PANELBOARD DP-3
- 10 PANELBOARD DP-4
- 11 DRY-TYPE TRANSFORMER 225KVA (T1)
- 12 PANELBOARD DPG1
- 13 PANELBOARD DPG2
- 14 DRY-TYPE TRANSFORMER 45KVA
- 15 PANELBOARD PPG1



**KEY NOTES:**

- 1 RELOCATE EXISTING LIGHTING AS REQUIRED TO PERMIT INSTALLATION OF NEW DUCTWORK.
- 2 FEEDER ROUTED AT UNDERSIDE OF PRE-CAST TEES PARALLEL TO EXISTING CONDUIT RACKS TO SERVE DEDICATED OUTSIDE AIR SYSTEM UNITS ON ROOF ABOVE (TYP)
- 3 FEEDER ROUTED BETWEEN PRE-CAST TEES ABOVE CURTAIN WALL PARTITION TO PULLBOX TO SERVE DEDICATED OUTSIDE AIR SYSTEM UNIT ON ROOF ABOVE (TYP)
- 4 FEEDERS ROUTED OVERHEAD TO NEW PULLBOX; PROVIDE UNISTRUT TRAPEZE SECURED TO STRUCTURE (TYP)
- 5 FEEDERS DOWN TO EFFLUENT GALLERY TO SERVE DEHUMIDIFICATION UNITS ON WASHWATER ROOF (TYP)
- 6 FEEDERS ROUTED OVERHEAD TO NEW CONDUIT CHASE; PROVIDE UNISTRUT TRAPEZE SECURED TO STRUCTURE (TYP)
- 7 FEEDERS TO DEHUMIDIFICATION UNITS ON ROOF ABOVE; PROVIDE UNISTRUT TRAPEZE SECURED TO STRUCTURE (TYP)

**Dehumidification System Design**

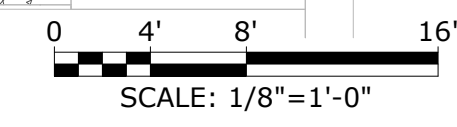
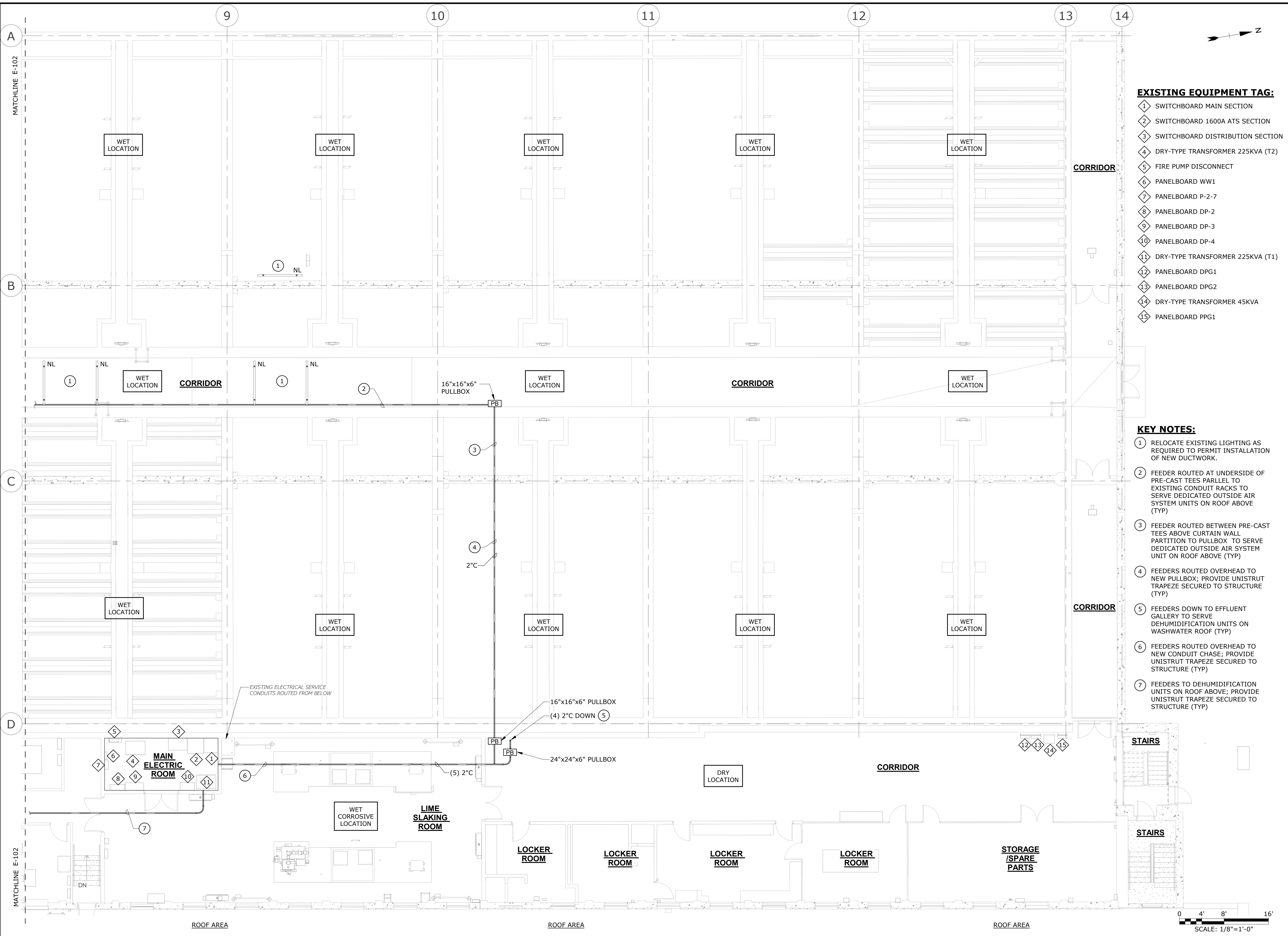
Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS
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ELECTRICAL - CENTRAL FILTER GALLERY POWER PLAN - NORTH

SCALE: AS SHOWN



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 User: BKA, HDA  
 Title: E-101

**BEN LEVESQUE**  
 No. 7864  
 REGISTERED PROFESSIONAL ENGINEER  
 CIVIL  
 04/02/2024

**MICHAEL JAMES ROSSINI**  
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**Dehumidification System Design**

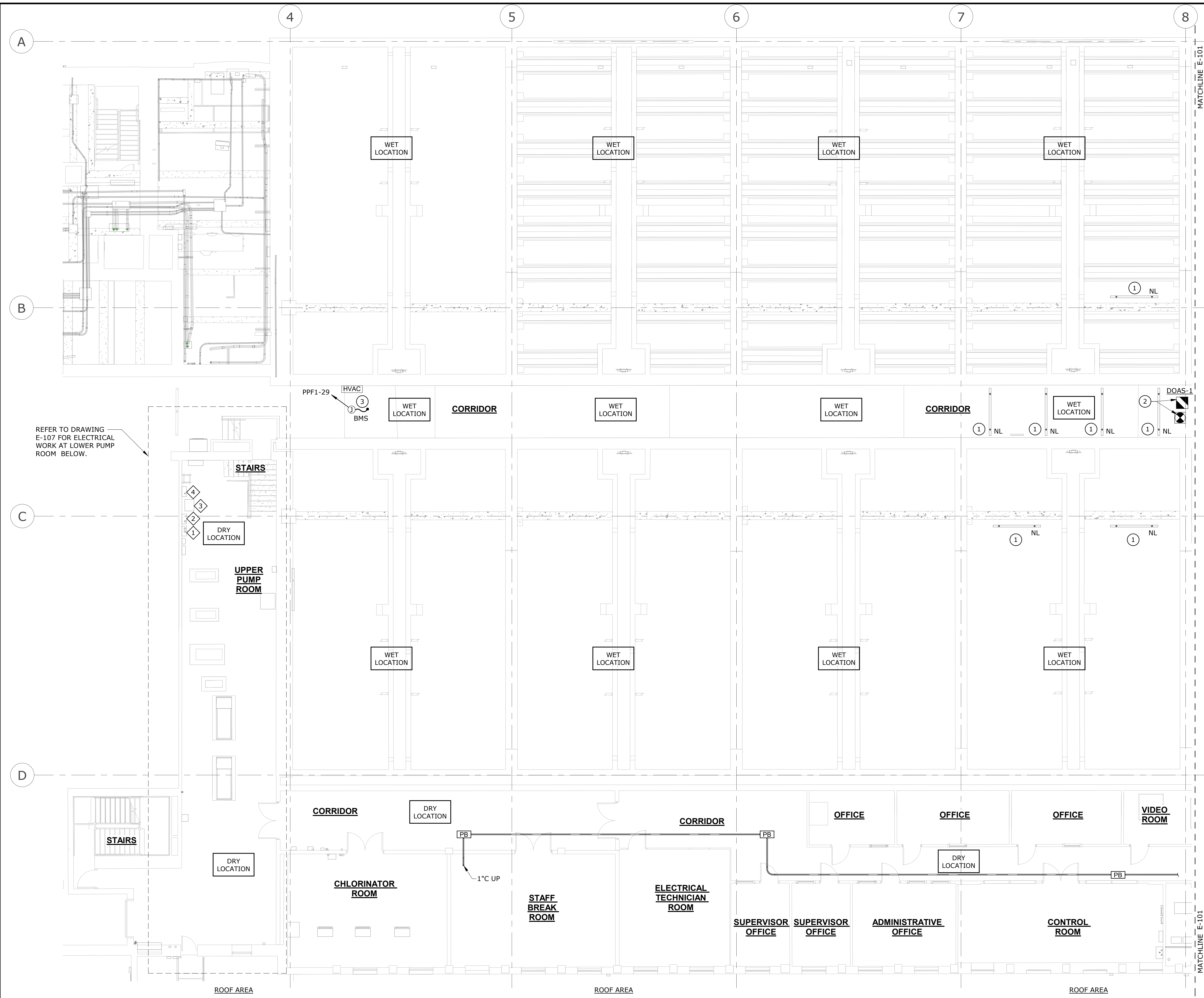
Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

ELECTRICAL - CENTRAL FILTER GALLERY POWER PLAN - SOUTH

SCALE: AS SHOWN



REFER TO DRAWING E-107 FOR ELECTRICAL WORK AT LOWER PUMP ROOM BELOW.

**EXISTING EQUIPMENT TAG:**

- ① PANELBOARD DPF1
- ② PANELBOARD DPF2
- ③ DRY-TYPE TRANSFORMER 45KVA
- ④ PANELBOARD PPF1

**KEY NOTES:**

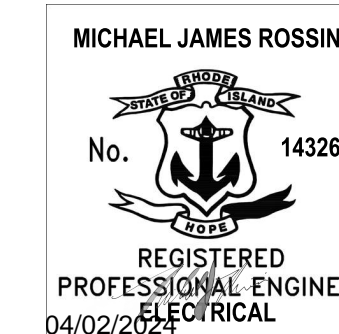
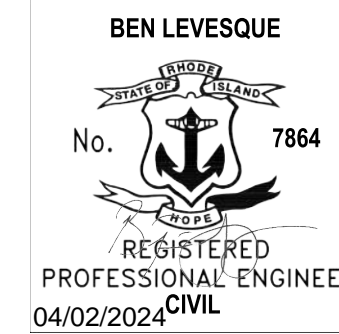
- ① RELOCATE EXISTING LIGHTING IN THIS AREA AS REQUIRED TO PERMIT INSTALLATION OF NEW DUCTWORK.
- ② CONNECT DUCT SMOKE DETECTOR TO FIRE ALARM SYSTEM.
- ③ CONNECT 120V POWER TO BUILDING MANAGEMENT SYSTEM.



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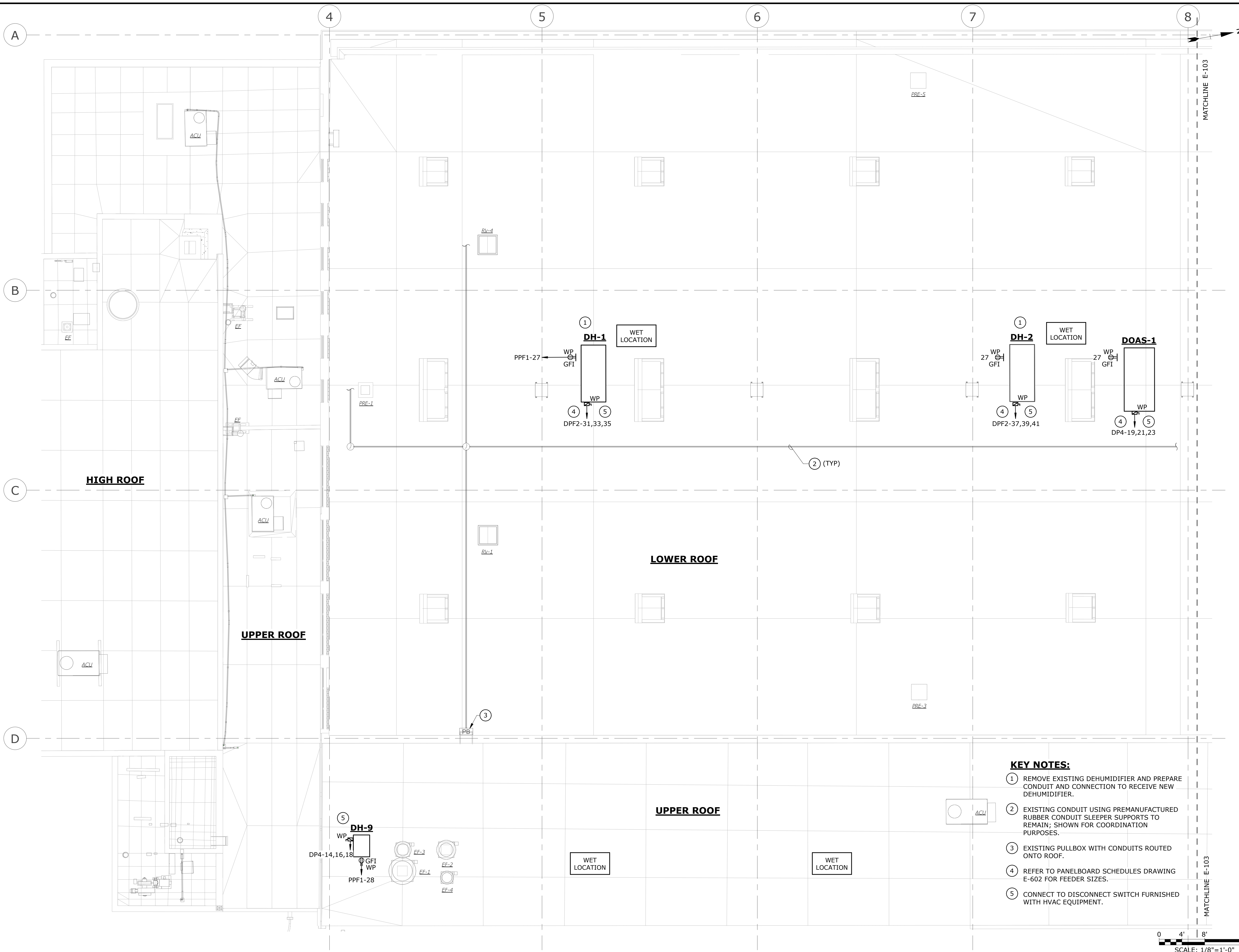




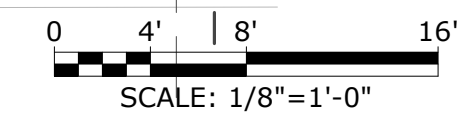
**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island



- KEY NOTES:**
- ① REMOVE EXISTING DEHUMIDIFIER AND PREPARE CONDUIT AND CONNECTION TO RECEIVE NEW DEHUMIDIFIER.
  - ② EXISTING CONDUIT USING PREMANUFACTURED RUBBER CONDUIT SLEEPER SUPPORTS TO REMAIN; SHOWN FOR COORDINATION PURPOSES.
  - ③ EXISTING PULLBOX WITH CONDUITS ROUTED ONTO ROOF.
  - ④ REFER TO PANELBOARD SCHEDULES DRAWING E-602 FOR FEEDER SIZES.
  - ⑤ CONNECT TO DISCONNECT SWITCH FURNISHED WITH HVAC EQUIPMENT.



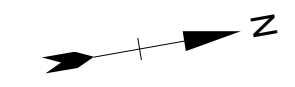
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MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: RAK, HDA  
DESIGNED/CHECKED BY: MB, MR  
APPROVED BY: BRL

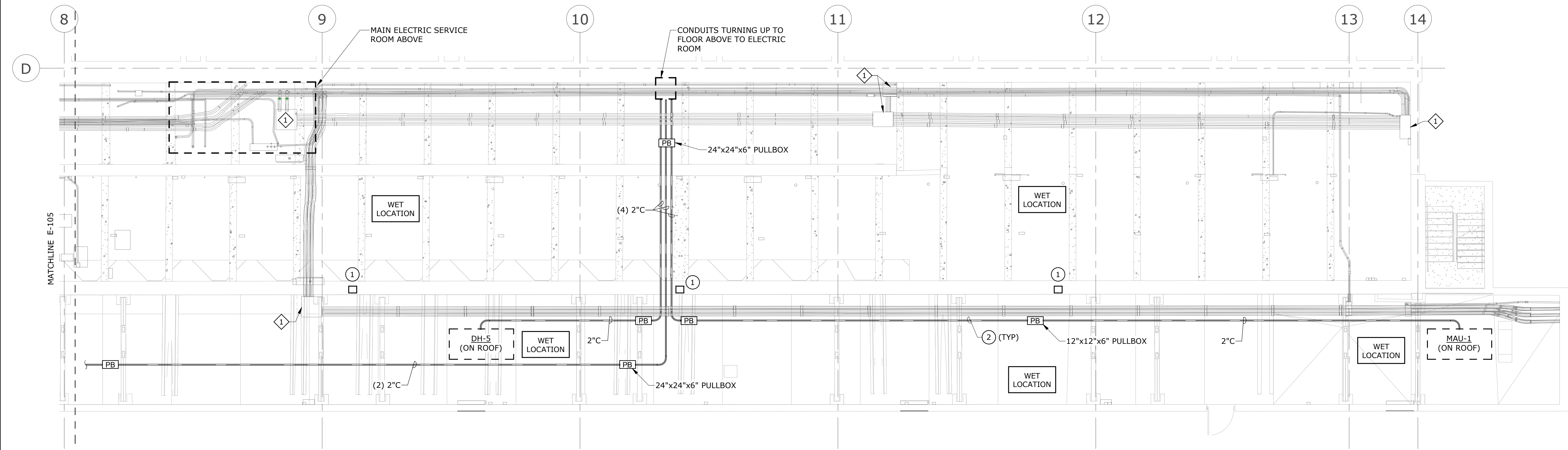
ELECTRICAL - ROOF POWER PLAN - SOUTH

SCALE: AS SHOWN

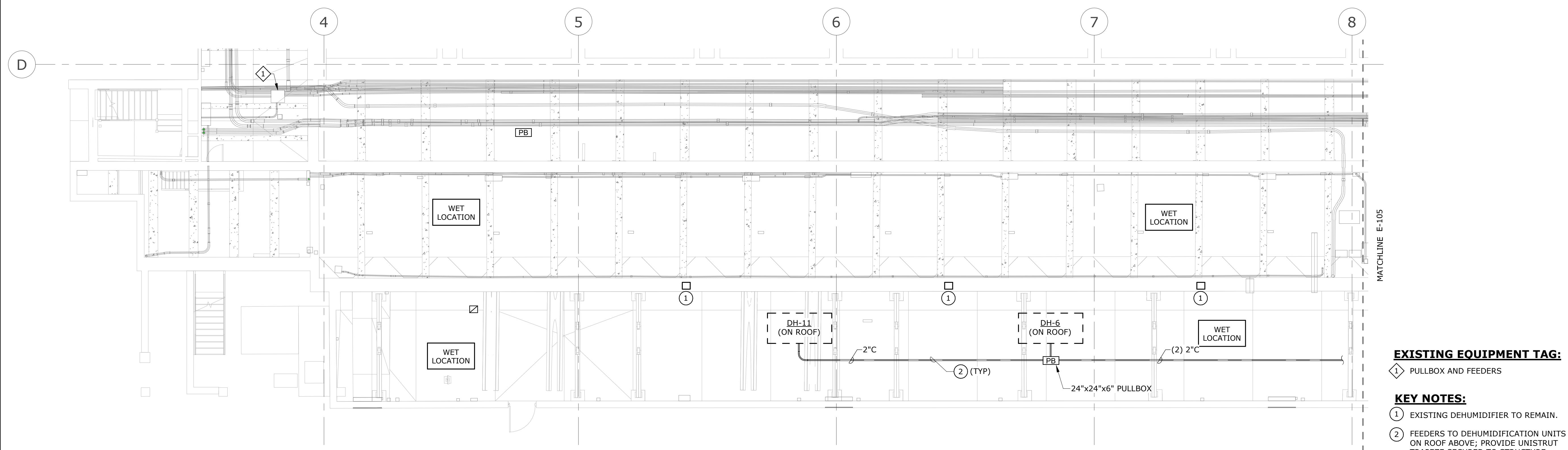


**BEN LEVESQUE**  
 No. 7864  
 REGISTERED PROFESSIONAL ENGINEER  
 CIVIL  
 04/02/2024

**MICHAEL JAMES ROSSINI**  
 No. 14326  
 REGISTERED PROFESSIONAL ENGINEER  
 ELECTRICAL  
 04/02/2024

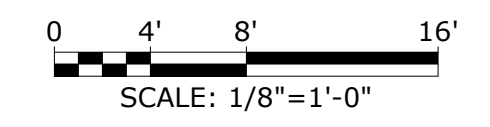


**ELECTRICAL - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - NORTH**



**ELECTRICAL - EFFLUENT GALLERY & WASHWATER UTILITY STRUCTURE - SOUTH**

- EXISTING EQUIPMENT TAG:**
- 1 PULLBOX AND FEEDERS
- KEY NOTES:**
- 1 EXISTING DEHUMIDIFIER TO REMAIN.
  - 2 FEEDERS TO DEHUMIDIFICATION UNITS ON ROOF ABOVE; PROVIDE UNISTRUT TRAPEZE SECURED TO STRUCTURE.



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

MARK	DATE	DESCRIPTION
0	04/02/2024	CONSTRUCTION DOCUMENTS

PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, HDA  
 DESIGNED/CHECKED BY: MB, MR  
 APPROVED BY: BRL

ELECTRICAL - EFFLUENT PIPE GALLERY & WASHWATER UTILITY STRUCTURE PLAN

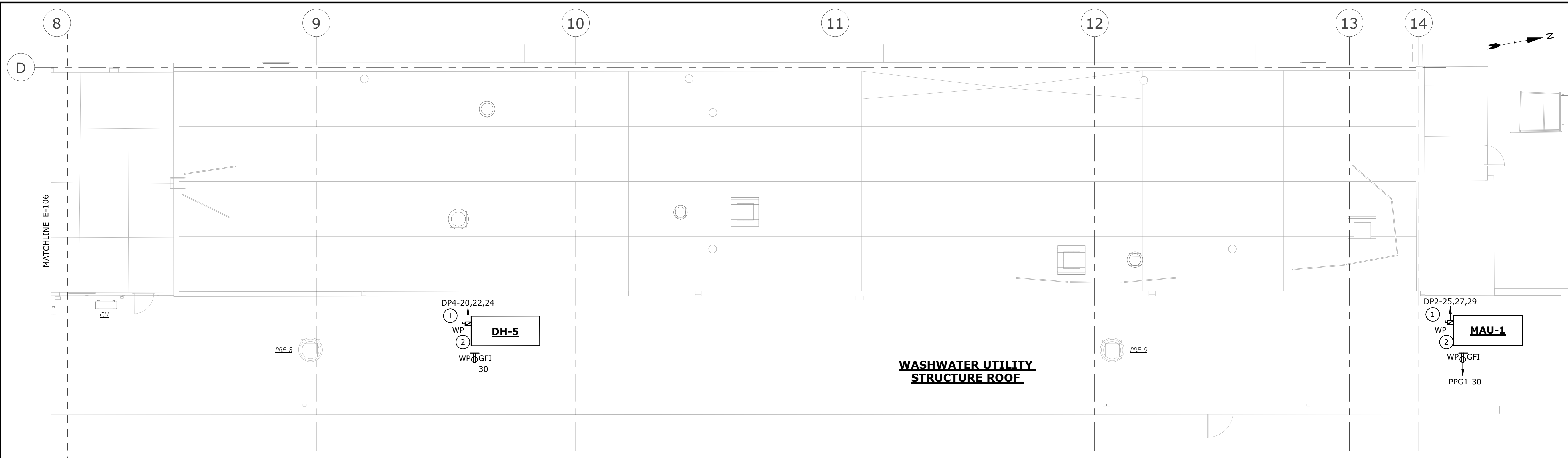
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**E-105**

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**BEN LEVESQUE**  
 No. 7864  
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 CIVIL  
 04/02/2024

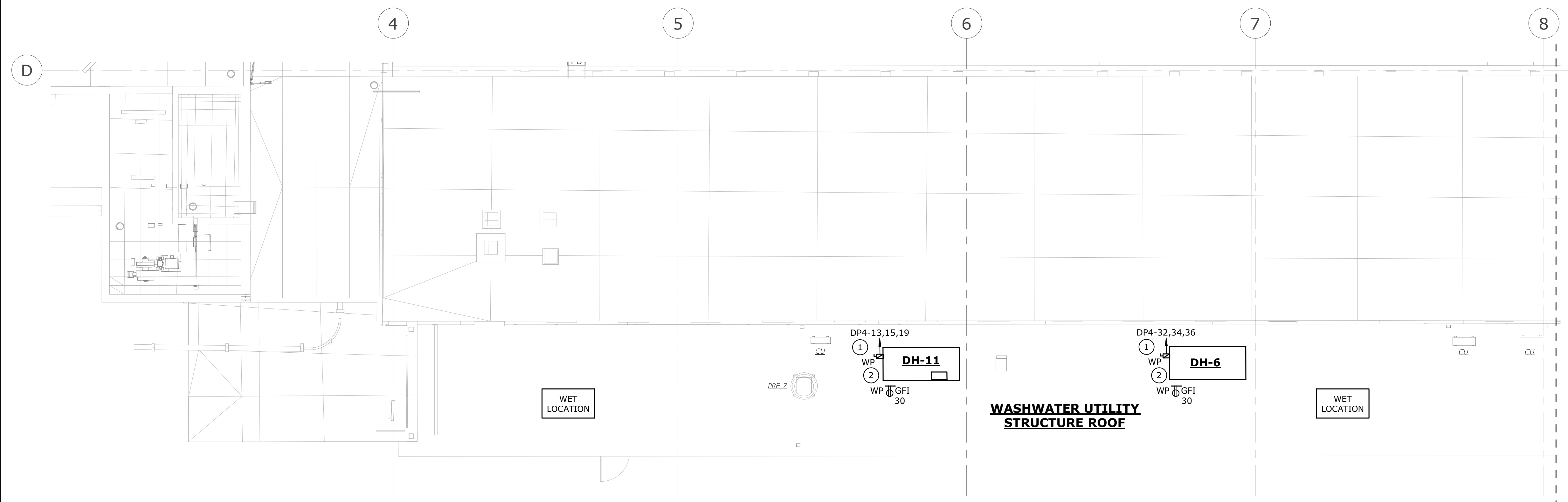
**MICHAEL JAMES ROSSINI**  
 No. 14326  
 REGISTERED PROFESSIONAL ENGINEER  
 ELECTRICAL  
 04/02/2024



**ELECTRICAL - WASHWATER & UTILITY STRUCTURE ROOF PLAN - NORTH**

**KEY NOTES:**

- ① REFER TO PANELBOARD SCHEDULES DRAWING E-602 AND E-604 FOR FEEDER SIZES.
- ② CONNECT TO DISCONNECT SWITCH FURNISHED WITH HVAC EQUIPMENT.



**ELECTRICAL - WASHWATER & UTILITY STRUCTURE ROOF PLAN - SOUTH**

**Dehumidification System Design**

Providence Water Supply Board

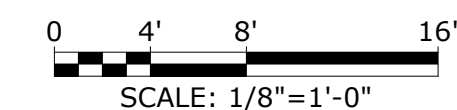
Philip J. Holton Water Purification Plant  
 Scituate, Rhode Island

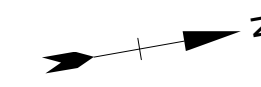
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PROJECT NO: P-0740-047  
 DATE: APRIL 2024  
 FILE: P-0740-047  
 DRAWN BY: RAK, HDA  
 DESIGNED/CHECKED BY: MB, MR  
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ELECTRICAL - WASHWATER UTILITY STRUCTURE ROOF PLAN

SCALE: AS SHOWN



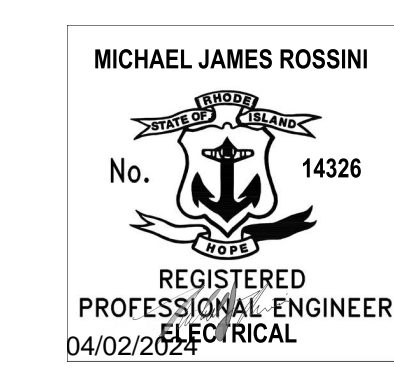


**EXISTING EQUIPMENT TAG:**

- 1 PANELBOARD DP-9
- 2 PANELBOARD R-9-3
- 3 DRY-TYPE TRANSFORMER 30KVA
- 4 DRY-TYPE TRANSFORMER 75KVA
- 5 PANELBOARD P-9-2
- 6 PANELBOARD P-9-1
- 7 PANELBOARD BR
- 8 PULLBOX AND FEEDERS
- 9 PANELBOARD P-9-1-1
- 10 LIGHTING CONTROL PANEL
- 11 PANELBOARD DP-3
- 12 PANELBOARD P-3-2
- 13 TRANSFORMER - 225KVA
- 14 PANELBOARD P-3-1A
- 15 PANELBOARD L
- 16 PANELBOARD WW1

**KEY NOTES:**

- 1 REINSTALL EXISTING LIGHTING COORDINATED WITH NEW DEHUMIDIFIER AND DUCTWORK. LOCATE LIGHTING 8'-0" A.F.F..
- 2 REFER TO PANELBOARD SCHEDULES ON DRAWING E-604 FOR FEEDER SIZES.
- 3 CONNECT TO DISCONNECT SWITCH FURNISHED WITH HVAC EQUIPMENT.
- 4 RELOCATE EXISTING LIGHTING IN THIS AREA AS REQUIRED TO PERMIT INSTALLATION OF NEW DUCTWORK.



**Dehumidification System Design**

Providence Water Supply Board

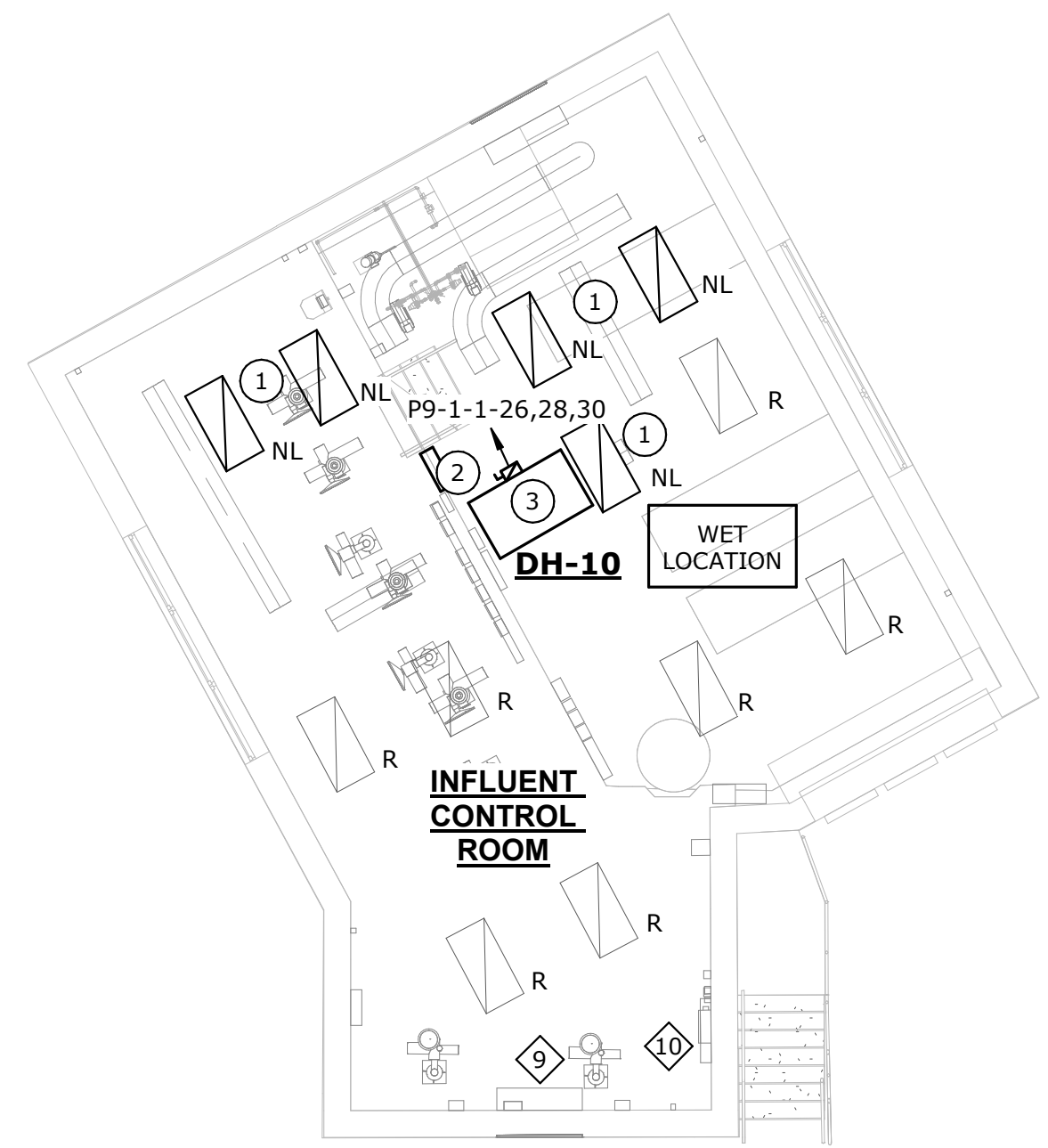
Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

MARK	DATE	DESCRIPTION
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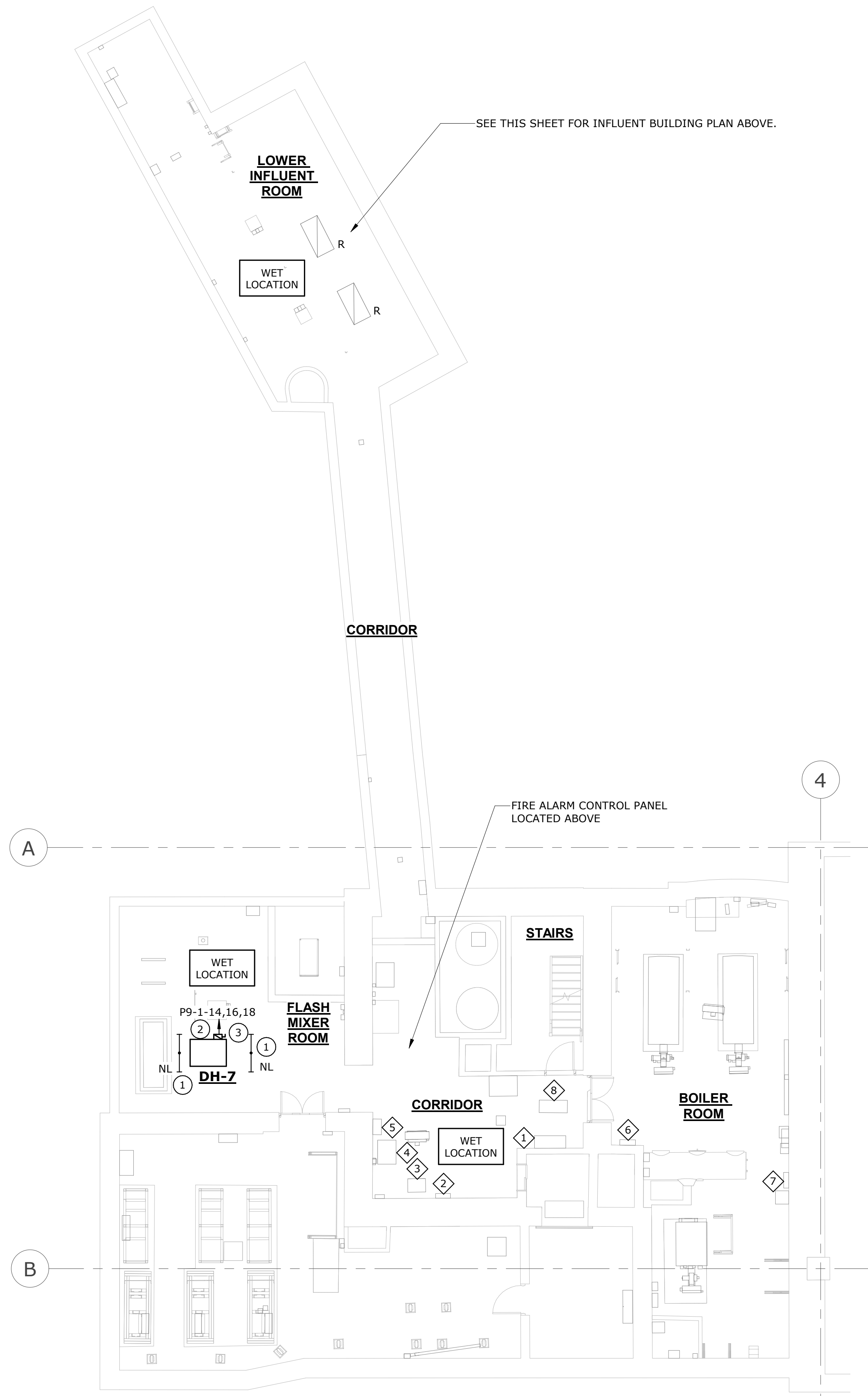
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DATE: APRIL 2024  
FILE: P-0740-047  
DRAWN BY: RAK, HDA  
DESIGNED/CHECKED BY: MB, MR  
APPROVED BY: BRL

ELECTRICAL - PARTIAL BASEMENT, INFLUENT BLDG & LOWER PUMP RM POWER PLANS

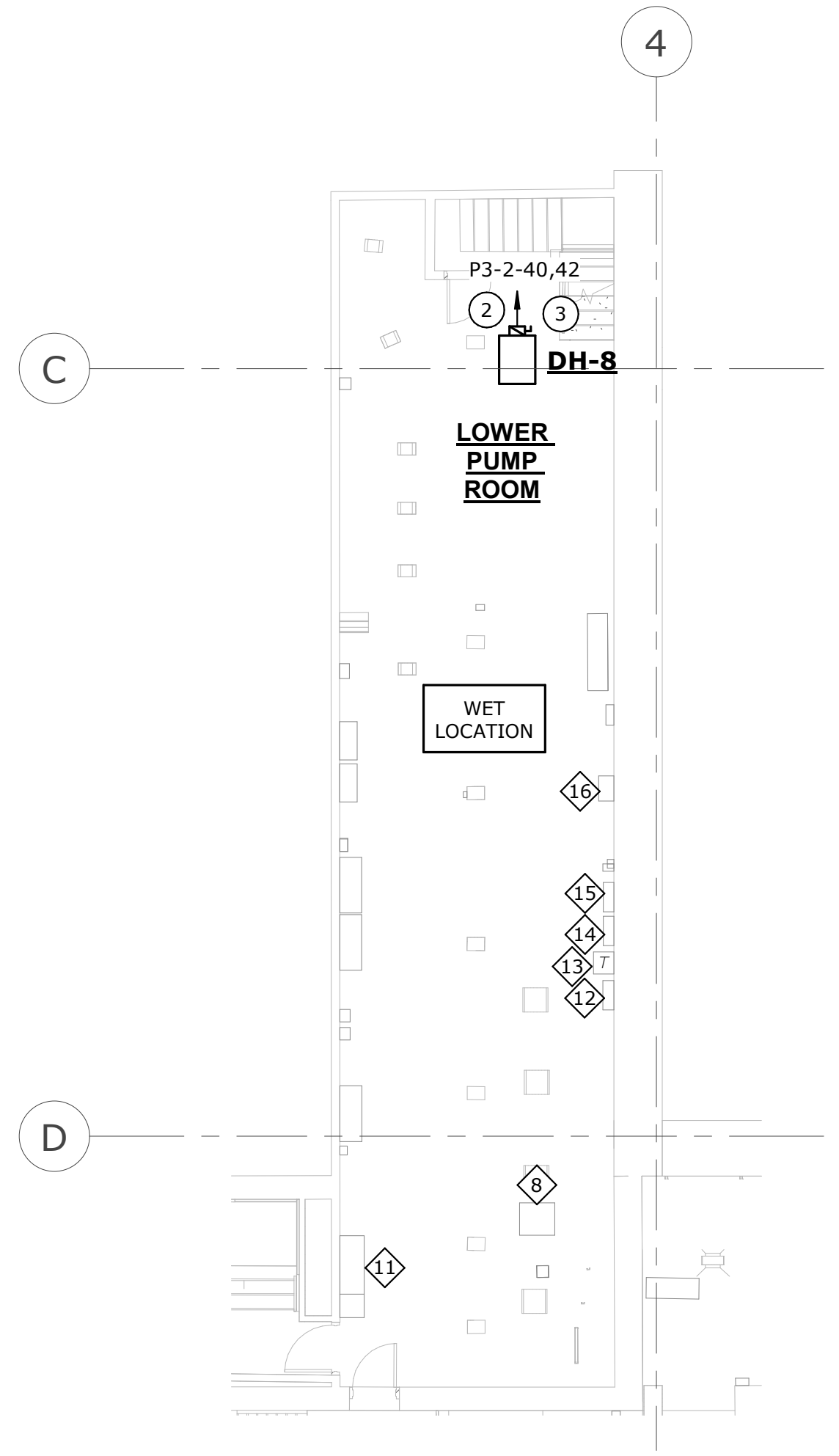
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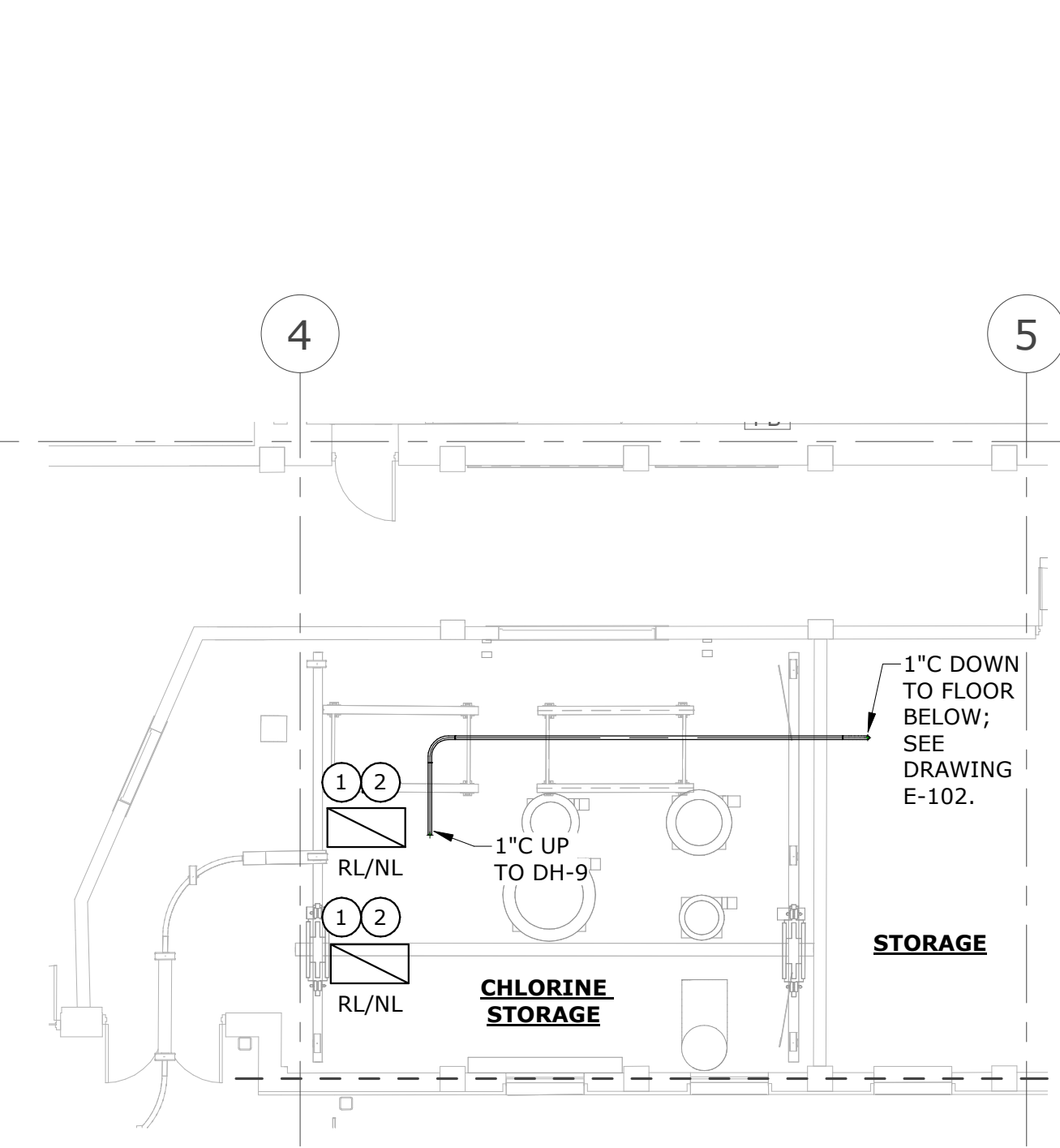
**ELECTRICAL - INFLUENT BUILDING PLAN FIRST FLOOR**



**ELECTRICAL POWER - PARTIAL BASEMENT**



**ELECTRICAL POWER - LOWER PUMP RM EFFLUENT GALLERY**



**ELECTRICAL PART PLAN - CHLORINE STORAGE**  
SCALE: 1/8" = 1'-0"

**KEY NOTES:**

- 1 REMOVE EXISTING LIGHTING AS REQUIRED TO PERMIT REMOVAL OF EXISTING DUCTWORK.
- 2 RELOCATE EXISTING LIGHTING IN THIS AREA AS REQUIRED TO PERMIT INSTALLTION OF NEW DUCTWORK.



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**BEN LEVESQUE**  
No. 7864  
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04/02/2024 CIVIL

**MICHAEL JAMES ROSSINI**  
No. 14326  
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04/02/2024 ELECTRICAL

**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

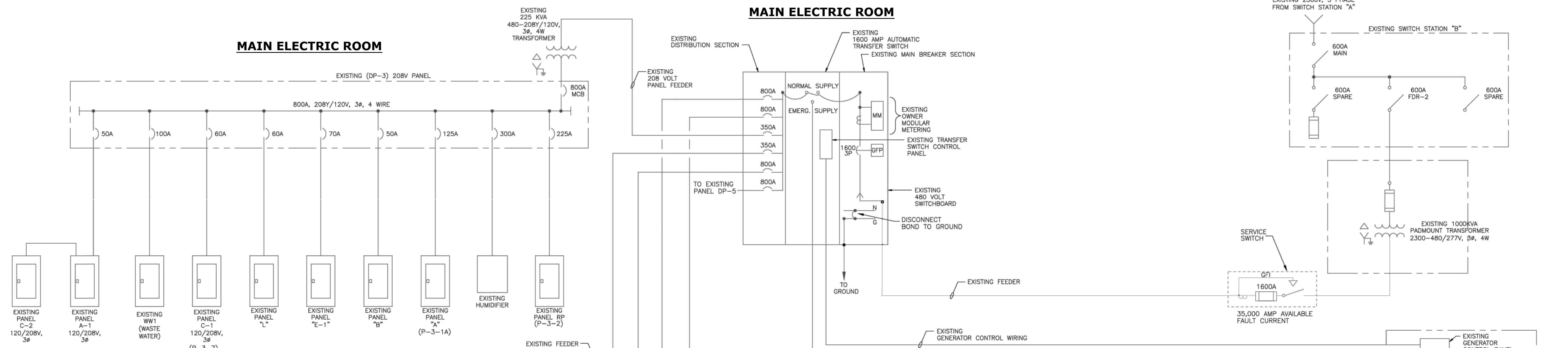
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DATE: APRIL 2024  
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DRAWN BY: RAK, HDA  
DESIGNED/CHECKED BY: MB, MR  
APPROVED BY: BRL

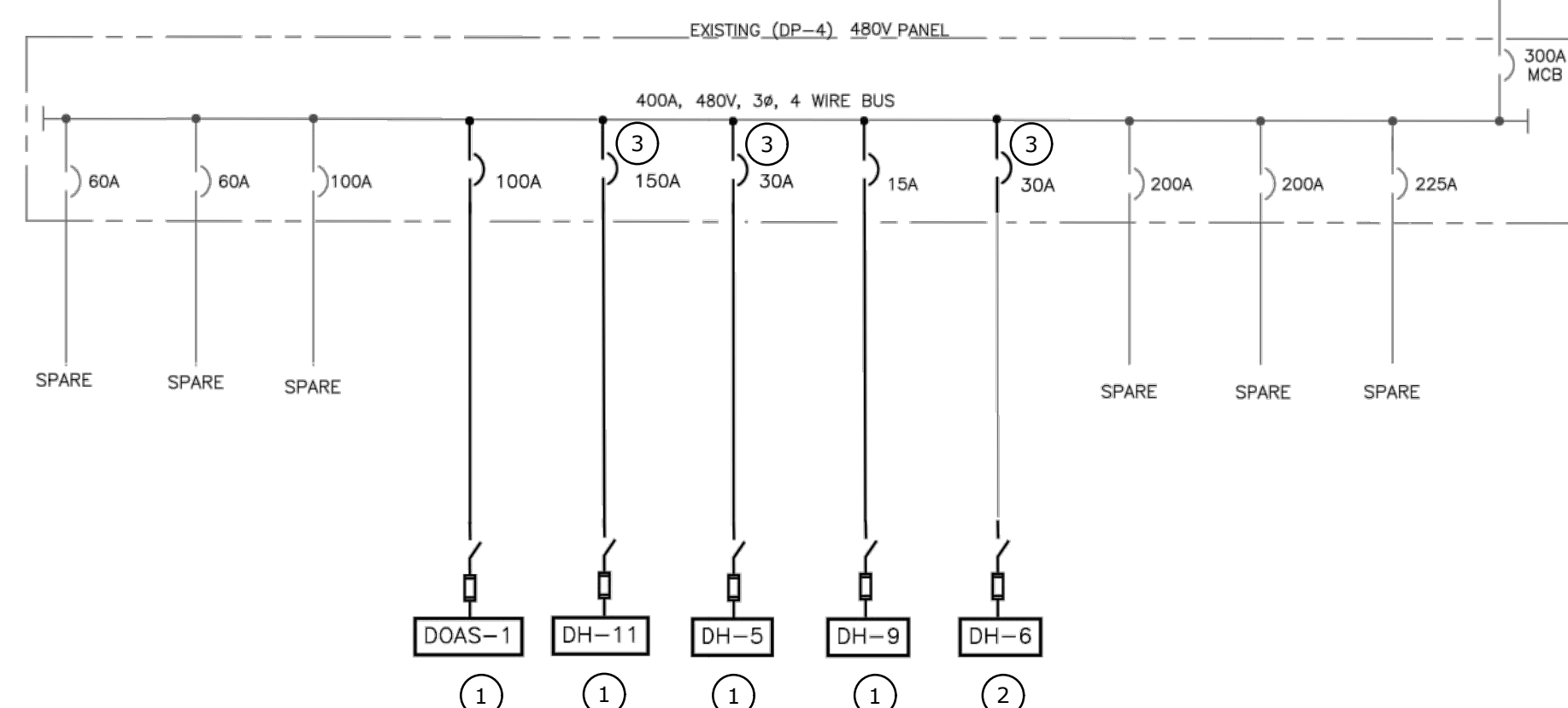
**ELECTRICAL ONE-LINE DIAGRAM**

SCALE: NO SCALE

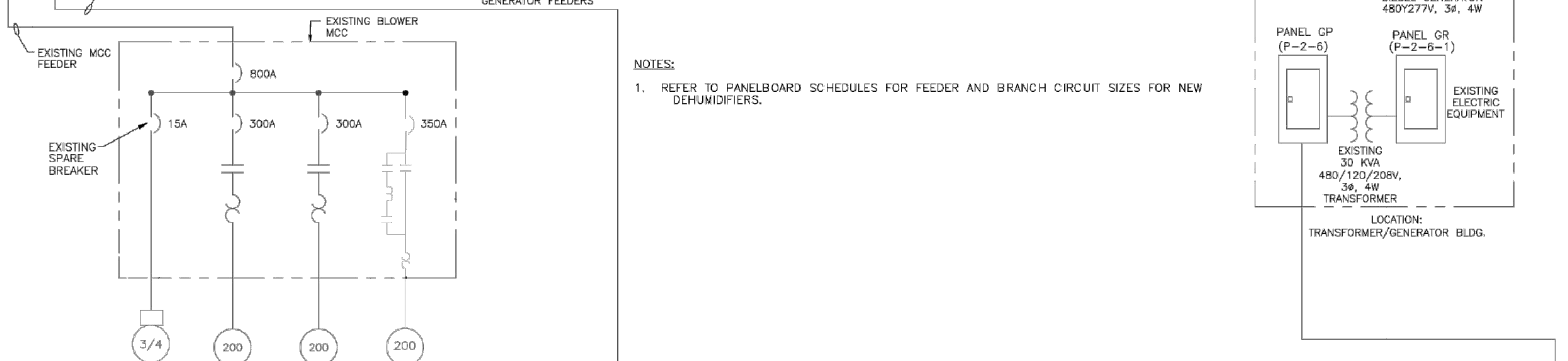
**MAIN ELECTRIC ROOM**



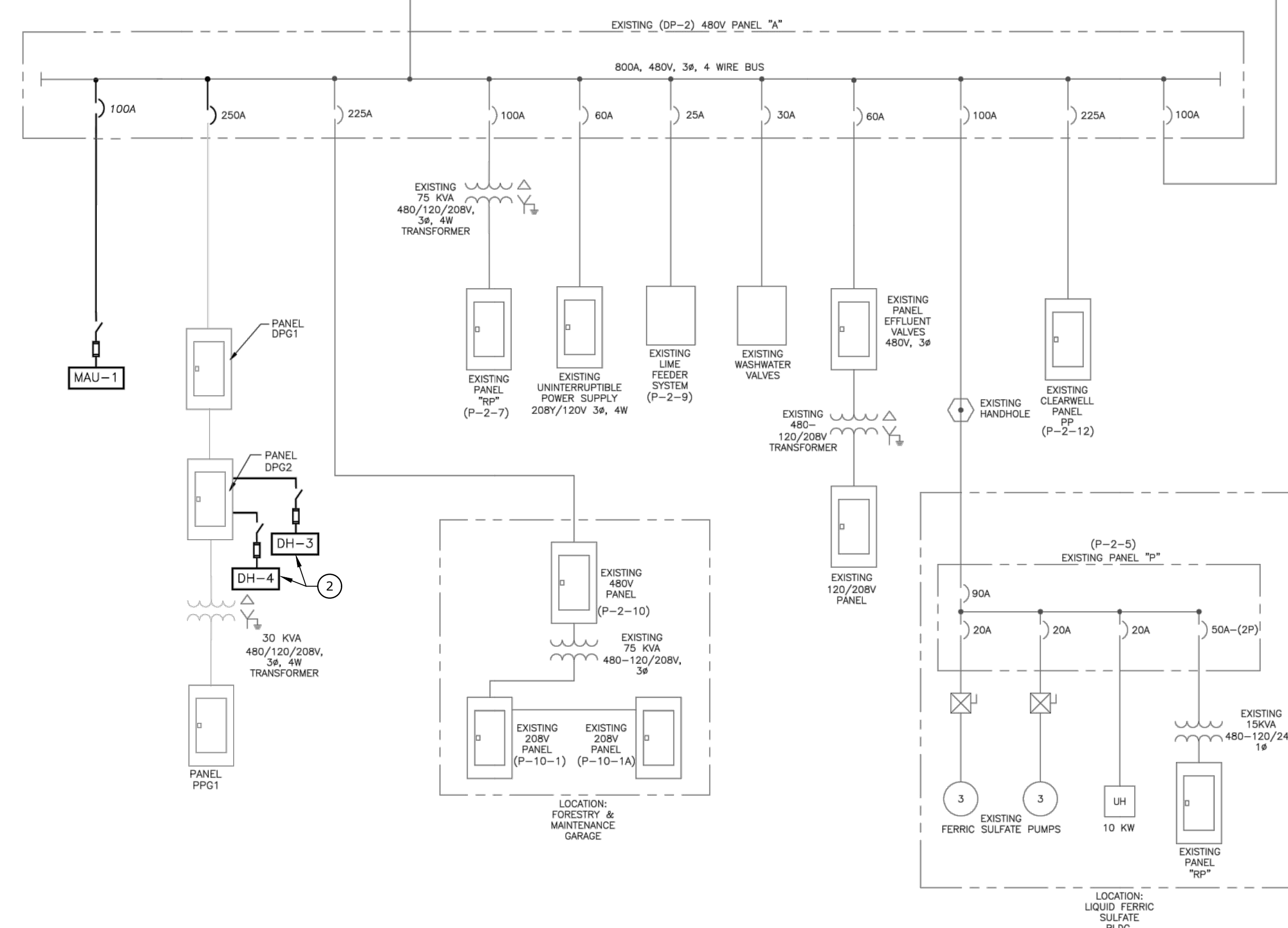
**MAIN ELECTRIC ROOM**



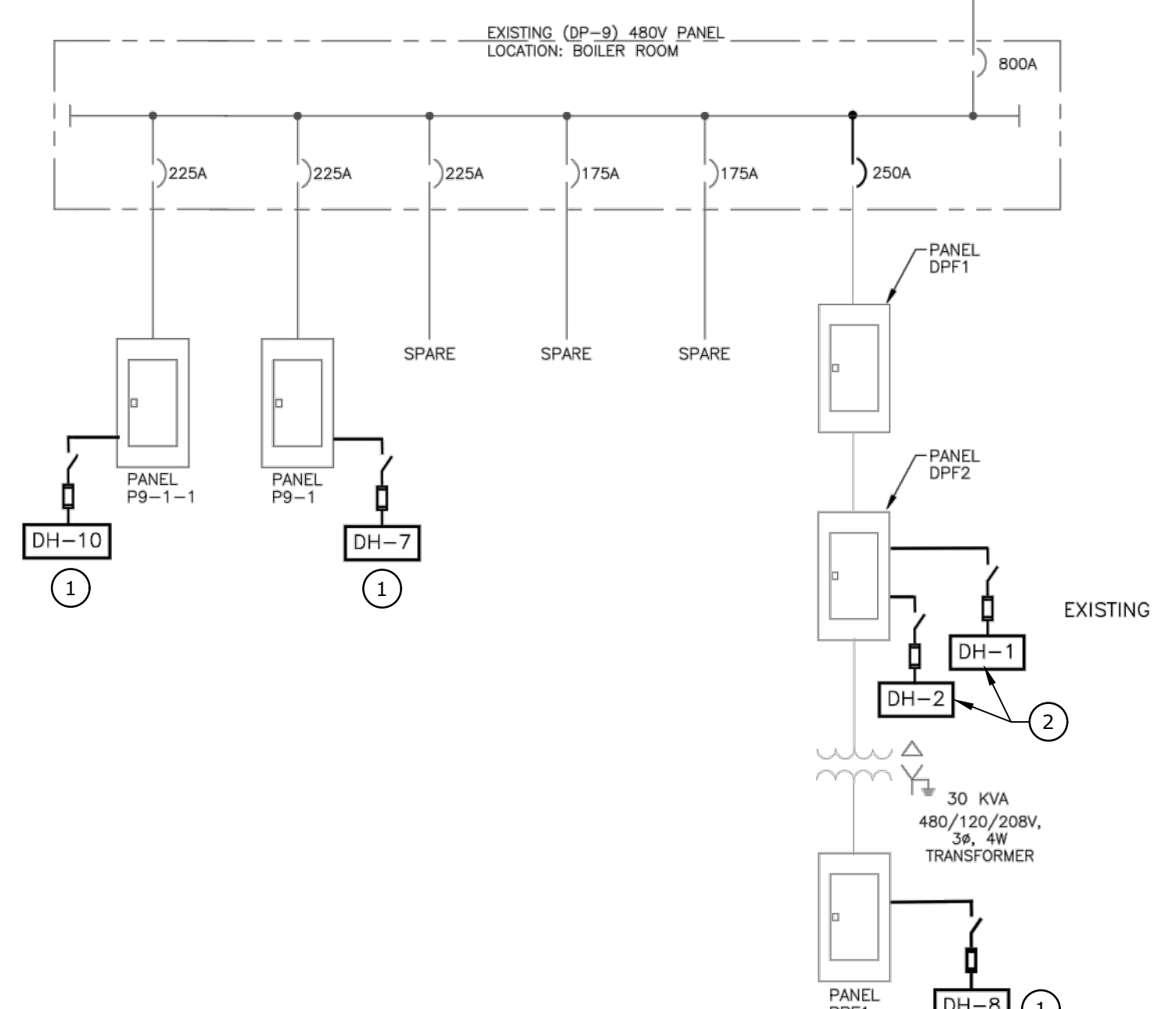
**MAIN ELECTRIC ROOM**



**MAIN ELECTRIC ROOM**



**INFLUENT BUILDING BASEMENT**



**KEY NOTES:**

- NEW EQUIPMENT LOAD ON EXISTING PANEL; REMOVE EXISTING CIRCUIT BREAKER AND PROVIDE NEW "IN-KIND" CIRCUIT BREAKER AND FEEDER. REFER TO PANELBOARD SCHEDULES.
- NEW EQUIPMENT LOAD ON EXISTING PANEL; REMOVE EXISTING CIRCUIT BREAKER AND PROVIDE NEW "IN-KIND" CIRCUIT BREAKER. CONNECT TO EXISTING FEEDER. REFER TO PANELBOARD SCHEDULES.
- PROVIDE NEW RATING CHIP IN CIRCUIT BREAKER.

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		VOLTAGE (L-L): 480 PHASE: 3 WIRE: 4		VA, L1	160,530	PANEL NO. EXISTING PANEL DP2							
		VOLTAGE (L-N): 277		VA, L2	159,470	LOCATION: MAIN ELECTRIC ROOM							
		MAIN BUS: 800 AMPS		VA, L3	160,300	NOTES:							
		MAIN BREAKER: 800 A FRAME 800 A TRIP		TOTAL VA		480,299							
		MOUNTING: SURFACE KAIC: 35		INCOMING FEEDER SIZE:		8-600 KCMIL, 2#10G, 2-4" C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			AMPS	CKT.	VA LOAD	DIRECTORY	CONDUIT SIZE	WIRE SIZE		
3#1 & 1#8G	1 1/2"	PANEL GP	L1	L2	L3	1	100	L1	L2	L3	PANEL P-2-12 (CLEARWELL PANEL)	2"	3#4.0 & 1#4G
-	-	-	7,000	7,000		3		2,260	1,200		-	-	-
3#4 & 1#10G	1"	EFFLUENT VALVES PANEL	10,637	10,637		9	60	1,200	1,200		3#4"	3#10 & 1#10G	-
3#4 & 1#10G	1"	UPS PANEL	10,637	10,637		13	60	1,200	1,200		1 1/2"	3#1 & 1#8G	-
3#4.0 & 1#4G	2"	PANEL P-2-10	9,357	9,357		19	225	17,728	17,728		2 1/2"	3-250 & 1#4G	-
3#1 & 1#8G	1 1/2"	MAU-1	12,298	12,298		25	100	11,080	11,080		1 1/2"	3#1 & 1#8G	-
3#12 & 1#12G	3/4"	SPARE				31	20				3/4"	3#10 & 1#10G	-
-	-	SPACE & HARDWARE				37					-	-	-
-	-	SPACE & HARDWARE				39					-	-	-
-	-	SPACE & HARDWARE				41					-	-	-

		VOLTAGE (L-L): 480 PHASE: 3 WIRE: 4		VA, L1	35,933	PANEL NO. EXISTING PANEL DPG1							
		VOLTAGE (L-N): 277		VA, L2	35,933	LOCATION: COORRIDOR 121							
		MAIN BUS: 250 AMPS		VA, L3	35,933	NOTES:							
		MAIN BREAKER: 200 A FRAME A TRIP		TOTAL VA		107,800							
		MOUNTING: SURFACE KAIC: 35		INCOMING FEEDER SIZE:		4-250 KCMIL, 1#4G, 3" C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			AMPS	CKT.	VA LOAD	DIRECTORY	CONDUIT SIZE	WIRE SIZE		
3#12 & 1#12G	3/4"	FILTER 1 EFFLUENT GALLERY BFV-0102A, 0103A, 0104A, 0105A, 0102B, 0103B, 0104B, 0105B	L1	L2	L3	1	20	L1	L2	L3	FILTER 2 EFFLUENT GALLERY BFV-0202A, 0203A, 0204A, 0205A, 0202B, 0203B, 0204B, 0205B	3/4"	3#12 & 1#12G
-	-	-	2,567	2,567		3		2,567	2,567		-	-	-
3#12 & 1#12G	3/4"	FILTER 3 EFFLUENT GALLERY BFV-0302A, 0303A, 0304A, 0305A, 0302B, 0303B, 0304B, 0305B	2,567			7	20	2,567	2,567		3/4"	3#12 & 1#12G	-
3#12 & 1#12G	3/4"	FILTER 5 EFFLUENT GALLERY BFV-0502A, 0503A, 0504A, 0505A, 0502B, 0503B, 0504B, 0505B	2,567			13	20	2,567	2,567		3/4"	3#12 & 1#12G	-
3#12 & 1#12G	3/4"	FILTER 7 EFFLUENT GALLERY BFV-0702A, 0703A, 0704A, 0705A, 0702B, 0703B, 0704B, 0705B	2,567			19	20	2,567	2,567		3/4"	3#12 & 1#12G	-
3#12 & 1#12G	3/4"	FILTER 9 EFFLUENT GALLERY BFV-0902A, 0903A, 0904A, 0905A, 0902B, 0903B, 0904B, 0905B	2,567			25	20	2,567	2,567		3/4"	3#12 & 1#12G	-
3#12 & 1#12G	3/4"	FILTER 11 EFFLUENT GALLERY BFV-1102A, 1103A, 1104A, 1105A, 1102B, 1103B, 1104B, 1105B	2,567			31	20	2,567	2,567		3/4"	3#12 & 1#12G	-
3#12 & 1#12G	3/4"	FILTER 13 EFFLUENT GALLERY BFV-1302A, 1303A, 1304A, 1305A, 1302B, 1303B, 1304B, 1305B	2,567			37	20	2,567	2,567		3/4"	3#12 & 1#12G	-
-	-	-				41					-	-	-

		VOLTAGE (L-L): 480 PHASE: 3 WIRE: 4		VA, L1	45,394	PANEL NO. EXISTING PANEL DPG2							
		VOLTAGE (L-N): 277		VA, L2	47,118	LOCATION: CORRIDOR 121							
		MAIN BUS: 250 AMPS		VA, L3	44,038	NOTES: FED FROM DPG1							
		MAIN BREAKER: MLO A FRAME A TRIP		TOTAL VA		136,551							
		MOUNTING: SURFACE KAIC: 35		INCOMING FEEDER SIZE:		4-250 KCMIL, 1#4G, 3" C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			AMPS	CKT.	VA LOAD	DIRECTORY	CONDUIT SIZE	WIRE SIZE		
3#12 & 1#12G	3/4"	FILTER 15 EFFLUENT GALLERY BFV-1502A, 1503A, 1504A, 1505A, 1502B, 1503B, 1504B, 1505B	L1	L2	L3	1	20	L1	L2	L3	FILTER 16 EFFLUENT GALLERY BFV-1602A, 1603A, 1604A, 1605A, 1602B, 1603B, 1604B, 1605B	3/4"	3#12 & 1#12G
-	-	-	2,567	2,567		3		2,567	2,567		-	-	-
3#12 & 1#12G	3/4"	FILTER 17 EFFLUENT GALLERY BFV-1702A, 1703A, 1704A, 1705A, 1702B, 1703B, 1704B, 1705B	2,567			7	20	2,567	2,567		3/4"	3#12 & 1#12G	-
3#12 & 1#12G	3/4"	SF-1	277			13	20	277	277		3/4"	3#12 & 1#12G	-
3#12 & 1#12G	3/4"	EUH-1	1,667			19	20	7,811	7,811		1"	3#6 & 1#10G	-
3#12 & 1#12G	3/4"	EXTERIOR LIGHTS CLEARWELL UTILITY	1,200			25	20	9,357	9,357		1"	3#6 & 1#10G	-
2#12 & 1#12G	3/4"	DEHUMIDIFIER DH-3				21					-	-	-
2#12 & 1#12G	3/4"	DEHUMIDIFIER DH-4				27					-	-	-
2#12 & 1#12G	3/4"	EXTERIOR LIGHTS CLEARWELL UTILITY	1,200			29	20	10,000	10,000		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	EFFLUENT GALLERY LIGHTING	350			31	20	44	44		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	CLEARWELL UTILITY STRUCTURE LIGHTING	2,990			33	20				3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	EFFLUENT GALLERY LIGHTING	3,230			39	20				1"	3#6 & 1#10G	-
2#12 & 1#12G	3/4"	CLEARWELL UTILITY STRUCTURE LIGHTING	1,570			41	20	10,000	10,000		-	-	-

		VOLTAGE (L-L): 208 PHASE: 3 WIRE: 4		VA, L1	2,230	PANEL NO. EXISTING PANEL PPG1							
		VOLTAGE (L-N): 120		VA, L2	3,060	LOCATION: CORRIDOR 121							
		MAIN BUS: 225 AMPS		VA, L3	4,240	NOTES:							
		MAIN BREAKER: 100 A FRAME A TRIP		TOTAL VA		9,530							
		MOUNTING: SURFACE KAIC: 22		INCOMING FEEDER SIZE:		4-#2 AWG, #8G, 1 1/2" C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			AMPS	CKT.	VA LOAD	DIRECTORY	CONDUIT SIZE	WIRE SIZE		
2#12 & 1#12G	3/4"	FILTER 1 INSTRUMENT PANEL	L1	L2	L3	1	20	L1	L2	L3	FILTER 2 INSTRUMENT PANEL	3/4"	2#12 & 1#12G
2#12 & 1#12G	3/4"	FILTER 3 INSTRUMENT PANEL	150			3	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	FILTER 5 INSTRUMENT PANEL	150			5	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	FILTER 7 INSTRUMENT PANEL	150			7	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	FILTER 9 INSTRUMENT PANEL	150			9	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	FILTER 11 INSTRUMENT PANEL	150			11	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	FILTER 13 INSTRUMENT PANEL	150			13	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	FILTER 15 INSTRUMENT PANEL	150			15	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	FILTER 17 INSTRUMENT PANEL	150			17	20	150	150		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	RECEPTACLES CLEARWELL UTILITY ROOM	540			19	20	540	540		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	RECEPTACLES EFFLUENT GALLERY	720			21	20	720	720		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	RECEPTACLES EFFLUENT GALLERY	720			23	20	720	720		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	CLEARWELL INSTRUMENT PANEL	150			25	20	100	100		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	HEAT TRACE-CLEARWELL (GFCI)	200			27	20	700	700		3/4"	2#12 & 1#12G	-
2#12 & 1#12G	3/4"	BLOWER #3 ENCLOSURE FAN	700			29	20	1,200	1,200		3/4"	2#12 & 1#12G	-
-	-	SPARE				31	20				-	-	-
-	-	SPARE				33	20				-	-	-
-	-	SPACE				35	-				-	-	-
-	-	SPACE				37	-				-	-	-
-	-	SPACE				39	-				-	-	-
-	-	SPACE				41	-				-	-	-

**NOTES:**

- PANELBOARD HOMERUNS SHALL BE PERMITTED TO BE CONSOLIDATED. CONTRACTOR SHALL SIZE CONDUIT AND DERATE CONDUCTOR AMPACITIES IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE.
- CONDUITS AND CONDUCTORS BETWEEN DISCONNECTING MEANS, MANUAL MOTOR STARTING SWITCHES OR CONTROL DEVICES AND LOADS SERVED SHALL BE THE SAME QUANTITIES AND SIZES AS THE HOMERUN WIRING UNLESS OTHERWISE SCHEDULED/NOTED OR REQUIRED.
- THE FOLLOWING CIRCUITS SHALL BE 2#10, 1#10G IN 3/4" CONDUIT:
  - DPF2 - CKT:9
  - DPF2 - CKT:10
  - DPF2 - CKT:14
  - DPF2 - CKT:39
  - DPF2 - CKT:41
  - DPG2 - CKT:33
  - DPG2 - CKT:35
  - DPG2 - CKT:37
  - DPG2 - CKT:39
  - DPG2 - CKT:41
- PANELBOARDS DPF1 AND DPG1 SHALL HAVE FEED-THRU LUGS.
- BOLD TEXT INDICATES NEW SCOPE WORK.

**Dehumidification System Design**

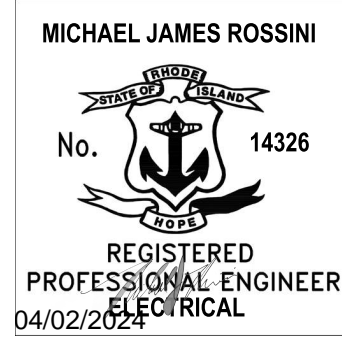
Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO:	P0740-047	
DATE:	APRIL 2024	
FILE:	P0740-047-E-602.dwg	
DRAWN BY:	RAK, HDA	
DESIGNED/CHECKED BY:	MB, MR	
APPROVED BY:	BRL	

ELECTRICAL SCHEDULES - 1

SCALE: NO SCALE



		VOLTAGE (L-L): 480 PHASE: 3 WIRE: 4				VA, L1		49,925		PANEL NO. EXISTING PANEL DP4					
		VOLTAGE (L-N): 277				VA, L2		49,925		LOCATION: MAIN ELECTRIC ROOM					
		MAIN BUS: 400 AMPS				VA, L3		49,925		NOTES:					
		MAIN BREAKER: 400 A FRAME 300 A TRIP				TOTAL VA		149,775							
		MOUNTING: SURFACE KAIC: 35				INCOMING FEEDER SIZE:		4-600 KCMIL, 1#3G, 4°C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			CKT.	AMPS	AMPS	CKT.	VA LOAD			DIRECTORY	CONDUIT SIZE	WIRE SIZE
			L1	L2	L3					L1	L2	L3			
-	-	SPARE				1	225	200	2			SPARE	-	-	
-	-					3			4				-	-	
-	-					5			6				-	-	
-	-	SPARE				7	200	15	8			SPARE	-	-	
-	-					9			10				-	-	
-	-					11			12				-	-	
3/10 & 1/60	1 1/2"	DEHUMIDIFIER DH-11	19,400			13	150	15	14	1,662		DEHUMIDIFIER DH-9	3/4"	3/12 & 1/12G	
-	-					15			16	1,662			-	-	
-	-					17			18	1,662			-	-	
3/10 & 1/60	1 1/2"	DOAS-1	20,719			19	150	30	20	4,072		DEHUMIDIFIER DH-5	3/4"	3/10 & 1/10G	
-	-					21			22	4,072			-	-	
-	-					23			24	4,072			-	-	
-	-	SPARE				25	60	100	26			SPARE	-	-	
-	-					27			28				-	-	
-	-					29			30				-	-	
-	-	SPARE				31	20	20	32			SPARE	-	-	
-	-					33			34				-	-	
-	-					35			36				-	-	
-	-	SPACE & HARDWARE				37	20	30	38	4,072		DEHUMIDIFIER DH-6	3/4"	3/10 & 1/10G	
-	-	SPACE & HARDWARE				39	20		40	4,072			-	-	
-	-	SPACE & HARDWARE				41	20		42	4,072			-	-	

		VOLTAGE (L-L): 480 PHASE: 3 WIRE: 4				VA, L1		41,527		PANEL NO. EXISTING PANEL DPF1					
		VOLTAGE (L-N): 277				VA, L2		41,527		LOCATION: PUMP ROOM					
		MAIN BUS: 250 AMPS				VA, L3		41,527		NOTES:					
		MAIN BREAKER: 200 A FRAME A TRIP				TOTAL VA		124,581							
		MOUNTING: SURFACE KAIC: 35				INCOMING FEEDER SIZE:		4-250 KCMIL, 1#4G, 3°C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			CKT.	AMPS	AMPS	CKT.	VA LOAD			DIRECTORY	CONDUIT SIZE	WIRE SIZE
			L1	L2	L3					L1	L2	L3			
3/12 & 1/12G	3/4"	BACKWASH AIR SUPPLY VALVE BFV-0108A, 0108B, 0308A, 0308B, 0508A, 0508B 0708A, 0708B, 0908A	2,987	2,987		1	20	20	2	2,987		BACKWASH AIR SUPPLY VALVE BFV-0208A, 0208B, 0408A, 0408B, 0608A, 0608B, 0808A, 0808B, 1008A	3/4"	3/12 & 1/12G	
-	-					3			4	2,987			-	-	
-	-					5			6	2,987			-	-	
3/12 & 1/12G	3/4"	BACKWASH AIR SUPPLY VALVE BFV-0908B, 1108A, 1108B, 1308A, 1308B, 1508A, 1508B, 1708A, 1708B	2,987	2,987		7	20	20	8	2,987		BACKWASH AIR SUPPLY VALVE BFV-1008B, 1208A, 1208B, 1408A, 1408B, 1608A, 1608B, 1808A, 1808B	3/4"	3/12 & 1/12G	
-	-					9			10	2,987			-	-	
-	-					11			12	2,987			-	-	
3/12 & 1/12G	3/4"	WASHWATER DRAIN/FILTER INLET VALVE BFV-0100, 0101, 0300, 0301	3,287			13	20	20	14	3,287		WASHWATER DRAIN/FILTER INLET VALVE BFV-0200, 0201, 0400, 0401	3/4"	3/12 & 1/12G	
-	-					15			16	3,287			-	-	
-	-					17			18	3,287			-	-	
3/12 & 1/12G	3/4"	WASHWATER DRAIN/FILTER INLET VALVE BFV-0500, 0501, 0700, 0701	3,287			19	20	20	20	3,287		WASHWATER DRAIN/FILTER INLET VALVE BFV-0600, 0601, 0800, 0801	3/4"	3/12 & 1/12G	
-	-					21			22	3,287			-	-	
-	-					23			24	3,287			-	-	
3/12 & 1/12G	3/4"	WASHWATER DRAIN/FILTER INLET VALVE BFV-0900, 0901, 1100, 1101	3,287			25	20	20	26	3,287		WASHWATER DRAIN/FILTER INLET VALVE BFV-1000, 1001, 1200, 1201	3/4"	3/12 & 1/12G	
-	-					27			28	3,287			-	-	
-	-					29			30	3,287			-	-	
3/12 & 1/12G	3/4"	WASHWATER DRAIN/FILTER INLET VALVE BFV-1300, 1301, 1500, 1501	3,287			31	20	20	32	3,287		WASHWATER DRAIN/FILTER INLET VALVE BFV-1400, 1401, 1600, 1601	3/4"	3/12 & 1/12G	
-	-					33			34	3,287			-	-	
-	-					35			36	3,287			-	-	
3/12 & 1/12G	3/4"	WASHWATER DRAIN/FILTER INLET VALVE BFV-1700, 1701	1,643			37	20	20	38	1,643		WASHWATER DRAIN/FILTER INLET VALVE BFV-1800, 1801	3/4"	3/12 & 1/12G	
-	-					39			40	1,643			-	-	
-	-					41			42	1,643			-	-	

		VOLTAGE (L-L): 480 PHASE: 3 WIRE: 4				VA, L1		46,609		PANEL NO. EXISTING PANEL DPF2					
		VOLTAGE (L-N): 277				VA, L2		52,620		LOCATION: PUMP ROOM					
		MAIN BUS: 250 AMPS				VA, L3		55,219		NOTES:					
		MAIN BREAKER: MLO A FRAME A TRIP				TOTAL VA		154,448							
		MOUNTING: SURFACE KAIC: 35				INCOMING FEEDER SIZE:		4-250 KCMIL, 1#4G, 3°C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			CKT.	AMPS	AMPS	CKT.	VA LOAD			DIRECTORY	CONDUIT SIZE	WIRE SIZE
			L1	L2	L3					L1	L2	L3			
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS LIGHTING	2,260			1	20	20	2	2,260		UPPER LEVEL FILTERS LIGHTING	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS SPOT LIGHTING		1,200		3	20	20	4	1,200		UPPER LEVEL FILTERS SPOT LIGHTING	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS SPOT LIGHTING			1,200	5	20	20	6	2,030		UPPER LEVEL FILTERS LIGHTING	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS LIGHTING	2,030			7	20	20	8	1,200		UPPER LEVEL FILTERS SPOT LIGHTING	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS SPOT LIGHTING		1,200		9	20	20	10	1,200		UPPER LEVEL FILTERS SPOT LIGHTING	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS LIGHTING			2,390	11	20	20	12	44		EXIT LIGHTS	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	STAIR NO.3 EXTERIOR LIGHTING	20			13	20	20	14	900		UPPER LEVEL FILTERS LIGHTS-HALLWAY	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS LIGHTING		9,357		15	20	20	16	525		UPPER LEVEL FILTERS EXTERIOR LIGHTS	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	UPPER LEVEL FILTERS LIGHTING			9,357	17	20	20	18	2,260		UPPER LEVEL FILTERS LIGHTING	3/4"	2#12 & 1#12G	
3#12 & 1#12G	3/4"	SAMPLE PUMPS	3,550			19	20	20	20	1,883		PRE-3 & PRE-4	3/4"	3#12 & 1#12G	
-	-					21			22	1,883			-	-	
-	-					23			24	1,883			-	-	
3#12 & 1#12G	3/4"	SPARE				25	20	20	26	1,883		PRE-5 & PRE-6	3/4"	3#12 & 1#12G	
-	-					27			28	1,883			-	-	
-	-					29			30	1,883			-	-	
3#6 & 1#10G	1"	DEHUMIDIFIER DH-1	7,811			31	60	50	32			SPARE	-	-	
-	-					33			34				-	-	
-	-					35			36				-	-	
3#6 & 1#10G	1"	DEHUMIDIFIER DH-2	7,811		7,811	37	60	50	38	15,000		45 KVA TRANSFORMER	1"	3#6 & 1#10G	
-	-					39			40	15,000			-	-	
-	-					41			42	15,000			-	-	

		VOLTAGE (L-L): 208 PHASE: 3 WIRE: 4				VA, L1		9,802		PANEL NO. EXISTING PANEL PPF1					
		VOLTAGE (L-N): 120				VA, L2		10,400		LOCATION: PUMP ROOM					
		MAIN BUS: 100 AMPS				VA, L3		9,982		NOTES:					
		MAIN BREAKER: 100 A FRAME 100 A TRIP				TOTAL VA		30,184							
		MOUNTING: SURFACE KAIC: 22				INCOMING FEEDER SIZE:		4-#2 AWG, #8G, 1 1/2°C							
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			CKT.	AMPS	AMPS	CKT.	VA LOAD			DIRECTORY	CONDUIT SIZE	WIRE SIZE
			L1	L2	L3					L1	L2	L3			
2#12 & 1#12G	3/4"	RECEPTACLES UPPER FILTERS SOUTH	900			1	20	20	2	900		RECEPTACLES UPPER FILTERS SOUTH	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	RECEPTACLES UPPER FILTERS NORTH		900		3	20	20	4	720		RECEPTACLES UPPER FILTERS NORTH	3/4"	2#12 & 1#12G	
-	-	RECEPTACLES UPPER FILTERS SOUTH			720	5	20	20	6	900		RECEPTACLES UPPER FILTERS SOUTH	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	RECEPTACLES UPPER FILTERS NORTH	720			7	20	20	8	720		RECEPTACLES UPPER FILTERS NORTH	3/4"	2#12 & 1#12G	
-	-	SPARE				9	20	20	10	1,060		PRE-1 & PRE-2 UNITS	3/4"	2#12 & 1#12G	
2#12 & 1#12G	3/4"	LIT-0205 THRU 1806			650	11	20	25	12	1,660		UH-5; CENTRAL FILTER GALLERY	3/4"	2#10 & 1#10G	
2#12 & 1#12G	3/4"	LIT-0105 THRU 1706	650			13	20	25	14	1,660		UH-6; CENTRAL FILTER GALLERY	3/4"	2#10 & 1#10G	
2#10 & 1#10G	3/4"	UH-1; CENTRAL FILTER GALLERY		1,660		15	25	25	16	1,660		UH-7; CENTRAL FILTER GALLERY	3/4"	2#10 & 1#10G	
2#10 & 1#10G	3/4"	UH-2; CENTRAL FILTER GALLERY			1,660	17	25	25	18	1,660		UH-8; CENTRAL FILTER GALLERY	3/4"	2#10 & 1#10G	
2#10 & 1#10G	3/4"	UH-3; CENTRAL FILTER													



		VOLTAGE (L-L):		480	PHASE:	3	WIRE:	4	VA, L1	35,220	PANEL NO.		EXISTING PANEL P9-1		
		VOLTAGE (L-N):		277					VA, L2	35,220	LOCATION:		BOILER ROOM		
		MAIN BUS:		225	AMPS				VA, L3	35,220	NOTES:				
		MAIN BREAKER:		MLO	A FRAME		A TRIP								
		MOUNTING:		SURFACE		KAIC: 22		TOTAL VA		105,660					
		INCOMING FEEDER SIZE:		4#4/0 AWG, 1#4G, 2 1/2" C											
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			CKT.	AMPS	AMPS	CKT.	VA LOAD			DIRECTORY	CONDUIT SIZE	WIRE SIZE
			L1	L2	L3					L1	L2	L3			
3/10 & 1#10G	3/4"	EXHAUST FAN	5,320			1	30	20	2	3,550			P-PW-1	3/4"	3#12 & 1#12G
-	-			5,320		3			4	3,550	3,550			-	-
-	-				5,320	5			6		3,550			-	-
3/12 & 1#12G	3/4"	PUMP P-1S (OFF)				7	20	20	8	3,550			ELEVATOR	3/4"	3#12 & 1#12G
-	-					9			10		3,550			-	-
-	-					11			12		3,550			-	-
3/4 & 1#10G	1"	PUMP P-1 (OFF)				13	60	30	14	<b>4,072</b>			DEHUMIDIFIER DH-7	3/4"	3#10 & 1#10G
-	-					15			16		<b>4,072</b>			-	-
-	-					17			18		<b>4,072</b>			-	-
3/4 & 1#10G	1"	PUMP P-2 (OFF)				19	60	20	20				SPARE	-	-
-	-					21		20	22				SPARE	-	-
-	-					23		20	24				SPARE	-	-
3/4 & 1#10G	1"	PUMP P-3 (OFF)				25	60	20	26				SPARE	-	-
-	-					27		20	28				SPARE	-	-
-	-					29		20	30				SPARE	-	-
-	-	INFLUENT LIGHTING	1,000			31	20	30	32	-			SPARE	-	-
-	-	AERATOR LIGHTING		1,000		33	20		34	-				-	-
-	-	LIGHTING			1,000	35	20		36	-				-	-
-	-	PANEL ?	17,728			37	100	20	38	-			SPARE	-	-
-	-			17,728		39			40	-				-	-
-	-				17,728	41			42	-				-	-

		VOLTAGE (L-L):		480	PHASE:	3	WIRE:	4	VA, L1	39,480	PANEL NO.		EXISTING PANEL P9-1-1		
		VOLTAGE (L-N):		277					VA, L2	39,480	LOCATION:		INFLUENT BUILDING		
		MAIN BUS:		225	AMPS				VA, L3	39,480	NOTES:				
		MAIN BREAKER:		MLO	A FRAME		A TRIP								
		MOUNTING:		SURFACE		KAIC: 22		TOTAL VA		118,440					
		INCOMING FEEDER SIZE:		4#4/0 AWG, 1#4G, 2 1/2" C											
WIRE SIZE	CONDUIT SIZE	DIRECTORY	VA LOAD			CKT.	AMPS	AMPS	CKT.	VA LOAD			DIRECTORY	CONDUIT SIZE	WIRE SIZE
			L1	L2	L3					L1	L2	L3			
3/12 & 1#12G	3/4"	RWBV-1,2	3,550			1	20	20	2	3,550	3,550		RWBV-3,4	3/4"	3#12 & 1#12G
-	-			3,550		3			4	3,550	3,550			-	-
-	-				3,550	5			6		3,550			-	-
3/12 & 1#12G	3/4"	SG-1,2	3,550			7	20	20	8	3,550			SG-3	3/4"	3#12 & 1#12G
-	-					9			10		3,550			-	-
-	-					11			12		3,550			-	-
3/12 & 1#12G	3/4"	SG-4	3,550			13	20	20	14	3,550			SG-5	3/4"	3#12 & 1#12G
-	-					15			16		3,550			-	-
-	-					17			18		3,550			-	-
3/12 & 1#12G	3/4"	BPGV-1,2	3,550			19	20	20	20	3,550			BPGV-3,4	3/4"	3#12 & 1#12G
-	-			3,550		21			22		3,550			-	-
-	-				3,550	23			24		3,550			-	-
3/12 & 1#12G	3/4"	SPARE				25	20	<b>80</b>	26	<b>11,080</b>			DEHUMIDIFIER DH-10	1"	3#3 & 1#8G
-	-					27			28		<b>11,080</b>			-	-
-	-					29			30		<b>11,080</b>			-	-
-	-	SPARE	-			31	20	20	32	-			SPARE	-	-
-	-					33			34	-				-	-
-	-					35			36	-				-	-
-	-	SPARE	-			37	20	20	38	-			SPARE	-	-
-	-					39			40	-				-	-
-	-					41			42	-				-	-

**NOTES:**

- PANELBOARD HOMERUNS SHALL BE PERMITTED TO BE CONSOLIDATED. CONTRACTOR SHALL SIZE CONDUIT AND DERATE CONDUCTOR AMPACITIES IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE.
- CONDUITS AND CONDUCTORS BETWEEN DISCONNECTING MEANS, MANUAL MOTOR STARTING SWITCHES OR CONTROL DEVICES AND LOADS SERVED SHALL BE THE SAME QUANTITIES AND SIZES AS THE HOMERUN WIRING UNLESS OTHERWISE SCHEDULED/NOTED OR REQUIRED.
- BOLD TEXT INDICATES NEW SCOPE WORK.



**Dehumidification System Design**

Providence Water Supply Board

Philip J. Holton Water Purification Plant  
Scituate, Rhode Island

0	04/02/2024	CONSTRUCTION DOCUMENTS
MARK	DATE	DESCRIPTION
PROJECT NO: P0740-047		
DATE: APRIL 2024		
FILE: P0740-047-E-604.dwg		
DRAWN BY: RAK, HDA		
DESIGNED/CHECKED BY: MB, MR		
APPROVED BY: BRL		

ELECTRICAL SCHEDULES - 3

SCALE: NO SCALE

E-604