

RFB NO. 321045



# CONSTRUCTION DOCUMENTS PROJECT MANUAL

DANE COUNTY PUBLIC WORKS,  
ENGINEERING DIVISION

**PUBLIC WORKS ENGINEERING DIVISION**  
1919 ALLIANT ENERGY CENTER WAY  
MADISON, WISCONSIN 53713

**REQUEST FOR BIDS NO. 321045**  
**FACILITIES EMERGENCY POWER**  
**DANE COUNTY COURTHOUSE & CITY-COUNTY BUILDING**  
**215 SOUTH HAMILTON ST. &**  
**210 MARTIN LUTHER KING JR. BLVD.**  
**MADISON, WISCONSIN**

**ISSUED FOR BIDS: JANUARY 18, 2022**

Due Date / Time: **TUESDAY, January, 18, 2022 / 2:00 P.M.**

Location: **PUBLIC WORKS OFFICE**

Performance / Payment Bond: **100% OF CONTRACT AMOUNT**

Bid Deposit: **5% OF BID AMOUNT**

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FOR INFORMATION ON THIS REQUEST FOR BIDS, PLEASE CONTACT:

TODD DRAPER, PROJECT MANAGER  
TELEPHONE NO.: 608/267-0119  
FAX NO.: 608/267-1533  
E-MAIL: DRAPER@COUNTYOFDANE.COM

SECTION 00 01 07

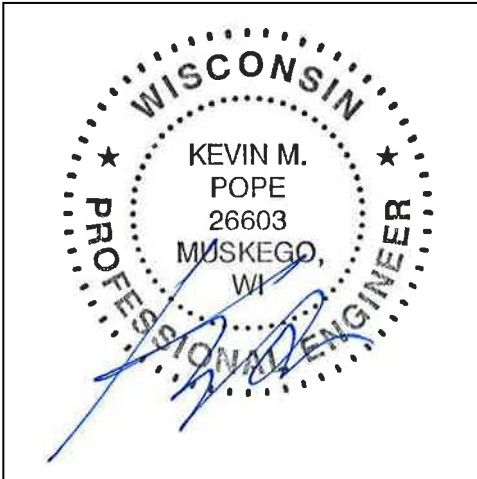
SEALS PAGE

**BID NO. 321045**

**PROJECT: FACILITIES EMERGENCY POWER  
DANE COUNTY COURTHOUSE & CITY-COUNTY BUILDING**

**MECHANICAL ENGINEER**

I hereby certify that this drawing, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Wisconsin.



KEVIN M. POPE - 26603

Dated: January 18, 2022

**ELECTRICAL ENGINEER**

I hereby certify that this drawing, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Wisconsin.



KEVIN M. STANDLEE - E-42707

Dated: January 18, 2022

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**DRAWINGS**

Plot drawings on 30” x 42” (ARCH E1) paper for correct scale or size.

- G000 – COVER SHEET, INDEX AND AREA PLANS
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- M001 – MECHANICAL GENERAL NOTES AND SYMBOLS
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- M201 – LEVEL 01 – HVAC PLAN
- M700 – MECHANICAL DETAILS AND SECTIONS
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- E100 – DEMOLITION PLAN
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END OF SECTION

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INVITATION TO BID

**LEGAL NOTICE**

Dane County Dept. of Administration, Public Works Engineering Division, 1919 Alliant Energy Center Way, Madison, WI 53713, will receive sealed Bids until:

**2:00 P.M., TUESDAY, FEBRUARY 22, 2022**

**RFB NO. 321045**

**FACILITIES EMERGENCY POWER**

**COURTHOUSE & CITY-COUNTY BLDG**

**MADISON, WI**

Dane County is inviting Bids for construction services to provide an emergency power system that will provide backup generator power for two buildings. Additional loads to be added and modifications to existing generator plant to increase capacity and simplify operations with a more efficient and redundant system. Only firms with capabilities, experience & expertise with similar projects should obtain this Request for Bids (RFB) document & submit Bids.

RFB document may be obtained after **2:00 p.m., January 18, 2022** from [bids-pwht.countyofdane.com](https://bids-pwht.countyofdane.com). Call Todd Draper, Project Mgr., 608/267-0119, or our office, 608/266-4018, with any questions.

Bidders must be qualified as Best Value Contractor before Bid Due Date / Time. Complete Application at [publicworks.countyofdane.com/bvc](https://publicworks.countyofdane.com/bvc) or call 608/267-0119.

Pre-bid facility & site tour will be February 1, 2022 at 9:00 a.m. starting at the City-County Bldg Room B-8, 210 Martin Luther King Jr. Blvd., Madison. Bidders are required to attend this mandatory tour in order to bid. Subcontractors are strongly encouraged to attend. See RFB for mandatory disease transmission prevention practices.

**PUBLISH:    JANUARY 18 & JANUARY 25, 2022 - WISCONSIN STATE JOURNAL  
                  JANUARY 19 & JANUARY 26, 2022 - THE DAILY REPORTER**

END OF SECTION

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INSTRUCTIONS TO BIDDERS

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**1. GENERAL**

- A. Before submitting Bid, bidder shall thoroughly examine all Construction Documents. Successful Bidder shall be required to provide all the Work that is shown on Drawings, set forth in Specifications, or reasonably implied as necessary to complete Contract for this project.
- B. Bidder shall visit site to become acquainted with adjacent areas, means of approach to site, conditions of actual site and facilities for delivering, storing, placing, and handling of materials and equipment.
- C. Pre-bid meeting is scheduled on February 1, 2022 at 9:00 a.m. at City County Building, 210 Martin Luther King Jr Blvd, in Room B-8. Bidders are required to attend this mandatory tour in order to bid. Subcontractors are strongly encouraged to attend.
- D. Safe distancing & face masks are required for all tour attendees. Tours will be limited to 10 people; please limit number of attending staff & subcontractors. If there are more than 10 people, group will be split & there will be two or more tours. Allow sufficient time if you do not make it in to first tour group. Do not visit the site if you are or have recently been ill.
- E. Failure to visit site or failure to examine any and all Construction Documents will in no way relieve successful Bidder from necessity of furnishing any necessary materials or equipment, or performing any work, that may be required to complete the Work in

accordance with Drawings and Specifications. Neglect of above requirements will not be accepted as reason for delay in the Work or additional compensation.

## **2. DRAWINGS AND SPECIFICATIONS**

- A. Drawings and Specifications that form part of this Contract, as stated in Article 1 of General Conditions of Contract, are enumerated in Document Index of these Construction Documents.
- B. Complete sets of Drawings and Specifications for all trades will be available to all Bidders, irrespective of category of work to be bid on, in order that all Bidders may be familiar with work of other trades as they affect their bid.

## **3. INTERPRETATION**

- A. No verbal explanation or instructions will be given in regard to meaning of Drawings or Specifications before Bid Due Date. Bidders shall bring inadequacies, omissions or conflicts to Owner or Architect / Engineer's attention at least ten (10) calendar days before Bid Due Date. Prompt clarification will be available to all bidders by Addendum.
- B. Failure to so request clarification or interpretation of Drawings and Specifications will not relieve successful Bidder of responsibility. Signing of Contract will be considered as implicitly denoting that Contractor has thorough understanding of scope of the Work and comprehension of Construction Documents.
- C. Owner and Engineer will not be responsible for verbal instructions.

## **4. QUALIFICATIONS OF BIDDER (CONTRACTOR AND SUBCONTRACTOR)**

- A. Before award of Contract can be approved, Owner shall be satisfied that Bidder involved meets following requirements:
  - 1. Has completed at least one (1) project of at least fifty percent (50%) of size or value of Division of work being bid and type of work completed is similar to that being bid. If greater magnitude of experience is deemed necessary, other than size or value of work, such requirements will be described in appropriate section of Specifications.
  - 2. Maintains permanent place of business.
  - 3. Can be bonded for terms of proposed Contract.
  - 4. Contractor and subcontractors shall meet all applicable Best Value Contractor requirements.
- B. County's Public Works Project Manager will make such investigations as are deemed necessary to determine ability of bidder to perform the Work, and bidder shall furnish to County's Public Works Project Manager or designee all such information and data for this purpose as County's Public Works Project Manager may request. Owner reserves right to reject Bid if evidence submitted by, or investigation of, bidder fails to satisfy Owner that bidder is responsible and qualified to carry out obligations of Contract and to complete the Work contemplated therein.



## **5. BID GUARANTEE**

- A. Bank certified check, cashier's check or Bid Bond, payable to County in amount not less than five percent (5%) of maximum bid, shall accompany each Bid as guarantee that if Bid is accepted, Bidder will execute and return proposed Contract and Performance and Payment Bonds within ten (10) business days after being notified of acceptance of Bid. Company issuing bonds must be licensed to do business in Wisconsin.
- B. Any bid, which is not accompanied by bid guarantee, will be considered "No Bid" and will not be read at Bid Due Date.
- C. If successful Bidder so delivers Contract, Certificate of Insurance, and Performance and Payment Bonds, check will be returned to Bidder. In case Bidder fails to deliver such Contract, insurance, and bond, amount of bid guarantee will be forfeited to County as liquidated damages.
- D. All checks tendered as bid guarantee, except those of three (3) lowest qualified, responsible bidders, will be returned to their makers within three (3) business days after Bid Due Date. All such retained checks will be returned immediately upon signing of Contract and Performance and Payment Bonds by successful Bidder.

## **6. WITHDRAWAL OF BIDS**

- A. Bids may be withdrawn by written request received from bidder or authorized representative thereof prior to time fixed for Bid Due Date, without prejudice to right of bidder to file new Bid. Withdrawn Bids will be returned unopened. Negligence on part of bidder in preparing their Bid confers no right for withdrawal of Bid after it has been opened.
- B. No Bid may be withdrawn for period of sixty (60) calendar days after Bid Due Date.
- C. If Bid contains error, omission or mistake, bidder may limit liability to amount of bidder's guarantee by giving written Notice of Intent not to execute Contract to Owner within seventy-two (72) hours of Bid Due Date.

## **7. CONTRACT FORM**

- A. Sample copy of contract that successful Bidder will be required to enter into is included in these Construction Documents and bidders are required to familiarize themselves with all conditions contained therein.

## **8. CONTRACT INTERESTS BY COUNTY PUBLIC OFFICIALS**

- A. In accordance with Wisconsin Statute 946.13, county official may not bid for or enter into any contract involving receipts or disbursements of more than \$15,000.00 in a year, in which they have private pecuniary interest, direct or indirect if at same time they are authorized to take official action with respect to making of this Contract. Any contract entered into in violation of this Statute is void and County incurs no liability thereon. This subsection does not affect application and enforcement of Wisconsin Statute 946.13 by state prosecutors in criminal courts of this state.

## **9. EMERGING SMALL BUSINESS PROVISIONS**

A. **Emerging Small Business Definition.** For purposes of this section, ESB is defined as:

1. Independent business concern that has been in business minimum of one year;
2. Business located in State of Wisconsin;
3. Business comprised of less than twenty-five (25) employees;
4. Business must not have gross sales in excess of three million dollars (\$3,000,000.00) over past three years; and
5. Business does not have history of failing to complete projects.

B. **Emerging Small Business (ESB) Involvement.** Bidder shall make good faith effort to award minimum of ten percent (10%) of the Work to ESBs. Bidder shall submit report to Dane County Contract Compliance Specialist within ten (10) business days of Bid Due Date demonstrating such efforts. Good faith efforts means significant contact with ESBs for purposes of soliciting bids from them. Failure to make or demonstrate good faith efforts will be grounds for disqualification.

C. **Emerging Small Business Report.** Emerging Small Business Enterprise Report is to be submitted by Bidder in separate envelope marked "Emerging Small Business Report". This report is due by 2:00 p.m. following specified ten (10) business days after Bid Due Date. Bidder who fails to submit Emerging Small Business Report shall be deemed not responsive.

D. **ESB Goal.** Goal of this project is ten percent (10%) ESB participation. ESB utilizations are shown as percentage of total Bid. If Bidder meets or exceeds specified goal, Bidder is only required to submit Form A - Certification, and Form B - Involvement. Goal shall be met if Bidder qualifies as ESB.

E. **Report Contents.** Following award of Contract, Bidder shall submit copies of executed contracts for all Emerging Small Businesses. Emerging Small Business Report shall consist of these:

1. Form A - Certification;
2. Form B - Involvement;
3. Form C - Contacts;
4. Form D - Certification Statement (if appropriate); and
5. Supportive documentation (i.e., copies of correspondence, telephone logs, copies of advertisements).

F. **ESB Listing.** Bidders may solicit bids from *Dane County Targeted Business Directory* by going to this website. Do not click as a link; copy & paste address into a web browser.

<https://equity.countyofdane.com/documents/PDFs/Targeted-Business-Directory.xlsx>

G. **DBE Listing.** Bidders may also solicit bids from *State of Wisconsin DOT Disadvantaged Business Enterprise Unified Certification Program (DBE / UCP)*

*Directory* by going to this website. These are not only transportation-related designers & contractors. Do not click as a link; copy & paste address into a web browser.  
<https://wisconsin.gov/Documents/doing-bus/civil-rights/dbe/dbe-ucp-directory.xlsx>

- H. **ESB Certification.** All contractors, subcontractors and suppliers seeking ESB certification must complete and submit Emerging Small Business Report to Dane County Contract Compliance Program.
- I. **Certification Statement.** If ESB firm has not been certified by County as ESB prior to submittal of this Bid, ESB Report cannot be used to fulfill ESB goal for this project unless firm provides “Form D - Certification Statement”. Certification statement must be completed and signed by ESB firm.
- J. **Questions.** Questions concerning Emerging Small Business provisions shall be directed to:  
  
[OEI@countyofdane.com](mailto:OEI@countyofdane.com)  
or  
Dane County Contract Compliance Specialist  
City-County Building, Room 356  
210 Martin Luther King, Jr. Blvd.  
Madison, WI 53703  
608/266-4192
- K. **Substituting ESBs.** In event of any significant changes in subcontract arrangements or if need arises to substitute ESBs, Bidder shall report such proposed changes to Contract Compliance Specialist to making any official changes and request authorization to substitute ESB firm. Bidder further agrees to make every possible effort to replace ESB firm with another qualified ESB firm.
- L. **Good Faith Efforts.** Good faith efforts can be demonstrated by meeting all of these obligations:
1. Selecting portions of the Work to be performed by ESBs in order to increase likelihood of meeting ESB goal including, where appropriate, breaking down Contract into smaller units to facilitate ESB participation.
  2. Advertising in general circulation, trade associations and women / minority focus media concerning subcontracting opportunities.
  3. Providing written notices to reasonable number of specific ESBs that their interest in Contract was being solicited in sufficient time to allow ESBs to participate effectively.
  4. Following up on initial solicitations of interest by contacting ESBs within five (5) business days prior to Bid Due Date to determine with certainty whether ESB were interested, to allow ESBs to prepare bids.
  5. Providing interested ESB with adequate information about Drawings, Specifications and requirements of Contract.
  6. Using services of available minority, women and small business organizations and other organizations that provide assistance in recruitment of MBEs / WBEs / ESBs.
  7. Negotiating in good faith with interested ESBs, not rejecting ESBs as unqualified without sound reason based on thorough investigation of their capabilities.

8. Submitting required project reports and accompanying documents to County's Contract Compliance Specialist within twenty-four (24) hours after Bid Due Date.
- M. **Appeals Disqualification of Bid.** Bidder who is disqualified may appeal to Public Works & Transportation Committee and Equal Opportunity Commission.

## **10. METHOD OF AWARD - RESERVATIONS**

- A. Following will be basis of award of Contract, providing cost does not exceed amount of funds then estimated by County as available to finance Contract(s):
1. Lowest dollar amount submitted by qualified responsible bidder on Base Bid for all work comprising project, combined with such additive Owner accepted alternates.
  2. Owner reserves right to reject all bids or any bid, to waive any informality in any bid, and to accept any bid that will best serve interests of County.
  3. Unit Prices and Informational Bids will not be considered in establishing low bidder.

## **11. SECURITY FOR PERFORMANCE AND PAYMENTS**

- A. Simultaneous with delivery of signed Contract, Bidder shall be required to furnish Performance and Payment Bonds as specified in Article 29 of General Conditions of Contract, "Contract Security". Surety Company shall be licensed to do business in Wisconsin. Performance and Payment Bonds must be dated same date or subsequent to date of Contract. Performance and Payment Bonds must emulate information in Sample Performance and Payment Bonds in Construction Documents.
- B. Provide certified copy of power of attorney from Surety Company showing that agent who signs Bond has power of attorney to sign for Surety Company. Secretary or Assistant Secretary of company must sign this certification, not attorney-in-fact. Certification must bear same or later date as Bond. Power of Attorney must emulate model power of attorney information detailed in Sample Performance and Payment Bonds.
- C. If Bidder is partnership or joint venture, State certified list, providing names of individuals constituting partnership or joint venture must be furnished. Contract itself may be signed by one partner of partnership, or one partner of each firm comprising joint venture, but Performance and Payment Bonds must be signed by all partners.
- D. If Bidder is corporation, it is necessary that current certified copy of resolution or other official act of directors of corporation be submitted showing that person who signs Contract is authorized to sign contracts for corporation. It is also necessary that corporate seal be affixed to resolution, contract, and performance and payment bonds. If your corporation has no seal, it is required that above documents include statement or notation to effect that corporation has no seal.

## **12. TAXES**

- A. Wisconsin Statute 77.54 (9m) allows building materials that become part of local unit government facilities to be exempt from sales & use tax. Vendors & materials suppliers may not charge Bidders sales & use tax on these purchases. This does not

include highways, streets or roads. Any other Sales, Consumer, Use & other similar taxes or fees required by law shall be included in Bid.

- B. In accordance with Wisconsin Statute 71.80(16)(a), successful nonresident bidder, whether incorporated or not, and not otherwise regularly engaged in business in this state, shall file surety bond with State of Wisconsin Department of Revenue payable to Department of Revenue, to guarantee payment of income taxes, required unemployment compensation contributions, sales and use taxes and income taxes withheld from wages of employees, together with any penalties and interest thereon. Amount of bond shall be three percent (3%) of Contract or subcontract price on all contracts of \$50,000 or more.

### **13. SUBMISSION OF BIDS**

- A. All Bids shall be submitted on standard Bid Form bound herein and only Bids that are made on this Bid Form will be considered. Entire Bid Form and other supporting documents, if any, shall be removed or copied from Construction Documents, filled out, and submitted in manner specified hereinafter. Submit completed Bid Bond with Bid as well.
- B. No bids for any subdivision or any sub-classification of the Work, except as indicated, will be accepted. Any conditional Bid, amendment to Bid Form or appended item thereto, or inclusion of any correspondence, written or printed matter, or details of any nature other than that specifically called for, which would alter any essential provision of Construction Documents, or require consideration of unsolicited material or data in determining award of Contract, will disqualify Bid. Telecommunication alterations to Bid will not be accepted.
- C. Bidders must submit single Bid for all the Work.
- D. Bid amounts shall be inserted in words and in figures in spaces provided on Bid Form; in case of conflict, written word amounts will govern.
- E. Addenda issued after Bid Letting shall become part of Construction Documents. Bidders shall acknowledge receipt of such addenda in appropriate space provided on Bid Form. Bid may be rejected if receipt of any particular addendum applicable to award of Contract has not been acknowledged on Bid Form.
- F. Bids shall be signed, placed in envelope, sealed and delivered before due time to place designated in Invitation to Bid, and identified with project name, bid number, location, category of work being bid upon, Bid Due Date, name and address of bidder.
- G. Bidder shall be responsible for sealed Bid being delivered to place designated for Bid Due Date on or before date and time specified. Bids received after time of closing will be rejected and returned to bidder unopened.
- H. Current conditions prevent public bid openings.
- I. Bids hand delivered & dropped off at Public Works' physical address should be placed in the "Public Works Bids & Proposals" drop box placed outside or just inside the building's front vestibule.
- J. Bid will be opened on listed due date & time & results should be available within 24 hours at [bids-pwht.countyofdane.com](https://bids-pwht.countyofdane.com).

- K. Bid will be considered invalid and will be rejected if bidder has not signed it.
- L. Faxed or emailed Bids will not be accepted.
- M. Bidder's organization shall submit completed with Bid, Fair Labor Practices Certification form, included in these Construction Documents.

#### **14. SUBCONTRACTOR LISTING**

- A. Bidders are required to submit Section 00 43 36, Proposed Subcontractors Form listing all subcontractors for this project including committed prices for each subcontractor. Project Manager must receive Form no later than when successful Bidder submits their signed Contract. Failure to submit may delay progress payments.

#### **15. ALTERNATE BIDS**

- A. Bidder shall carefully read requests for Alternate Bids, and thoroughly examine Drawings and Specifications to determine extent various changes and conditions will affect Bid.
- B. Space is provided in Bid Form for requested Alternate Bids. Failure to submit bid for any requested Alternate Bids may result in rejection of entire Bid.
- C. Bidder shall state amount to be added / subtracted to Base Bid for providing alternates, including all incidentals, omissions, additions, and adjustments as may be necessary or required by such changes. If there is no difference in price, Bidder shall state, "No Change".
- D. Descriptions of requested Alternate Bids are as set forth in Construction Documents.

#### **16. INFORMATIONAL BIDS**

- A. Not Applicable

#### **17. UNIT PRICES**

- A. Not Applicable

#### **18. COMMENCEMENT AND COMPLETION**

- A. Successful Bidder shall commence work when schedule and weather permit, but no later than stated in Bid Form. Contractor shall pursue the Work regularly and continuously at reasonable rate to insure completion of the Work within time stated in Bid.
- B. Should it be found impossible to complete the Work on or before time specified for completion, written request may be submitted for extension of time setting forth reasons believed to justify granting of such request. Refer to Article 20 of General Conditions of Contract, titled "Time for Completion".

#### **19. WORK BY OWNER**

- A. Not Applicable.

**20. SPECIAL HAZARDS COVERAGE**

A. Not Applicable.

**FORM A**

**DANE COUNTY  
EMERGING SMALL BUSINESS REPORT - CERTIFICATION**

In accordance with General Conditions of Contract, submit this Emerging Small Business Report within ten (10) days after Bid Due Date.

PROJECT NAME: \_\_\_\_\_

\_\_\_\_\_

BID NO.: \_\_\_\_\_ BID DUE DATE: \_\_\_\_\_

**BIDDER INFORMATION**

COMPANY NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

\_\_\_\_\_

TELEPHONE NO.: \_\_\_\_\_

CONTACT PERSON: \_\_\_\_\_

EMAIL ADDRESS: \_\_\_\_\_



**FORM B**

Page \_\_\_ of \_\_\_

**DANE COUNTY**

(Copy this Form as necessary to provide complete information)

**EMERGING SMALL BUSINESS REPORT - INVOLVEMENT**

COMPANY NAME: \_\_\_\_\_

PROJECT NAME: \_\_\_\_\_

BID NO.: \_\_\_\_\_ BID DUE DATE: \_\_\_\_\_

ESB NAME: \_\_\_\_\_

CONTACT PERSON: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE NO & EMAIL.: \_\_\_\_\_

Indicate percentage of financial commitment to this ESB: \_\_\_\_\_ % Amount: \$ \_\_\_\_\_

ESB NAME: \_\_\_\_\_

CONTACT PERSON: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

PHONE NO & EMAIL.: \_\_\_\_\_

Indicate percentage of financial commitment to this ESB: \_\_\_\_\_ % Amount: \$ \_\_\_\_\_

**FORM C**

**DANE COUNTY  
EMERGING SMALL BUSINESS REPORT - CONTACTS**

(Copy this Form as necessary to provide complete information)

COMPANY NAME: \_\_\_\_\_

PROJECT NAME: \_\_\_\_\_

BID NO.: \_\_\_\_\_ BID DUE DATE: \_\_\_\_\_

	<u>ESB FIRM NAME CONTACTED</u>	<u>DATE</u>	<u>PERSON CONTACTED</u>	<u>DID ESB BID?</u>	<u>ACC- EPT BID?</u>	<u>REASON FOR REJECTION</u>
1)	_____	_____	_____	_____	_____	_____
2)	_____	_____	_____	_____	_____	_____
3)	_____	_____	_____	_____	_____	_____
4)	_____	_____	_____	_____	_____	_____
5)	_____	_____	_____	_____	_____	_____
6)	_____	_____	_____	_____	_____	_____
7)	_____	_____	_____	_____	_____	_____
8)	_____	_____	_____	_____	_____	_____

**FORM D**

**DANE COUNTY  
EMERGING SMALL BUSINESS REPORT - CERTIFICATION STATEMENT**

I, \_\_\_\_\_, \_\_\_\_\_ of  
Name Title

\_\_\_\_\_ certify to best of my knowledge and  
Company

belief that this business meets Emerging Small Business definition as indicated in Article 9 and  
that information contained in this Emerging Small Business Report is true and correct.

\_\_\_\_\_  
Bidder's Signature

\_\_\_\_\_  
Date

Name of Bidding Firm: \_\_\_\_\_

SECTION 00 41 13

BID FORM

**BID NO. 321045**

**PROJECT: FACILITIES EMERGENCY POWER  
DANE COUNTY COURTHOUSE & CITY-COUNTY BUILDING**

**TO: DANE COUNTY DEPARTMENT OF ADMINISTRATION,  
PUBLIC WORKS PROJECT MANAGER  
1919 ALLIANT ENERGY CENTER WAY  
MADISON, WISCONSIN 53713**

**NOTE: WISCONSIN STATUTE 77.54 (9M) ALLOWS FOR NO SALES & USE TAX ON  
THE PURCHASE OF MATERIALS FOR COUNTY PUBLIC WORKS PROJECTS.**

**BASE BID - LUMP SUM:**

Dane County is inviting Bids for construction services to provide an emergency power system that will provide backup generator power for two buildings. Additional loads to be added and modifications to existing generator plant to increase capacity and simplify operations with a more efficient and redundant system. The undersigned, having examined the site where the Work is to be executed and having become familiar with local conditions affecting the cost of the Work and having carefully examined the Drawings and Specifications, all other Construction Documents and Addenda thereto prepared by Dane County Public Works, Engineering Division hereby agrees to provide all labor, materials, equipment and services necessary for the complete and satisfactory execution of the entire Work, as specified in the Construction Documents, for the Base Bid stipulated sum of:

\_\_\_\_\_ and \_\_/100 Dollars  
Written Price

\$ \_\_\_\_\_  
Numeric Price

The undersigned agrees to add the alternate(s) portion of the Work as described, for the following addition(s) to or subtraction(s) from the Base Bid, as stipulated below.

**ALTERNATE BID 1 - LUMP SUM:**

Add price for providing short circuit, arc flash and coordination studies as defined in specification sections 260572, 260573 and 260574 for all electrical equipment in the CCB building including equipment that is not shown in the drawings. This scope will also include producing accurate electrical floor plans and one line diagrams for the entire building electrical system.

\_\_\_\_\_ and \_\_/100 Dollars  
Written Price

\$ \_\_\_\_\_  
Numeric Price (circle: Add or Deduct)

Receipt of the following addenda and inclusion of their provisions in this Bid is hereby acknowledged:

Addendum No(s). \_\_\_\_\_ through \_\_\_\_\_

Dated \_\_\_\_\_

Dane County Department of Administration must have this project completed by January 27, 2023. Assuming this Work can be started by April 18, 2022, what dates can you commence and complete this job?

Commencement Date: \_\_\_\_\_ Completion Date: \_\_\_\_\_  
(final, not substantial)

I hereby certify that all statements herein are made on behalf of:

\_\_\_\_\_  
(Name of Corporation, Partnership or Person submitting Bid)

Select one of the following:

1. A corporation organized and existing under the laws of the State of \_\_\_\_\_, or
2. A partnership consisting of \_\_\_\_\_, or
3. A person conducting business as \_\_\_\_\_;

Of the City, Village, or Town of \_\_\_\_\_ of the State of \_\_\_\_\_.

I have examined and carefully prepared this Bid from the associated Construction Documents and have checked the same in detail before submitting this Bid; that I have full authority to make such statements and submit this Bid in (its) (their) (my) behalf; and that the said statements are true and correct. In signing this Bid, we also certify that we have not, either directly or indirectly, entered into any agreement or participated in any collusion or otherwise taken any action in restraint of free competition; that no attempt has been made to induce any other person or firm to submit or not to submit a Bid; that this Bid has been independently arrived at without collusion with any other bidder, competitor, or potential competitor; that this Bid has not been knowingly disclosed prior to the Bids Due Date to another bidder or competitor; that the above statement is accurate under penalty of perjury.

The undersigned is qualified as a Best Value Contractor or has proven their exemption. Qualification or exemption shall be complete before Bid Due Date / Time.

The undersigned further agrees to honor the Base Bid and the Alternate Bid(s) for sixty (60) calendar days from date of Award of Contract.

**SIGNATURE:** \_\_\_\_\_  
(Bid is invalid without signature)

Print Name: \_\_\_\_\_ Date: \_\_\_\_\_

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

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

Telephone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

Contact Person: \_\_\_\_\_

END OF SECTION

**THIS PAGE IS FOR BIDDERS' REFERENCE**  
**DO NOT SUBMIT WITH BID FORM.**

**BID CHECK LIST:**

These items **must** be included with Bid:

- |                                                             |                                                |
|-------------------------------------------------------------|------------------------------------------------|
| <input type="checkbox"/> Bid Form                           | <input type="checkbox"/> Bid Bond              |
| <input type="checkbox"/> Fair Labor Practices Certification | <input type="checkbox"/> Waste Management Plan |

**DANE COUNTY BEST VALUE CONTRACTING QUALIFICATION**

General Contractors & all Subcontractors must be qualified as a Best Value Contractor with the Dane County Public Works Engineering Division. Qualification & listing is not permanent & must be renewed every 36 months. Complete a *Best Value Contracting Application* online at:

[publicworks.countyofdane.com/bvc](http://publicworks.countyofdane.com/bvc)

**DANE COUNTY VENDOR REGISTRATION PROGRAM**

All bidders are strongly encouraged to be a registered vendor with Dane County. Registering allows vendors an opportunity to receive notifications for RFBs & RFPs issued by the County and provides the County with up-to-date company contact information. Complete a new form or renewal online at:

[danepurchasing.com/Account/Login?](http://danepurchasing.com/Account/Login?)

SECTION 00 43 36

PROPOSED SUBCONTRACTORS FORM

General Contractor Name: \_\_\_\_\_ Bid No: \_\_\_\_\_

Instructions:

1. Complete all information in table below.
2. Include this Form with signed Construction Contract (Section 00 52 96).
3. General contractors & subcontractors must be qualified & registered as Best Value Contractor (Dane County Ordinances, Chapter 40.07). General contractors must be qualified & registered before bids are due. Subcontractors must be qualified & registered 10 working days before performing any work related to Construction Contract. No contractor can perform work without being qualified & registered.
4. Sample Best Value Contracting Application is included in this RFB package for informational purposes; fill out form online ([publicworks.countyofdane.com/bvc](http://publicworks.countyofdane.com/bvc)).

SUBCONTRACTOR NAME	ADDRESS & PHONE NO.	DIVISION OF WORK	\$\$ AMOUNT OF CONTRACT

Check box if there is another form page attached to include additional subcontractors.

The undersigned, for and on behalf of the General Contractor named herein, certifies the information on this Form is accurate.

\_\_\_\_\_  
Officer or Authorized Agent Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed or Typed Name and Title



SUBCONTRACTOR NAME	ADDRESS & PHONE NO.	DIVISION OF WORK	\$\$ AMOUNT OF CONTRACT

END OF SECTION

**COUNTY OF DANE**

**PUBLIC WORKS CONSTRUCTION CONTRACT**

Contract No. \_\_\_\_\_ Bid No. 321045

Authority: 2021 RES - \_\_\_\_\_

**THIS CONTRACT**, made and entered into as of the date by which authorized representatives of both parties have affixed their signatures, by and between the County of Dane (hereafter referred to as "COUNTY") and \_\_\_\_\_ (hereafter, "CONTRACTOR"), and

**WITNESSETH:**

**WHEREAS**, COUNTY, whose address is c/o Deputy Public Works Director, 1919 Alliant Energy Center Way, Madison, WI 53713, desires to have CONTRACTOR provide Facilities Emergency Power - Dane County Courthouse & City-County Building ("the Project"); and

**WHEREAS**, CONTRACTOR, whose address is \_\_\_\_\_ is able and willing to construct the Project, in accordance with the Construction Documents;

**NOW, THEREFORE**, in consideration of the above premises and the mutual covenants of the parties hereinafter set forth, the receipt and sufficiency of which is acknowledged by each party for itself, COUNTY and CONTRACTOR do agree as follows:

1. CONTRACTOR agrees to construct, for the price of \$\_\_\_\_\_ the Project and at the CONTRACTOR'S own proper cost and expense to furnish all materials, supplies, machinery, equipment, tools, superintendence labor, insurance, and other accessories and services necessary to complete the Project in accordance with the conditions and prices stated in the Bid Form, General Conditions of Contract, the drawings which include all maps, plats, plans, and other drawings and printed or written explanatory matter thereof, and the specifications therefore as prepared by Hammel, Green and Abrahamson, Inc. (HGA) (hereinafter referred to as "the Architect / Engineer"), and as enumerated in the Project Manual Table of Contents, all of which are made a part hereof and collectively evidence and constitute the Contract.

2. The term of this Contract shall commence when fully executed by the parties. The CONTRACTOR shall commence the Work by \_\_\_\_\_. The Work's substantial completion date shall be \_\_\_\_\_. Failure to meet commence work or substantial completion dates on the Work as set forth herein is grounds for termination of the Contract and other remedies as set forth in the General Conditions of Contract incorporated herein.

3. COUNTY agrees to pay the CONTRACTOR in current funds for the performance of the Contract subject to additions and deductions, as provided in the General Conditions of Contract, and to make payments on account thereof as provided in Article entitled, "Payments to Contractor" of the General Conditions of Contract.

4. During the term of this Contract, CONTRACTOR agrees to take affirmative action to ensure equal employment opportunities. The CONTRACTOR agrees in accordance with Wisconsin

Statute 111.321 and Chapter 19 of the Dane County Code of Ordinances not to discriminate on the basis of age, race, ethnicity, religion, color, gender, disability, marital status, sexual orientation, national origin, cultural differences, ancestry, physical appearance, arrest record or conviction record, military participation or membership in the national guard, state defense force or any other reserve component of the military forces of the United States, or political beliefs. Such equal opportunity shall include, but not be limited to, the following: employment, upgrading, demotion, transfer, recruitment, advertising, layoff, termination, training, rates of pay, and any other form of compensation. CONTRACTOR agrees to post in conspicuous places, available to all employees and applicants for employment, notices setting forth the provisions of this paragraph.

**5.** CONTRACTOR shall file an Affirmative Action Plan with the Dane County Contract Compliance Specialist in accord with Chapter 19 of the Dane County Code of Ordinances. CONTRACTOR must file such plan within fifteen (15) business days of the effective date of this Contract. During the term of this Contract CONTRACTOR shall also provide copies of all announcements of employment opportunities to COUNTY'S Office of Equity & Inclusion, and shall report annually the number of persons, by race, ethnicity, gender, and disability status, which apply for employment and, similarly classified, the number hired and number rejected.

**6.** During the term of this Contract, all solicitations for employment placed on CONTRACTOR'S behalf shall include a statement to the effect that CONTRACTOR is an "Equal Opportunity Employer".

**7.** CONTRACTOR agrees to furnish all information and reports required by COUNTY'S Contract Compliance Specialist as the same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance with Chapter 19, Dane County Code of Ordinances, and the provisions of this Contract.

**8.** The intent of this Contract is to be a Contract solely between the parties hereto and for their benefit only. Do not construe any part of this Contract to add to, supplement, amend, abridge or repeal existing rights, benefits or privileges of any third party or parties including, but not limited to, employees of the parties.

**9.** The entire agreement of the parties is contained herein and this Contract supersedes any and all oral agreements and negotiations between the parties relating to the subject matter hereof. The parties expressly agree that the express terms of this Contract shall not be amended in any fashion except in writing, executed by both parties.

**10.** CONTRACTOR must be qualified as a Best Value Contractor or have proven their exemption with Dane County Public Works Engineering Division before Bid Due Date / Time. All contractors and subcontractors must be qualified as a Best Value Contractor or have proven their exemption to perform any work under this Contract.

**11.** This Contract, and any amendment or addendum relating to it, may be executed and transmitted to any other party by legible facsimile reproduction or by scanned legible electronic PDF copy, and utilized in all respects as, an original, wet-inked manually executed document. Further, this Contract and any amendment or addendum thereto, may be stored and reproduced by each party electronically, photographically, by photocopy or other similar process, and each party may at its option destroy any original document so reproduced. All parties hereto stipulate that any such legible reproduction shall be admissible in evidence as the original itself in any judicial, arbitration or administrative proceeding whether or not the original is in existence and whether or not each party made such reproduction in the regular course of business. This term does not apply to the service of notices under this Contract.

**IN WITNESS WHEREOF**, COUNTY and CONTRACTOR, by their respective authorized agents, have caused this Contract and its Schedules to be executed, effective as of the date by which all parties hereto have affixed their respective signatures, as indicated below.

\* \* \* \* \*

**FOR CONTRACTOR:**

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Printed or Typed Name and Title

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Printed or Typed Name and Title

NOTE: If CONTRACTOR is a corporation, Secretary should attest. In accordance with IRS Regulations, unincorporated entities are required to provide either their Social Security or Employer Number in order to receive payment for services rendered.

**SAMPLE**

\* \* \* \* \*

This Contract is not valid or effectual for any purpose until approved by the appropriate authority designated below, and work is not authorized until the CONTRACTOR has been given notice to proceed by COUNTY'S Deputy Public Works Director.

**FOR COUNTY:**

\_\_\_\_\_  
Joseph T. Parisi, County Executive Date

\_\_\_\_\_  
Scott McDonell, County Clerk Date

# AIA<sup>®</sup> Document A310<sup>™</sup> – 2010

## Bid Bond

**CONTRACTOR:**

(Name, legal status and address)

**SURETY:**

(Name, legal status and principal place of business)

**OWNER:**

(Name, legal status and address)

**BOND AMOUNT:****PROJECT:**

(Name, location or address, and Project number, if any)

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, 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.

Signed and sealed this \_\_\_\_\_ day of \_\_\_\_\_

_____	(Contractor as Principal)	_____	(Seal)
(Witness)		_____	(Title)
		_____	(Surety)
_____		_____	(Seal)
(Witness)		_____	(Title)

**CAUTION:** You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.

# AIA<sup>®</sup> Document A312<sup>™</sup> – 2010

## Performance Bond

**CONTRACTOR:**

*(Name, legal status and address)*

**SURETY:**

*(Name, legal status and principal place of business)*

**OWNER:**

*(Name, legal status and address)*

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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

AIA Document A312–2010 combines two separate bonds, a Performance Bond and a Payment Bond, into one form. This is not a single combined Performance and Payment Bond.

**CONSTRUCTION CONTRACT**

Date:

Amount:

Description:

*(Name and location)*

**BOND**

Date:

*(Not earlier than Construction Contract Date)*

Amount:

Modifications to this Bond:  None  See Section 16

**CONTRACTOR AS PRINCIPAL**

Company: *(Corporate Seal)*

**SURETY**

Company: *(Corporate Seal)*

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

Name \_\_\_\_\_  
and Title: \_\_\_\_\_

*(Any additional signatures appear on the last page of this Performance Bond.)*

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

Name \_\_\_\_\_  
and Title: \_\_\_\_\_

*(FOR INFORMATION ONLY — Name, address and telephone)*

**AGENT or BROKER:**

**OWNER'S REPRESENTATIVE:**

*(Architect, Engineer or other party:)*

§ 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 Section 3.

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

- .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 Section 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;
- .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
- .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 Section 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 Section 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 Owner's 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 Section 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:

- .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
- .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 Section 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 Section 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 Section 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

- .1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
- .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 Section 5; and
- .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 Section 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 period of limitation 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 to the Contractor of 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:

Sample

*(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)*

**CONTRACTOR AS PRINCIPAL**

**SURETY**

Company: \_\_\_\_\_

*(Corporate Seal)*

Company: \_\_\_\_\_

*(Corporate Seal)*

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

Name and Title: \_\_\_\_\_

Address \_\_\_\_\_

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

Name and Title: \_\_\_\_\_

Address \_\_\_\_\_

**CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.**



# AIA® Document A312™ – 2010

## Payment Bond

**CONTRACTOR:**

*(Name, legal status and address)*

**SURETY:**

*(Name, legal status and principal place of business)*

**OWNER:**

*(Name, legal status and address)*

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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

AIA Document A312–2010 combines two separate bonds, a Performance Bond and a Payment Bond, into one form. This is not a single combined Performance and Payment Bond.

**CONSTRUCTION CONTRACT**

Date:

Amount:

Description:

*(Name and location)*

**BOND**

Date:

*(Not earlier than Construction Contract Date)*

Amount:

Modifications to this Bond:  None  See Section 18

**CONTRACTOR AS PRINCIPAL**

Company: *(Corporate Seal)*

**SURETY**

Company: *(Corporate Seal)*

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

Name \_\_\_\_\_  
and Title: \_\_\_\_\_

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

Name \_\_\_\_\_  
and Title: \_\_\_\_\_

*(Any additional signatures appear on the last page of this Payment Bond.)*

*(FOR INFORMATION ONLY — Name, address and telephone)*

**AGENT or BROKER:**

**OWNER'S REPRESENTATIVE:**

*(Architect, Engineer or other party:)*

§ 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 Section 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 Section 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,

- .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
- .2 have sent a Claim to the Surety (at the address described in Section 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 Section 13).

§ 6 If a notice of non-payment required by Section 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 Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 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 Section 7.1 or Section 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 Section 7.1 or Section 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 Section 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 Section 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 request 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 "labor, materials or equipment" that part of 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:

*(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)*

**CONTRACTOR AS PRINCIPAL**

Company: \_\_\_\_\_

(Corporate Seal)

**SURETY**

Company: \_\_\_\_\_

(Corporate Seal)

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

Name and Title: \_\_\_\_\_

Address \_\_\_\_\_

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

Name and Title: \_\_\_\_\_

Address \_\_\_\_\_

**CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.**

SECTION 00 72 12

GENERAL CONDITIONS OF CONTRACT

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## **1. CONSTRUCTION DOCUMENTS**

- A. Construction Documents, listed in Table of Contents of this Specification volume shall form part of this Contract and provisions of Construction Documents shall be as binding upon parties as if they were fully set forth in Contract itself.
- B. These shall also be considered as part of Construction Documents: Addenda, including additions and modifications incorporated in such addenda before execution of Contract; requests for information; construction bulletins; change orders; and written interpretations by Architect / Engineer or Public Works Project Manager that are made after execution of Contract.
- C. Construction Documents are complementary, and what is required by one shall be as binding as if required by all. Intent of Construction Documents is to include all labor, materials and equipment necessary for proper execution of the Work.

## **2. DEFINITIONS**

- A. These terms as used in this Contract are respectively defined as follows:
  - 1. All uses of term “County” in Construction Documents shall mean Dane County.
  - 2. All uses of term “Department” in Construction Documents shall mean Department of Administration, Public Works Division, which is a unit of Dane County government. Department is County agency overseeing Contract with Contractor.
  - 3. Public Works Project Manager is appointed by and responsible to Department. Public Works Project Manager has authority to act on behalf of Department and will sign change orders, payment requests and other administrative matters related to projects.
  - 4. Public Works Project Manager is responsible for supervision, administration and management of field operations involved in construction phase of this Work.
  - 5. Term “Work” includes all labor, equipment and materials necessary to produce project required by Construction Documents.
  - 6. Term “Substantial Completion” is date when project or specified area of project is certified by Architect / Engineer that construction is sufficiently completed, in accordance with Construction Documents, and as modified by any subsequent changes agreed to by parties, so that County may occupy project or specified area of project for use for which it was intended subject to permit approval for occupancy.
  - 7. Contractor is person, firm, or corporation with whom County makes Contract. Though multiple contracts may be involved, Construction Documents treat them throughout as if each were of singular number.

## **3. ADDITIONAL INSTRUCTIONS AND DRAWINGS**

- A. Contractor may be furnished additional instructions and detail drawings as necessary to carry out the Work included in Contract. Additional drawings and instructions thus supplied to Contractor will coordinate with Construction Documents and will be so prepared that they can be reasonably interpreted as part thereof. Contractor shall carry out the Work in accordance with additional detail drawings and instructions.

## **4. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

- A. Unless otherwise specified, Contractor shall submit three (3) copies of all Shop Drawings for each submission, until receiving final approval. After final approval, provide five (5) additional copies for distribution and such other copies as may be required.

- B. Contractor shall submit, on an on-going basis and as directed, Product Data such as brochures that shall contain catalog cuts and specifications of all furnished mechanical and electrical equipment. After Architect / Engineer's approval, one (1) copy shall remain in Architect / Engineer's file, one (1) kept at Department's office and one (1) kept at job site by Contractor for reference purposes.
- C. Samples shall consist of physical examples furnished by Contractor in sufficient size and quantity to illustrate materials, equipment or workmanship, and to establish standards to compare the Work.
  - 1. Submit Samples in sufficient quantity (minimum of two (2)) to permit Architect / Engineer to make all necessary tests and of adequate size showing quality, type, color range, finish, and texture. Label each Sample stating material, type, color, thickness, size, project name, and Contractor's name.
  - 2. Submit transmittal letter requesting approval, and prepay transportation charges to Architect / Engineer's office on samples forwarded.
  - 3. Materials installed shall match approved Samples.
- D. Contractor shall review Shop Drawings and place their dated stamp thereon to evidence their review and approval and shall submit with reasonable promptness and in orderly sequence to cause no delay in the Work or in work of any other contractor. At time of submission, Contractor shall inform Architect / Engineer in writing of any deviation in Shop Drawings or Samples from requirements of Construction Documents. Architect / Engineer will not consider partial lists.
- E. Architect / Engineer will review and approve or reject Shop Drawings with reasonable promptness to cause no delay. Architect / Engineer's approval shall not relieve Contractor from responsibility for errors or omissions in Shop Drawings.
- F. Contractor shall not commence any work requiring Shop Drawing, Product Data or Sample submission until Architect / Engineer has approved submission. All such work shall be in accordance with approved Shop Drawings, Product Data and Samples.
- G. Contractor shall keep on site of the Work, approved or conformed copy of Shop Drawings and shall at all times give Department access thereto.
- H. By stamping and submitting Shop Drawings, Product Data and Samples, Contractor thereby represents that he or she has or will determine and verify all field measurements, field construction criteria, materials, catalog numbers, and similar data and that he or she has checked and coordinated each Shop Drawing, Product Data and Sample with requirements of the Work and of Construction Documents. Architect / Engineer shall return without examination, Shop Drawings, Product Data and Samples not so noted.
- I. All Shop Drawings from any one Contractor should be numbered consecutively and on cover sheet shall bear name and location of project, name of Contractor, date of submittal and date of each correction or revision and associated Specification section and page number.

## **5. CUTTING AND PATCHING**

- A. Contractor shall be responsible for all cutting, fitting or patching required to complete the Work or to make its parts fit together properly.



- B. Contractor shall not damage or endanger portion of the Work or fully or partially completed construction of County or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. Contractor shall not cut or otherwise alter such construction by County or separate contractor except with written consent of County and of such separate contractor; such consent shall not be unreasonably withheld. Contractor shall not withhold unreasonably from County or separate contractor, Contractor's consent to cutting or otherwise altering the Work.

## **6. CLEANING UP**

- A. Contractor shall keep premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under Contract. Contractor shall remove from and about the Work waste materials, rubbish, Contractor's tools, construction equipment, machinery, and surplus materials at completion of the Work. Contractor shall maintain streets and sidewalks around the Work site in clean condition. Contractor shall remove all spillage and prevent tracking of spillage arising from performance of the Work, into, out of, and within the Work site. Contractor shall establish regular maintenance program of sweeping, vacuuming and / or hosing to minimize accumulation of dirt and dust upon such areas.
- B. If Contractor fails to clean up as directed in Construction Documents, County may do so and shall charge Contractor cost thereof.
- C. Contractor shall be responsible for broken windows and glass, and at completion of the Work shall replace such damaged or broken windows and glass. After replacing damaged or broken windows and glass, Contractor shall remove all labels, wash and polish both sides of all windows and glass.
- D. In addition to general cleaning (sweeping, vacuuming and / or hosing, as is appropriate to work surface), Contractor shall perform following final cleaning for all trades at completion of the Work:
  - 1. Remove temporary protections;
  - 2. Remove marks, stains, fingerprints and other soil or dirt from painted, decorated and finished woodwork and wall surfaces;
  - 3. Remove spots, plaster, soil and paint from ceramic tile, marble and other finished materials, and wash or wipe clean;
  - 4. Clean fixtures, cabinet work and equipment, removing stains, paint, dirt and dust, and leave same in undamaged, new condition;
  - 5. Clean aluminum in accordance with recommendations of manufacturer; and
  - 6. Clean resilient floors thoroughly with well-rinsed mop containing only enough moisture to clean off any surface dirt or dust and buff dry by machine to bring surfaces to sheen.

## **7. USE OF SITE**

- A. Contractor shall provide County and Architect / Engineer access to the Work under all circumstances.
- B. Contractor shall confine operations at site to areas permitted by County, law, ordinance, permits and Construction Documents and shall not unreasonably encumber site with materials or equipment. Contractor shall assure free, convenient, unencumbered, direct and safe access to all properties adjacent to the Work for County, its employees, invitees and guests.

- C. Contractor & subcontractors shall follow all current *Public Health - Madison & Dane County* procedures & recommendations including the mandatory use of face masks while inside any County facility. County Project Manager shall clarify these procedures & recommendations at pre-construction meeting.

## **8. MATERIALS AND WORKMANSHIP**

- A. Contractor shall perform all work and furnish all supplies and materials, machinery, equipment, facilities and means, necessary to complete the Work required by this Contract, within time specified, in accordance with provisions of Construction Documents.
- B. All equipment and materials incorporated in the Work covered by this Contract are to be new; use recycled and / or recovered materials to extent that such use is technically and economically feasible. Recovered materials are products recovered from solid waste in form identical to original form for use that is same as, or similar to original use. Recycled materials are products manufactured from solid waste.
- C. If requested, Contractor shall furnish satisfactory evidence as to kind and quality of construction materials proposed or used. Contractor shall furnish to Architect / Engineer, for approval, manufacturer name and model, performance capacities and other pertinent information of machinery, mechanical, electrical or other types of equipment, which Contractor plans to install.
- D. If not otherwise provided, materials and labor called for in this Contract shall be provided and performed in accordance with established practice and standards recognized by Architects, Engineers, Department, and construction industry.
- E. Reference to “Standard” specifications of any association or manufacturer, or codes of County authorities, intends most recent printed edition or catalog in effect on date that corresponds with date of Construction Documents.
- F. Whenever reference is made in Specifications that work shall be “performed”, “applied”, in accordance with “manufacturer’s directions or instructions”, Contractor to whom those instructions are directed shall furnish three (3) printed copies of such instructions to Architect / Engineer before execution of the Work.

## **9. CONTRACTOR’S TITLE TO MATERIALS**

- A. Contractor or any subcontractor shall not purchase materials or supplies for the Work subject to any chattel mortgage or under conditional sale contract or other agreement by which seller retains interest. Contractor warrants that all materials and supplies used in the Work are free from all liens, claims or encumbrances and Contractor has good title to them.

## **10. “OR EQUAL” CLAUSE**

- A. Whenever equipment or materials are identified on Drawings or in Specifications by reference to manufacturer’s or vendor’s name, trade name, catalog number, and other identifying information, it is intended to establish standards; and any equipment or material of other manufacturers and vendors which will perform adequately duties imposed by general design will be considered equally accepted provided equipment or material so proposed is, in opinion of Architect / Engineer, of equal substance and function. Architect / Engineer and Department shall provide written approval before Contractor may purchase or install it.

- B. Equipment or materials of manufacturers, other than those named, may be used only upon following conditions:
1. That, in opinion of Architect / Engineer and Department, proposed material or equipment item is fully equal or superior (in design, materials, construction, workmanship, performance, finish, etc.) to named item. No compromise in quality level, however small, is acceptable.
  2. That, in substituting materials or equipment, Contractor assumes responsibility for any changes in system or for modifications required in adjacent or related work to accommodate such substitution despite Architect / Engineer's and Department's approval, and all costs growing out of approval of "or equal" items shall be responsibility of Contractor. No extra costs resulting from such approval shall become responsibility of Department, Architect / Engineer or any other separate Contractor.
  3. It shall be understood that use of materials or equipment other than those specified, or approved equal by Architect / Engineer and Department, shall constitute violation of Contract, and that Architect / Engineer and Department shall have right to require removal of such materials or equipment and their replacement with specified materials or equipment at Contractor's expense.
  4. Product and manufacturer named first in Specifications or on information shown on Drawings is basis of selection of manufactured items and equipment, particularly mechanical equipment. In using other than first named products or manufacturers, including those specified as additionally approved or acceptable, Contractor assumes responsibility for any changes in system and for modifications in any work required to accommodate them. Architect / Engineer's approval of such additionally acceptable products or manufacturers, either in Specifications or in Addendum, does not relieve Contractor from obligation to coordinate such optional products with other Contractors, whose work may be affected by them, and to pay all additional costs resulting from their inclusion into the Work. Contractor's liability shall include payment of Architect / Engineer's fees for any additional services made necessary by or directly connected to such product changes. No extra costs resulting from such changes shall become responsibility of Department, Architect / Engineer or any other separate Contractor.
- C. No request for approval of "or equal" materials will be entertained except from Contractor. Identify any request for substitution as substitution on Contractor's letter of transmittal and give reasons for substitution. Department may in its sole discretion allow substitutions of materials.

## **11. PATENTS AND ROYALTIES**

- A. If Contractor uses any design, device or material covered by letters, patent or copyright, it is mutually agreed and understood, that, without exception, contract prices shall include all royalties or costs arising from use of such design, device or materials, in any way involved in the Work.
- B. Contractor shall indemnify and save harmless County from any and all claims for infringement by reason of use of such patent or copyright in connection with the Work agreed to be performed under this Contract, and shall indemnify County for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during prosecution of the Work or after completion of the Work.

## **12. SURVEYS, PERMITS, REGULATIONS AND TAXES**

- A. Department will furnish to Contractor all site, topography and property surveys necessary for execution of the Work.
- B. Contractor shall procure all permits and pay associated fees , licenses and approvals necessary for execution of this Contract.
- C. Contractor shall give all notices and comply with all State of Wisconsin, Federal and local laws, codes, rules and regulations relating to performance of the Work, protection of adjacent property, and maintenance of passageways, guard fences or other protective facilities.
- D. Contractor does not need to pay State and local sales & use taxes on building materials that become part of local unit government facilities. See Wisconsin Statute 77.54 (9m). This does not include materials for highways, streets or roads. Contractor shall pay any other Sales, Consumer, Use & other similar taxes or fees required by law.
- E. Contractor shall promptly notify Architect / Engineer of any variances of Drawings or Specifications with that of any State of Wisconsin, federal or local law, code, rule or regulation. Upon such notification, Architect / Engineer will require correction of variance to comply with applicable law, code, rule or regulation at no additional cost to Contractor.
- F. Work under this Contract shall comply with all applicable State of Wisconsin, Federal and local laws, codes and regulations.
- G. Contractor shall pay charges for water, sewer and other utility connections made by municipalities where required by Specifications.

### **13. CONTRACTOR'S OBLIGATIONS AND SUPERINTENDENCE**

- A. Contractor shall provide and pay for all materials, labor, tools, equipment, transportation and superintendence necessary to execute, complete and deliver the Work within specified time. Contractor agrees to secure at their own expense all personnel necessary to carry out the Work. Such personnel shall not be deemed County employees nor shall they have or be deemed to have any direct contractual relationship with County.
- B. Performance of any work necessary after regular working hours, on Sundays or Legal Holidays shall be without additional expense to County. Performance of any work at site at other than normal working hours must be coordinated with Public Works Project Manager.
- C. Contractor shall furnish, erect, maintain and remove such temporary works as may be required.
- D. Contractor shall observe, comply with, and be subject to all terms, conditions, requirements and limitations of Construction Documents.
- E. At the Work site, Contractor shall give personal superintendence to the Work or shall employ construction superintendent or foreman, experienced in character of work covered by Contract, who shall have full authority to act for Contractor. Understand that such superintendent or foreman shall be acceptable to Architect / Engineer and Department.
- F. Remove from project or take other corrective action upon notice from Architect / Engineer or Department for Contractor's employees whose work is considered by Architect / Engineer or Department to be unsatisfactory, careless, incompetent, unskilled or otherwise objectionable.

- G. Contractor and subcontractors shall be required to conform to Labor Laws of State of Wisconsin and various acts amendatory and supplementary thereto and to other laws, ordinances and legal requirements applicable to the Work.
- H. Presence and observation of the Work by Architect / Engineer or Public Works Project Manager shall not relieve Contractor of any obligations.

#### **14. WEATHER CONDITIONS**

- A. In event of temporary suspension of work, or during inclement weather, or whenever Architect / Engineer shall direct, Contractor shall, and shall cause subcontractors to protect carefully all work and materials against damage or injury from weather. If, in opinion of Architect / Engineer or Department, any work or materials that have been damaged or injured due to failure on part of Contractor or any subcontractors so to protect the Work, such materials shall be removed and replaced at expense of Contractor.

#### **15. PROTECTION OF WORK AND PROPERTY**

- A. Contractor shall at all times safely guard County's property from injury or loss in connection with this Contract. Contractor shall at all times safely guard and protect the Work, and adjacent property, from damage. Contractor shall replace or make good any such damage, loss or injury unless such is caused directly by errors contained in Contract, or by County, or County's duly authorized representative.
- B. Contractor may act diligently, without previous instructions from Architect / Engineer and / or Department, in emergency that threatens loss or injury of property, or safety of life. Contractor shall notify Architect / Engineer and / or Department immediately thereafter. Promptly submit any claim for compensation by Contractor due to such extra work to Architect / Engineer and / or Department for approval as provided for in Article 18 herein.

#### **16. INSPECTION AND TESTING OF MATERIALS**

- A. Authorized representatives and agents of County government shall have access at all times to the Work wherever it is in preparation or progress and Contractor shall provide facilities for such access and for inspection.
- B. Should it be considered necessary or advisable at any time before final acceptance of the Work to make examination of work already completed, by removing or tearing out same, Contractor shall upon request, promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any aspect, due to fault of Contractor or subcontractors thereof, Contractor shall assume all expenses of such examination and of satisfactory reconstruction. Contractor will be reimbursed for such examination and replacement in accordance with Article 18 - A.3., of these General Conditions of Contract if such work is found to meet requirements of Contract.
- C. If Specifications, Architect / Engineer's, or Public Works Project Manager's instructions require any work to be specially tested or approved, Contractor shall give Architect / Engineer and Public Works Project Manager timely notice of its readiness for testing or inspection. Test all materials and equipment requiring testing in accordance with accepted or specified standards, as applicable. Architect / Engineer shall recommend laboratory or inspection agency and Department will select and pay for all initial laboratory inspection

services. Should retesting be required, due to failure of initial testing, cost of such retesting shall be borne by Contractor.

- D. Cost of any testing performed by manufacturers or Contractor for substantiating acceptability of proposed substitution of materials and equipment, or necessary conformance testing in conjunction with manufacturing processes or factory assemblage, shall be borne by Contractor or manufacturer responsible.

## **17. REPORTS, RECORDS AND DATA**

- A. Contractor shall submit to Architect / Engineer and Public Works Project Manager such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, invoices, records and other data as either may request concerning work performed or to be performed under this Contract.

## **18. CHANGES IN THE WORK**

- A. Make no changes, except in cases of emergency, in the Work covered by approved Construction Documents without having prior written approval of Department. Charges or credits for the Work covered by approved change shall be determined by one of these methods:
1. Unit bid prices previously approved.
  2. Agreed lump sum based on actual cost of:
    - a) Labor, including foremen, and all fringe benefits that are associated with their wages.
    - b) Materials entering permanently into the Work.
    - c) Ownership or rental cost of construction tools and equipment during time of use on extra work.
    - d) Power and consumable supplies for operation of power equipment.
    - e) Workmen's Compensation Insurance, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance.
    - f) Social Security and old age and unemployment contributions.
    - g) Add to cost under (2), fixed fee to be agreed upon, but not to exceed fifteen percent (15%) of actual cost of work performed with their own labor force. Fee shall be compensation to cover cost of supervision, overhead, bond, profit and any other general expense.
    - h) On that portion of the Work under (2) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit and any other general expense.
    - i) Department may require correct amount of costs with supporting vouchers; Contractor shall keep and present in such form as directed.
  3. Cost-plus work, with not-to-exceed dollar limit, based on actual cost of:
    - a) Labor, including foremen, and all fringe benefits that are associated with their wages.
    - b) Materials entering permanently into the Work.
    - c) Ownership or rental cost of construction tools and equipment during time of use on extra work. Rental cost cannot exceed fifty percent (50%) replacement value of rented equipment.
    - d) Power and consumable supplies for operation of power equipment.
    - e) Workmen's Compensation Insurance, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance.
    - f) Social Security and old age and unemployment contributions.
    - g) To cost under (3), there shall be added fixed fee to be agreed upon but not to exceed fifteen percent (15%) of actual cost of work performed with their own labor force.

Fee shall be compensation to cover cost of supervision, overhead, bond, profit, and any other general expense.

- h) On that portion of the Work under (3) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit, and any other general expense.
  - i) Contractor shall keep and present, in such form as directed, correct amount of cost together with such supporting vouchers as may be required by Department.
- B. If Contractor claims that by any instructions given by Architect / Engineer, Department, by drawings or otherwise, regarding performance of the Work or furnishing of material under Contract, involves extra cost, Contractor shall give Department written notice of cost thereof within two (2) weeks after receipt of such instructions and in any event before proceeding to execute work, unless delay in executing work would endanger life or property.
- C. No claim for extra work or cost shall be allowed unless it was done in pursuance of written Change Order from Architect / Engineer and approved by Department, as previously mentioned, and claim presented with payment request submitted after changed or extra work is completed.
- D. Negotiation of cost for change in the Work shall not be cause for Contractor to delay prosecution of the Work if Contractor has been authorized in writing by Public Works Project Manager to proceed.

## **19. EXTRAS**

- A. Without invalidating Contract, Department may order extra work or make changes by altering, adding to or deducting from the Work, contract sum being adjusted in accordance with Article 18 herein.

## **20. TIME FOR COMPLETION**

- A. Contractor agrees that the Work shall be prosecuted regularly and diligently and complete the Work as stated in Construction Documents.

## **21. CORRECTION OF WORK**

- A. All work, all materials whether incorporated in the Work or not, and all processes of manufacture shall at all times and places be subject to inspection of Architect / Engineer and Public Works Project Manager who shall be judge of quality and suitability of the Work, materials, and processes of manufacture for purposes for which they are used. Should they fail to meet Architect / Engineer's and Public Works Project Manager's approval they shall be reconstructed, made good, replaced or corrected, by Contractor at Contractor's expense. Immediately remove all rejected material from site.
- B. If Contractor defaults or neglects to carry out the Work in accordance with Construction Documents or fails to perform any provision of Contract, Department may, after ten (10) business days' written notice to Contractor and without prejudice to any other remedy County may have, make good such deficiencies. In such case, appropriate Change Order shall be issued deducting from Contractor's payments then or thereafter, cost of correcting such deficiencies, including cost of Architect / Engineer's additional services made necessary by such default, neglect or failure.

## **22. SUBSURFACE CONDITIONS FOUND DIFFERENT**

- A. If Contractor encounters subsurface or latent conditions at site materially differing from those shown on Drawings or indicated in Specifications, Contractor shall immediately give notice to Architect / Engineer and Public Works Project Manager of such conditions before they are disturbed. Architect / Engineer will thereupon promptly investigate conditions, and if Architect / Engineer finds that they materially differ from those shown on Drawings or indicated in Specifications, Architect / Engineer will at once make such changes as necessary, any increase or decrease of cost resulting from such changes to be adjusted in manner provided in above Article 18 entitled "Changes in the Work".

## **23. RIGHT OF DEPARTMENT TO TERMINATE CONTRACT**

- A. In event that any provisions of this Contract are violated by Contractor or by any subcontractors, County may serve written notice upon Contractor and Surety of its intention to terminate Contract, such notice to contain reasons for such intention to terminate Contract, and unless within ten (10) business days after serving of such notice upon Contractor, such violation or delay shall cease and satisfactory arrangement or correction be made, Contract shall, upon expiration of said ten (10) business days, cease and terminate.
- B. In event of any such termination, County shall immediately serve notice thereof upon Surety and Contractor, and Surety shall have right to take over and perform Contract subject to County's approval; provided, however, that if Surety does not commence performance thereof within ten (10) business days from date of mailing to such Surety of notice of termination, County may take over the Work and prosecute same to completion by contract, or by force account, at expense of Contractor; Contractor and Surety shall be liable to County for any excess cost occasioned County thereby, and in such event County may take possession of and utilize in completing the Work, such materials and equipment as may be on the Work site and therefore necessary.

## **24. CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES**

- A. Contractor shall be responsible for Construction Schedule and coordination. Immediately after execution and delivery of Contract and before making first payment, Contractor shall notify all subcontractors to furnish all required information to develop Construction Schedule. Contractor and all subcontractors associated with the Work shall furnish following information from each Division of Specifications:
1. List of construction activities;
  2. Start, finish and time required for completion of each activity;
  3. Sequential relationships between activities;
  4. Identify all long lead-time items, key events, meetings or activities such as required submittals, fabrication and delivery, procurement of materials, installation and testing;
  5. Weekly definition of extent of work and areas of activity for each trade or Subcontract; and
  6. Other information as determined by Public Works Project Manager.
- B. In addition to above requested items, Contractor shall request delivery dates for all County-furnished equipment, materials or labor. This shall include any work handled by Department under separate contracts such as asbestos abatement, air and water balancing, etc. Indicate on Construction Schedule these associated delivery and installation dates.
- C. Progress Reporting:



1. Contractor shall update and publish Construction Schedule on monthly basis. Revisions to Schedule shall be by Contractor and made in same detail as original Schedule and accompanied by explanation of reasons for revision; and shall be subject to approval by Department.
  2. Failure of Contractor to keep Schedule in updated format shall result in County hiring firm specializing in construction schedule development and deducting those costs associated with updating process from payments due Contractor.
  3. Contractor shall submit show actual percentage of each activity completed, estimated future progress, and anticipated completion time.
- D. Responsibility for timely completion requires:
1. Contractor and subcontractors understand that performance of each is interdependent upon performance of others.
  2. Whenever it becomes apparent from current schedule, that phasing or progress completion dates will not be met, Contractor must take some or all following actions at no additional cost to County:
    - a) Increase construction labor in such quantities and crafts as will eliminate backlog of work.
    - b) Increase number of working hours per shift, shifts per working day, working days per week, amount of construction equipment, or any combination of foregoing to eliminate backlog of work.
    - c) Reschedule work (yet remain in conformance with Drawings and Specifications).
  3. Prior to proceeding with any of above actions, Contractor shall notify Public Works Project Manager.
- E. Maintain current Construction Schedule at all times. Revise Construction Schedule in same detail as original and accompany with explanation of reasons for revision. Schedule shall be subject to approval by Architect / Engineer and Public Works Project Manager.

## **25. PAYMENTS TO CONTRACTOR**

- A. Contractor shall provide:
1. Detailed estimate giving complete breakdown of contract price by Specification Division; and
  2. Periodic itemized estimates of work done for purpose of making partial payments thereon.
- B. Submit these estimates for approval first to Architect / Engineer, then to Public Works Project Manager. Costs employed in making up any of these schedules are for determining basis of partial payments and not considered as fixing basis for additions to or deductions from Contract price.
- C. County will make partial payments to Contractor for value, proportionate to amount of Contract, of all labor and material incorporated in the Work during preceding calendar month upon receipt of Application and Certificate for Payment form from Architect / Engineer and approval of Department.
- D. Contractor shall submit for approval first to Architect / Engineer, and then to Public Works Project Manager all Application and Certificate for Payment forms. If requested, Application and Certificate for Payment shall be supported by such additional evidence as may be required, showing Contractor's right to payment claimed.

- E. Application and Certificate for Payment for preparatory work and materials delivered and suitably stored at site to be incorporated into the Work at some future period, will be given due consideration. Requesting payment for materials stored off site, may be rejected, however, if deemed essential for reasons of job progress, protection, or other sufficient cause, requests will be considered, conditional upon submission by Contractor of bills of sale, photographs and such other procedures as will adequately protect County's interest such as storage in bonded warehouse with adequate coverage. If there is any error in payment, Contractor is obligated to notify Department immediately, but no longer than ten (10) business days from receipt of payment.
- F. Payments by County will be due within forty-five (45) business days after receipt by Department of Application and Certificate for Payment.
- G. County will retain five percent (5%) of each Application and Certificate for Payment until final completion and acceptance of all the Work covered by Contract. However, anytime after fifty percent (50%) of the Work has been furnished and installed at site, County will make remaining payments in full if Architect / Engineer and Public Works Project Manager find that progress of the Work corresponds with Construction Schedule. If Architect / Engineer and Public Works Project Manager find that progress of the Work does not correspond with Construction Schedule, County may retain up to ten percent (10%) of each Application and Certificate for Payment for the Work completed.
- H. All material and work covered by partial payments made shall become sole property of County, but this provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made, or restoration of any damaged work, or as waiver of right of County to require fulfillment of all of terms of Contract.
- I. County will make final payment within sixty (60) calendar days after final completion of the Work, and will constitute acceptance thereof.
- J. County may make payment in full, including retained percentages and less authorized deductions, upon completion and acceptance of each Division where price is stated separately in Contract.
- K. Every contractor engaged in performance of any contract for Department of Administration, Public Works Division shall submit to this Department, as requested and with final application for payment for work under said contract, affidavit(s) as required to prove that all debts and claims against this Work are paid in full or otherwise satisfied, and give final evidence of release of all liens against the Work and County.

## **26. WITHHOLDING OF PAYMENTS**

- A. County, after having served written notice on said Contractor, may either pay directly any unpaid bills of which Department has written notice, or withhold from Contractor's unpaid compensation sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged; whereupon, payment to Contractor shall be resumed in accordance with terms of this Contract, but in no event shall these provisions be construed to impose any obligations upon County to either Contractor or Contractor's Surety.
- B. In paying any unpaid bills of Contractor, County shall be deemed agent of Contractor, and any payment so made by County, shall be considered as payment made under Contract by

County to Contractor and County shall not be liable to Contractor for any such payment made in good faith.

- C. Contractor shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives from all claims growing out of lawful demands of subcontractors, laborers, workers, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in performance of this Contract.
- D. At Department's request, Contractor shall furnish satisfactory evidence that all obligations of nature designated above have been paid, discharged or waived.

**27. ACCEPTANCE OF FINAL PAYMENT AS RELEASE**

- A. Making of final payment shall constitute waiver of all claims by County except those arising from:
  - 1. Unsettled lien;
  - 2. Faulty or defective work appearing after substantial completion;
  - 3. Failure of the Work to comply with requirements of Construction Documents; or
  - 4. Terms of any special guarantees required by Construction Documents.
- B. Acceptance of final payment shall constitute waiver of all claims by Contractor.

**28. PAYMENTS BY CONTRACTOR**

- A. Contractor shall pay following not later than fifth (5<sup>th</sup>) business day following each payment received from County:
  - 1. All transportation and utility services rendered;
  - 2. All materials, tools, and other expendable equipment that have been delivered at site of the Work to extent of ninety percent (90%) of cost thereof, and balance of cost thereof when said balance is paid to Contractor; and
  - 3. Each subcontractor, respective amount allowed Contractor because of work performed by subcontractor to extent of subcontractor's interest therein.

**29. CONTRACT SECURITY**

- A. Contractor shall furnish Performance and Payment Bonds in amount at least equal to one hundred percent (100%) of Contract price as security for faithful performance of this Contract and payment of all persons performing labor on project under this Contract and furnishing materials in connection with this Contract.
- B. Sample Performance and Payment Bonds that Contractor will be required to execute is bound into these Construction Documents. Before construction Contract is consummated, completed Performance and Payment Bonds must be approved by Department.

**30. ASSIGNMENTS**

- A. Contractor shall not assign whole or any part of this Contract or any moneys due or to become due hereunder without written consent of Department. In case Contractor assigns all or any part of any moneys due or to become due under this Contract, instrument of assignment shall contain clause substantially to effect that it is agreed that right of assignee in and to any moneys due or to become due to Contractor shall be subject to prior claims of all

persons, firms and corporations for services rendered or materials supplied for performance of the Work called for in this Contract.

### **31. MUTUAL RESPONSIBILITY OF CONTRACTORS**

- A. If, through acts of neglect on part of Contractor or any subcontractor shall suffer loss or damage on the Work, Contractor agrees to settle with such subcontractor by agreement or arbitration if such other subcontractor will so settle. If such subcontractor shall assert any claim against County on account of any damage alleged to have been sustained, Department shall notify Contractor, who shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives against any such claim.

### **32. SEPARATE CONTRACTS**

- A. Department may award other contracts for the Work and all Contractors shall fully cooperate with each other and carefully adjust their work to that provided under other contracts as may be directed by Department. No Contractor shall commit or permit any act that will interfere with performance of the Work by any other Contractor.
- B. Contractor shall coordinate the Work with those of other Contractors. Cooperation will be required in arrangement for storage of materials and in detailed execution of the Work. Contractor, including subcontractors, shall keep informed of progress and detail work of others and shall notify Architect / Engineer or Department immediately of lack of progress or defective workmanship on part of others. Failure of Contractor to keep informed of the Work progressing on site and failure to give notice of lack of progress or defective workmanship by others shall be construed as acceptance by Contractor of status of the Work as being satisfactory for proper coordination with Contractor's own work.

### **33. SUBCONTRACTS**

- A. Contractor may use services of specialty subcontractors on those parts of the Work that, under normal contracting practices, are performed by specialty subcontractors.
- B. Contractor shall not award any work to any subcontractor without prior approval of Department. Qualifications of subcontractors shall be same as qualifications of Contractor. Request for subcontractor approval shall be submitted to Department fifteen (15) business days before start of subcontractor's work. If subcontractors are changed or added, Contractor shall notify Department in writing.
- C. Contractor shall be as fully responsible to County for acts and omissions of subcontractors, and of persons either directly or indirectly employed by them, as Contractor is for acts and omissions of persons directly employed by Contractor.
- D. Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind subcontractors to Contractor by terms of General Conditions of Contract and other Construction Documents insofar as applicable to work of subcontractors and to give Contractor same power as regards terminating any subcontract that Department may exercise over Contractor under any provision of Construction Documents.
- E. Nothing contained in this Contract shall create any contractual relation between any subcontractor and County.

- F. Contractor shall insert in all subcontracts, Articles 26, 33, 43 and 45, respectively entitled: “Withholding of Payments”, “Subcontracts”, “Affirmative Action Provision and Minority / Women / Disadvantaged Business Enterprises”, and “Minimum Wages”, and shall further require all subcontractors to incorporate physically these same Articles in all subcontracts.

#### **34. PROJECT MANAGER’S AUTHORITY**

- A. Public Works Project Manager shall:
1. Administer and ensure compliance with Construction Documents;
  2. Provide responsible on-site observations of construction and have authority to request work and to stop work whenever necessary to insure proper enforcement of Construction Documents;
  3. Convene and chair project meetings and foreman’s coordination meetings when necessary to coordinate resolution of conflicts between Contractors, Architects, Engineers, Consultants, and Department; and
  4. Check and inspect material, equipment and installation procedures of all trades for proper workmanship and for compliance with Drawings, Specifications and Shop Drawings, permit no material on project site that is not satisfactory and reject work not in compliance with Construction Documents.

#### **35. CONSULTANT’S AUTHORITY**

- A. Engineer is retained by, and is responsible to Department acting for County.
- B. Engineer shall determine amount, quality, acceptability, and fitness of several kinds of work and materials that are provided under this Contract and shall decide all questions that may arise in relation to said work and construction thereof.
- C. Engineer shall decide meaning and intent of any portion of Specifications and of any Drawings where they may be found obscure or be in dispute.
- D. Engineer shall provide responsible observation of construction. Architect / Engineer has authority to stop the Work whenever such stoppage may be necessary to insure proper execution of Construction Documents.
- E. Engineer shall be interpreter of conditions of Construction Documents and judge of its performance.
- F. Within reasonable time, Engineer shall make decisions on all matters relating to progress of the Work or interpretation of Construction Documents.
- G. Engineer’s decisions are subject to review by Public Works Project Manager.

#### **36. STATED ALLOWANCES**

- A. Stated allowances enumerated in Instructions to Bidders shall cover net cost of materials or equipment, and all applicable taxes. Contractor’s cost of delivery and unloading at site, handling costs on site, labor, installation costs, overhead, profit and any other incidental costs shall be included in Contractor’s bid, but not as part of cash allowance.

- B. Department will solicit at least two (2) bids on materials or equipment for which allowance is stated and select on basis of lowest qualified responsible bid. Contractor will then be instructed to purchase “Allowed Materials”. If actual price for purchasing “Allowed Materials”, including taxes, is more or less than “Cash Allowance”, Contract price shall be adjusted accordingly. Adjustment in Contract price shall not contain any cost items excluded from cash allowance.

### **37. ESTIMATES OF QUANTITIES**

- A. Whenever estimated quantities of work to be done and materials to be furnished under this Contract are shown in any of Construction Documents, they are given for use in comparing bids and right is especially reserved to increase or diminish them as they may be deemed reasonably necessary or desirable by Department to complete the Work included in this Contract, and cost for such increase or diminution shall be adjusted in manner provided for in General Conditions of Contract Article 18 entitled “Changes in the Work”.

### **38. LANDS AND RIGHTS-OF-WAY**

- A. Prior to start of construction, County shall furnish all land and rights-of-way necessary for carrying out and completion of the Work to be performed under this Contract.

### **39. GENERAL GUARANTEE**

- A. Neither final certificate of payment nor any provision in Construction Documents nor partial or entire occupancy of premises by County shall constitute acceptance of work not done in accordance with Construction Documents or relieve Contractor of liability in respect to any expressed warranties or responsibility for faulty materials or workmanship.
  - 1. In no event shall making of any payment required by Contract constitute or be construed as waiver by County of any breach of covenants of Contract or waiver of any default of Contractor and making of any such payment by County while any such default or breach shall exist shall in no way impair or prejudice right of County with respect to recovery of damages or other remedy as result of such breach or default.
- B. Contractor shall remedy and make good all defective workmanship and materials and pay for any damage to other work resulting there from, which appear within period of one (1) year from date of substantial completion, providing such defects are not clearly due to abuse or misuse by County. Department will give notice of observed defects with reasonable promptness.
- C. Guarantee on work executed after certified date of substantial completion will begin on date when such work is inspected and approved by Engineer’s and Public Works Project Manager.
- D. Where guarantees or warranties are required in sections of Specifications for periods in excess of one (1) year, such longer terms shall apply; however, Contractor’s Performance and Payment Bonds shall not apply to any guarantee or warranty period in excess of one (1) year.

### **40. CONFLICTING CONDITIONS**

- A. Any provision in any of Construction Documents which may be in conflict or inconsistent with any Articles in these General Conditions of Contract or Supplementary Conditions shall be void to extent of such conflict or inconsistency.

- B. In case of ambiguity or conflict between Drawings and Specifications, Specifications shall govern.
- C. Printed dimensions shall be followed in preference to measurements by scale. Large-scale drawings take precedence over small-scale drawings. Dimensions on Drawings and details are subject to field measurements of adjacent work.

#### **41. NOTICE AND SERVICE THEREOF**

- A. Any notice to Contractor from Department relative to any part of this Contract shall be in writing and considered delivered and service thereof completed, when said notice is posted, by certified or registered mail, to Contractor at Contractor's last given address, or delivered in person to said Contractor, or Contractor's authorized representative on the Work.

#### **42. PROTECTION OF LIVES AND HEALTH**

- A. In order to protect lives and health of Contractor's employees under Contract, Contractor shall comply with all pertinent provisions of Wisconsin Administrative Code, Rules of Department of Commerce, relating to Safety and Health.
- B. Contractor alone shall be responsible for safety, efficiency and adequacy of Contractor's tools, equipment and methods, and for any damage that may result from their failure or their improper construction, maintenance or operation.

#### **43. AFFIRMATIVE ACTION PROVISION AND MINORITY / WOMEN / DISADVANTAGED BUSINESS ENTERPRISES**

- A. Affirmative Action Provisions.
  - 1. During term of their Contract, Contractor agrees not to discriminate on basis of race, religion, color, sex, handicap, age, sexual preference, marital status, physical appearance, or national origin against any person, whether recipient of services (actual or potential), employee, or applicant for employment. Such equal opportunity shall include but not be limited to following: employment, upgrading, demotion, transfer, recruitment, advertising, layoff, termination, training, rates of pay, and any other form of compensation or level of service(s). Contractor agrees to post in conspicuous places, these affirmative action standards so as to be visible to all employees, service recipients and applicants for this paragraph. Listing of prohibited bases for discrimination shall not be construed to amend in any fashion state or federal law setting forth additional bases and exceptions shall be permitted only to extent allowable in state or federal law.
  - 2. Contractor is subject to this Article only if Contractor has twenty (20) or more employees and receives \$20,000.00 or more in annual aggregate contracts with County. Contractor shall file and Affirmative Action Plan with Dane County Contract Compliance Specialist in accord with Chapter 19 of Dane County Code of Ordinances. Such plan must be filed within fifteen (15) business days of effective date of this Contract and failure to do so by said date shall constitute ground for immediate termination of Contract by County. Contractor shall also, during term of this Contract, provide copies of all announcements of employment opportunities to County's Office of Equity & Inclusion, and shall report annually number of persons, by race, sex and handicap status, who apply for employment, and, similarly classified, number hired and number rejected.
  - 3. Contact Dane County Contract Compliance Specialist at Dane County Office of Equity & Inclusion, 210 Martin Luther King, Jr. Blvd., Room 356, Madison, WI 53703, 608/266-4192.

4. In all solicitations for employment placed on Contractor's behalf during term of this Contract, Contractor shall include statement to affect Contractor is "Equal Opportunity Employer". Contractor agrees to furnish all information and reports required by County's Contract Compliance Specialist as same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance with Chapter 19, Dane County Code of Ordinances, and provision of this Contract.

B. Minority / Women / Disadvantaged / Emerging Small Business Enterprises.

1. Chapter 19.508 of Dane County Code of Ordinances is official policy of Dane County regarding utilization of, to fullest extent of, Minority Business Enterprises (MBEs), Women Business Enterprises (WBEs) Disadvantage Business Enterprises (DBEs) and Emerging Small Business Enterprises (ESBEs).
2. Contractor may utilize MBEs / WBEs / DBEs / ESBEs as subcontractors or suppliers. List of subcontractors will be required of low bidder as stated in this Contract. List shall indicate which are MBEs / WBEs / DBEs / ESBEs and percentage of subcontract awarded, shown as percentage of total dollar amount of bid.

#### **44. COMPLIANCE WITH FAIR LABOR STANDARDS**

- A. During term of this Contract, Contractor shall report to County Contract Compliance Specialist, within ten (10) business days, any allegations to, or findings by National Labor Relations Board (NLRB) or Wisconsin Employment Relations Commission (WERC) that Contractor has violated statute or regulation regarding labor standards or relations. If investigation by Contract Compliance Specialist results in final determination that matter adversely affects Contractor's responsibilities under this Contract, and which recommends termination, suspension or cancellation of this Contract, County may take such action.
- B. Contractor may appeal any adverse finding by Contract Compliance Specialist as set forth in Dane County Ordinance 25.015(11)(c) through (e).
- C. Contractor shall post this statement in prominent place visible to employees: "As condition of receiving and maintaining contract with Dane County, this employer shall comply with federal, state and all other applicable laws prohibiting retaliation or union organizing."

#### **45. USE AND OCCUPANCY PRIOR TO ACCEPTANCE**

- A. Contractor agrees to use and occupancy of portion or unit of the Work before formal acceptance by Department, provided Department:
1. Secures written consent of Contractor; except when in opinion of Public Works Project Manager, Contractor is chargeable with unwarranted delay in final cleanup of punch list items or other Contract requirements.
  2. Secures endorsement from insurance carrier and consent of Surety permitting occupancy of building or use of the Work during remaining period of construction, or, secures consent of Surety.
  3. Assumes all costs and maintenance of heat, electricity and water.
  4. Accepts all work completed within that portion or unit of the Work to be occupied, at time of occupancy.

#### **46. CLAIMS**



- A. No claim may be made until Department's Deputy Public Works Director has reviewed Engineer's decision as provided for in Article 35 of General Conditions of Contract. If any claim remains unresolved after such review by Department's Deputy Public Work Director, the claim may be filed under Wisconsin Statute 893.80. Work shall progress during period of any dispute or claim. Unless specifically agreed between parties, venue will be in Dane County, Wisconsin.

#### **47. ANTITRUST AGREEMENT**

- A. Contractor and County recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by County. Therefore, Contractor hereby assigns to County any and all claims for such overcharges as to goods and materials purchased in connection with this Contract, except as to overcharges which result from antitrust violations commencing after price is established under this Contract and any change order thereto.

#### **48. INSURANCE**

- A. Contractor Carried Insurance:
1. Contractor shall not commence work under this Contract until Contractor has obtained all insurance required under this Article and has provided evidence of such insurance to Risk Manager, 425 City-County Building, 210 Martin Luther King Jr. Blvd., Madison, WI 53703. Contractor shall not allow any subcontractor to commence work until insurance required of subcontractor has been so obtained and approved. Company providing insurance must be licensed to do business in Wisconsin.
  2. Worker's Compensation Insurance:
    - a) Contractor shall procure and shall maintain during life of this Contract, Worker's Compensation Insurance as required by statute for all of Contractor's employees engaged in work at site of project under this Contract and, in case of any such work sublet, Contractor shall require subcontractor similarly to provide Worker's Compensation Insurance for all of latter's employees to be engaged in such work unless such employees are covered by protection afforded by Contractor's Worker's Compensation Insurance.
    - b) If any claim of employees engaged in hazardous work on project under this Contract is not protected under Worker's Compensation Statute, Contractor shall provide and shall cause each subcontractor to provide adequate Employer's Liability Insurance for protection of such of Contractor's employees as are not otherwise protected.
  3. Contractor's Public Liability and Property Damage Insurance:
    - a) Contractor shall procure and maintain during life of this Contract, Contractor's Public Liability Insurance and Contractor's Property Damage Insurance in amount not less than \$1,000,000 bodily injury, including accidental death, to any one person, and subject to same limit for each person, in amount not less than \$1,000,000 on account of one accident, and Contractor's Property Damage Insurance in amount not less than \$1,000,000 or combined single limit of at least \$1,000,000 with excess coverage over and above general liability in amount not less than \$5,000,000. Contractor shall add "Dane County" as additional insured for each project.
    - b) Contractor's Public Liability and Property Damage Insurance shall include Products, Completed Operation, and Contractual Liability under Insurance Contract. "Contractor shall in all instances save, defend, indemnify and hold harmless County and Architect / Engineer against all claims, demands, liabilities, damages or any other costs which may accrue in prosecution of the Work and that Contractor will save, defend, indemnify and hold harmless County and Architect / Engineer from all damages caused by or as result of Contractor's operations" and each shall be listed as additional insured on Contractor's and subcontractors' insurance policies.

- c) Obligations of Contractor under Article 50.A.2.b) shall not extend to liability of Architect / Engineer, agents or employees thereof, arising out of:
  - 1) Preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications; or
  - 2) Giving of or failure to give directions or instructions by Architect / Engineer, agents or employees thereof provided such giving or failure to give is primary cause of injury or damage.
- d) Contractor shall procure and shall maintain during life of this Contract, Comprehensive Automobile Liability Insurance covering owned, non-owned and hired automobiles for limits of not less than \$1,000,000 each accident single limit, bodily injury and property damage combined with excess coverage over and above general liability in amount not less than \$5,000,000.
- e) Contractor shall either:
  - 1) Require each subcontractor to procure and to maintain during life of subcontract, subcontractor's Public Liability Property Damage Insurance, and Comprehensive Automobile Liability Insurance of type and in same amount specified in preceding paragraphs; or
  - 2) Insure activities of subcontractors in Contractor's own policy.
- 4. Scope of Insurance and Special Hazards: Insurance required under Article 50.A.2 & 50.A.3. hereof shall provide adequate protection for Contractor and subcontractors, respectively, against damage claims which may arise from operations under this Contract, whether such operation be by insured or by anyone directly or indirectly employed by insured and also against any of special hazards which may be encountered in performance of this Contract as enumerated in Supplementary Conditions.
- 5. Proof of Carriage of Insurance: Contractor shall furnish Risk Manager with certificates showing type, amount, class of operations covered, effective dates, dates of expiration of policies and "Dane County" listed as additional insured. Such certificates shall also contain (substantially) following statement: "Insurance covered by this certificate will not be canceled or materially altered, except after ten (10) business days written notice has been received by Risk Manager."

**B. Builder's Risk:**

- 1. County shall provide Builder's Risk insurance coverage for its insurable interests in construction or renovation projects with completed value of \$1,000,000 or less. Therefore, if project completed value is more than \$1,000,000, Contractor shall obtain and maintain in force, at its own expense, Builder's Risk Insurance on all risks for amount equal to full completed value of covered structure or replacement value of alterations or additions. Any deductible shall not exceed \$25,000 for each loss. Policy shall include occupancy clause and list Dane County as loss payee.

**C. Indemnification / Hold Harmless:**

- 1. Contractor shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives from and against all claims, damages, losses and expenses including attorneys' fees arising out of or resulting from performance of the Work, provided that any such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, and is caused in whole or in part by any act or omission of Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by part indemnified hereunder.
- 2. In any and all claims against Dane County, its boards, commissions, agencies, officers, employees and representatives or by any employee of Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of

- them may be liable, indemnification obligation under this Contract shall not be limited in any way by any limitation on amount or type of damages, compensation or benefits payable by or for Contractor or any subcontractor under worker's compensation acts, disability benefits or other employee benefit acts.
3. Obligations of Contractor under this Contract shall not extend to liability of Architect / Engineer, its agents or employees arising out of:
    - a) Preparation or approval of maps, drawings, opinion, reports, surveys, change orders, designs or specifications; or
    - b) Giving of or failure to give directions or instruction by Architect / Engineer, its agents or employees provided such giving or failure to give is primary cause of injury or damage.
  4. Dane County shall not be liable to Contractor for damages or delays resulting from work by third parties or by injunctions or other restraining orders obtained by third parties.

#### **49. WISCONSIN LAW CONTROLLING**

- A. It is expressly understood and agreed to by parties hereto that in event of any disagreement or controversy between parties, Wisconsin law shall be controlling.


END OF SECTION

SECTION 00 73 00

SUPPLEMENTARY CONDITIONS

1. APPLICATION & CERTIFICATE FOR PAYMENT

- A. Every contractor engaged in performance of any contract for Department of Public Works shall submit partial and final Application & Certificate for Payment for work under said contract. Form shall provide similar information as shown on AIA G702™ and G703™ forms (samples shown below). Forms shall be submitted to project Architect / Engineer for approval.


**AIA Document G702™ – 1992**

**Application and Certificate for Payment**

TO OWNER:	PROJECT:	APPLICATION NO:	Distribution to:
FROM CONTRACTOR:	VIA ARCHITECT:	PERIOD TO:	OWNER <input type="checkbox"/>
		CONTRACT FOR:	ARCHITECT <input type="checkbox"/>
		CONTRACT DATE:	CONTRACTOR <input type="checkbox"/>
		PROJECT NOS:	FIELD <input type="checkbox"/>
			OTHER <input type="checkbox"/>

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**CONTRACTOR'S APPLICATION FOR PAYMENT**

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

1. ORIGINAL CONTRACT SUM ..... \$ \_\_\_\_\_

2. NET CHANGE BY CHANGE ORDERS ..... \$ \_\_\_\_\_

3. CONTRACT SUM TO DATE (Line 1 ± 2) ..... \$ \_\_\_\_\_

4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) ..... \$ \_\_\_\_\_

5. RETAINAGE:

a. \_\_\_\_\_ % of Completed Work  
(Columns D + E on G703) ..... \$ \_\_\_\_\_

b. \_\_\_\_\_ % of Stored Material  
(Column F on G703) ..... \$ \_\_\_\_\_

Total Retainage (Lines 5a + 5b, or Total in Column I of G703) ..... \$ \_\_\_\_\_

6. TOTAL EARNED LESS RETAINAGE ..... \$ \_\_\_\_\_  
(Line 4 minus Line 5 Total)

7. LESS PREVIOUS CERTIFICATES FOR PAYMENT ..... \$ \_\_\_\_\_  
(Line 6 from prior Certificate)

8. CURRENT PAYMENT DUE ..... \$ \_\_\_\_\_

9. BALANCE TO FINISH, INCLUDING RETAINAGE ..... \$ \_\_\_\_\_  
(Line 3 minus Line 6)

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	\$ _____	\$ _____
Total approved this month	\$ _____	\$ _____
<b>TOTAL</b>	<b>\$ _____</b>	<b>\$ _____</b>
<b>NET CHANGES by Change Order</b>	<b>\$ _____</b>	

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

CONTRACTOR:  
By: \_\_\_\_\_ Date: \_\_\_\_\_  
State of: \_\_\_\_\_  
County of: \_\_\_\_\_  
Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_

Notary Public:  
My commission expires: \_\_\_\_\_

---

**ARCHITECT'S CERTIFICATE FOR PAYMENT**

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

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

ARCHITECT:  
By: \_\_\_\_\_ Date: \_\_\_\_\_

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

**CAUTION:** You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.

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**AIA** Document G703™ – 1992

**Continuation Sheet**

AIA Document G702™-1992, Application and Certificate for Payment, or G732™-2009, Application and Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached. In tabulations below, amounts are in US dollars. Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:  
APPLICATION DATE:  
PERIOD TO:  
ARCHITECT'S PROJECT NO:

A ITEM NO.	B DESCRIPTION OF WORK	C SCHEDULED VALUE	D WORK COMPLETED		F MATERIALS PRESENTLY STORED <i>(Not in D or E)</i>	G TOTAL COMPLETED AND STORED TO DATE <i>(D+E+F)</i>	H BALANCE TO FINISH <i>(C-G)</i>	I RETAINAGE <i>(if variable rate)</i>
			D FROM PREVIOUS APPLICATION <i>(D-E)</i>	E THIS PERIOD				
GRAND TOTAL								

**CAUTION:** You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.

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**2. INSURANCE**

A. Not Applicable

**3. ASBESTOS DISPOSAL PROCEDURES**

A. Not Applicable

END OF SECTION

SECTION 00 73 00

BEST VALUE CONTRACTING

**1. CONTRACTORS / LICENSURE APPLICANTS**

The Dane County Department of Public Works requires contractors & subcontractors to be a Best Value Contractor (BVC) before being hired. Contractor & subcontractor application documents should be turned in immediately. Contractor approval or exemption must be complete prior to Bid Due Date / Time. All subcontractors must also be approved or prove their exemption ten (10) business or more days before performing any work under a County contract. This document shall be completed, properly executed, along with the necessary attachments and additional information that the County requires for the protection and welfare of the public in the performance of a County contract.

Contractors or subcontractors of any tier who attain qualification status will retain that status for a period of three (3) years from the date of qualification. Contractors shall notify the Dane County Department of Public Works, Highway & Transportation within fifteen (15) days of any changes to its business or operations that are relevant to the application or status. Failure to do so could result in suspension, revocation of the contractor’s qualification, debarment from County contracts for up to three (3) years and / or other sanctions available under the law.

No contracts will be awarded for construction work performed on Dane County projects unless the contractor is currently approved as a Wisconsin Trade Trainer or has applied for approval as an Apprenticeship Trade Trainer to the Wisconsin Department of Workforce Development and agrees to an acceptable apprenticeship program. If you are not currently approved as a Wisconsin Trade Trainer, or have not applied for approval as an Apprenticeship Trade Trainer, please contact the Department of Workforce Development - Bureau of Apprenticeship Standards at 608/266-3133 or visit their web site at: <https://dwd.wisconsin.gov/apprenticeship/>.

Fill out the BVC Application at the Public Works Engineering Division web site ([publicworks.countyofdane.com/bvc](http://publicworks.countyofdane.com/bvc)). This document is only provided in the RFB for reference. The following page shows what the questions are on the application.

**2. EXEMPTIONS TO QUALIFICATION**

Contractors performing work that does not apply to an apprenticeable trade, as outlined in Item 4. Apprenticeable Trades, is the only reason for claiming an exemption if not an active Wisconsin Trades Trainer. See Question 18A.

**3. APPLICATION QUESTIONS**

NO.	PROOF OF RESPONSIBILITY	CHECK IF APPLICABLE
1	Does your firm acknowledge that in doing work under any County Public Works Contract, it will be required to use as subcontractors only those contractors that are also qualified with the County or become so ten (10) or more days before beginning any work?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
2	Does your firm possess all technical qualifications and resources, including equipment, personnel and financial resources, necessary to perform the work required for any project or obtain the same through the use of responsible, qualified subcontractors?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
3	Will your firm possess all valid, effective licenses, registrations or certificates required by federal, state, county, or local law, which are necessary for the type of work to be performed including, but not limited to, those for any type of trade work or specialty work?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>

4	Will your firm meet all bonding requirements as required by applicable law or contract specifications?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
5	Will your firm meet all insurance requirements as required by applicable law or specifications, including general liability insurance, workers compensation insurance and unemployment insurance requirements?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
6	Will your firm maintain a substance abuse policy for employees hired for public works contracts that comply with Wis. Stats. Sec. 103.503?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
7	Will your employees who will perform work on a Public Works project all be covered under a current workers compensation policy and be properly classified under such policy?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
8	Will your employees who will perform work on a Public Works project have the opportunity to enroll in minimum essential coverage and not be subject to an enrollment period of more than 60 days per the federal Affordable Care Act, Sec. 1513?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
9	Will your firm fully abide by the equal opportunity and affirmative action requirements of all applicable laws, including County ordinances?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
10	Has your firm been the subject of any order or judgement from any State or Federal Agency or court concerning employment practice, including but not limited to: classification of employees under state unemployment or workers compensation laws; minimum wage, overtime pay, recordkeeping, and child labor standards imposed by federal or state law; and employment discrimination or unfair labor practices prohibited by federal or state law. (Attach copies of any order or judgement)	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
11	Is your firm authorized or registered to transact business in the state by the Department of Financial Institutions in compliance with Wis. Stat. Chaps. 178, 179, 180, 181, or 183?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
12	In the past three (3) years, has your firm had control or has another corporation, partnership or other business entity operating in the construction industry controlled it? If so, please attach a statement explaining the nature of the firm relationship?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
13	In the past three (3) years, has your firm had any type of business, contracting or trade license, certification or registration revoked or suspended?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
14	In the past three (3) years, has your firm been debarred by any federal, state or local government agency?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
15	In the past three (3) years, has your firm defaulted or failed to complete any contract?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
16	In the past three (3) years, has your firm committed a willful violation of federal, state or local government safety laws as determined by a final decision of a court or government agency authority.	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
17	In the past three (3) years, has your firm been in violation of any law relating to your contracting business where the penalty for such violation resulted in the imposition of a penalty greater than \$10,000?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.
18	Is your firm an active Wisconsin Trade Trainer as determined by the Wisconsin Bureau of Apprenticeship Standards?	Yes: <input type="checkbox"/>	No: <input type="checkbox"/> If Yes, attach details.



18A	Is your firm claiming an exemption to qualification?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach details.
19	Contractor has been in business less than one year?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>

**4. APPRENTICEABLE TRADES:**

- Bricklayer
- Boilermaker
- Carpenter
- Cement Mason (Concrete Finisher)
- Cement Mason (Heavy Highway)
- Construction Craft Laborer
- Data Communications Installer
- Electrician
- Elevator Mechanic / Technician
- Environmental Systems Technician / HVAC Service Technician / HVAC Install & Service
- Glazier
- Heavy Equipment Operator / Operating Engineer
- Insulation Worker (Heat & Frost)
- Iron Worker (Assembler, Metal Buildings)
- Painter / Decorator
- Plasterer
- Plumber
- Roofer / Waterproofer
- Sheet Metal Worker
- Sprinkler Fitter
- Steamfitter (Service & Refrigeration)
- Taper & Finisher
- Telecommunications (Voice, Data & Video) Installer / Technician
- Tile Setter

END OF SECTION

SECTION 00 73 11

FAIR LABOR PRACTICES CERTIFICATION

The undersigned, for and on behalf of the BIDDER, APPLICANT or PROPOSER named herein, certifies as follows:

A. That he or she is an officer or duly authorized agent of the above-referenced BIDDER, APPLICANT or PROPOSER, which has a submitted a bid, application or proposal for a contract or agreement with the county of Dane.

B. That BIDDER, APPLICANT or PROPOSER has (check one):

\_\_\_\_\_ not been found by the National Labor Relations Board (“NLRB”) or the Wisconsin Employment Relations Commission (“WERC”) to have violated any statute or regulation regarding labor standards or relations in the seven years prior to the signature date of this Certification.

\_\_\_\_\_ been found by the National Labor Relations Board (“NLRB”) or the Wisconsin Employment Relations Commission (“WERC”) to have violated any statute or regulation regarding labor standards or relations in the seven years prior to the signature date of this Certification.

\_\_\_\_\_  
Officer or Authorized Agent Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed or Typed Name and Title

\_\_\_\_\_  
Printed or Typed Business Name

**NOTE:** You can find information regarding the violations described above at: [www.nlr.gov](http://www.nlr.gov) and [werc.wi.gov](http://werc.wi.gov).

For reference, Dane County Ordinance 25.09 is as follows:

(1) BIDDER RESPONSIBILITY. (a) Any bid, application or proposal for any contract with the county, including public works contracts regulated under chapter 40, shall include a certification indicating whether the bidder has been found by the National Labor Relations Board (NLRB) or the Wisconsin Employment Relations Committee (WERC) to have violated any statute or regulation regarding labor standards or relations within the last seven years. The Controller shall investigate any such finding and make a recommendation to the committee, which shall determine whether the conduct resulting in the finding affects the bidder’s responsibility to perform the contract.

**If you indicated that the NLRB or WERC have found you to have such a violation, you must include copies of any relevant information regarding such violation with your proposal, bid or application.**

Include this completed Certification with your bid, application or proposal.

END OF SECTION

## SECTION 01 00 00

### GENERAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Summary
  2. Summary of the Work
  3. Contractor Use of Premises
  4. Applications for Payment
  5. Change Procedures
  6. Alternates
  7. Lump Sum Allowances for Work
  8. Coordination
  9. Cutting and Patching
  10. Conferences
  11. Progress Meetings
  12. Job Site Administration
  13. Submittal Procedures
  14. Proposed Products List
  15. Shop Drawings
  16. Product Data
  17. Samples
  18. Manufacturers' Instructions
  19. Manufacturers' Certificates
  20. Quality Assurance / Quality Control of Installation
  21. References
  22. Interior Enclosures
  23. Protection of Installed Work
  24. Parking
  25. Staging Areas
  26. Occupancy During Construction and Conduct of Work
  27. Protection
  28. Progress Cleaning
  29. Products
  30. Transportation, Handling, Storage and Protection
  31. Product Options
  32. Substitutions
  33. Starting Systems
  34. Demonstration and Instructions
  35. Contract Closeout Procedures
  36. Final Cleaning
  37. Adjusting
  38. Operation and Maintenance Data
  39. Spare Parts and Maintenance Materials

#### 40. As-Built and Record Drawings and Specifications

##### 1.2 SUMMARY OF THE WORK

- A. Project Description: Perform the Work as specified and detailed in Construction Documents package. Contractor to provide construction services to provide an emergency power system that will provide backup generator power for two buildings. Additional loads to be added and modifications to existing generator plant to increase capacity and simplify operations with a more efficient and redundant system.
- B. Work by Owner: Not applicable.
- C. Permits: Prior to commencement of the Work, Contractor to secure any and all necessary permits for completion of the Work and facility occupancy. Provide Public Works Project Manager with copies of all permits.
- D. Diggers Hotline:
  - 1. It is General Contractor's responsibility to contact Diggers Hotline to have all utility locations marked prior to excavation and planning excavation so as not to delay the Work.
  - 2. Use Diggers Hotline to obtain information on safe working clearances from overhead lines.
  - 3. Completely comply with all requirements of each affected utility company.
  - 4. It is General Contractor's responsibility to contact & hire private utility locating services if necessary.

##### 1.3 CONTRACTOR USE OF PREMISES

- A. Limit use of premises to allow work by others and work by Owner.
- B. Coordinate utility outages and shutdowns with Owner.
- C. Contractors or Subcontractors shall not visit the site if they are or have recently been ill.

##### 1.4 APPLICATIONS FOR PAYMENT

- A. Submit each Application for Payment on AIA G702™ and G703™ forms or approved contractors invoice form. Contractor shall have these forms notarized and signed.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Payment Period: Monthly.
- D. Submit Applications for Payment to Architect / Engineer electronically for initial approval. Architect / Engineer will forward approved copies to Owner who will also approve & process for payment.

## 1.5 CHANGE PROCEDURES

- A. Contractor's costs for Products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from contingency allowance.

## 1.6 ALTERNATES

- A. Owner shall review and accept or reject alternates quoted on Bid Form.
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Alternates:
  - 1. Alternate Bid 1.
    - a. Provide short circuit, arc flash and coordination studies as defined in specification sections 260572, 260573 and 260574 for all electrical equipment in the CCB building including equipment that is not shown in the drawings. This scope will also include producing accurate electrical floor plans and one line diagrams for the entire building electrical system.

## 1.7 LUMP SUM ALLOWANCES FOR WORK

- A. Not Applicable.

## 1.8 COORDINATION

- A. Coordinate scheduling, submittals, and work of various sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.
- C. Coordinate space requirements and installation of mechanical and electrical work indicated diagrammatically on Drawings.
- D. Contractor shall provide Public Works Project Manager with work plan that ensures the Work's completion within required time & schedule.
- E. Construct work in stages to accommodate Dane County operations. All activities shall be coordinated one (1) week (minimum) in advance with Public Works Project Manager unless noted otherwise in these specifications.
- F. Public Works Project Manager may choose to photograph or videotape site or workers as the Work progresses.

## 1.9 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching new work; restore work with new Products.
- B. Submit written request in advance of cutting or altering structural or building enclosure elements.
- C. Fit work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- D. Refinish surfaces to match adjacent finishes.

## 1.10 CONFERENCES

- A. Project shall have pre-bid conference; see Instructions to Bidders.
- B. Owner will schedule preconstruction conference after Award of Contract for all affected parties.
- C. Contractor shall submit Construction Schedule at pre-construction meeting.
- D. When required in individual Specification section, convene pre-installation conference at project site prior to commencing work of Section.
- E. Safe distancing & facemasks are required for all conference attendees. In-person conferences will be limited to 10 people; please limit number of attending staff & subcontractors. If there are more than 10 people, we will split group & there will be two or more conferences. Allow sufficient time if you do not make it in to first group.

## 1.11 PROGRESS MEETINGS

- A. Day & time of progress meetings to be determined at pre-construction meeting.
- B. General Contractor shall schedule and administer meetings throughout progress of the Work at minimum of one (1) per week, (time and day to be determined ) with Public Works Project Manager, involved Dane County staff & other individuals as required.
- C. General Contractor shall preside at meetings, record minutes, and distribute copies within two (2) business days to those attending & those affected by decisions made.
- D. Attendance at progress meetings by General Contractor, subcontractors, or their authorized representative, is mandatory.
- E. Contractors shall give verbal reports of progress on the Work, discuss schedule for upcoming period and present all conflicts, discrepancies or other difficulties for resolution.

- F. In-person meetings shall be limited & shall follow current *Public Health - Madison & Dane County* procedures & recommendations (see [publichealthmdc.com/documents/office\\_space\\_checklist.pdf](http://publichealthmdc.com/documents/office_space_checklist.pdf) and [publichealthmdc.com/coronavirus/forward-dane/current-order](http://publichealthmdc.com/coronavirus/forward-dane/current-order)). Whenever possible, hold meetings via teleconference or videoconference, to be hosted by contractor or consultant. Dane County reserves right to mandate safe physical distancing & use of facemasks by all personnel while inside any County facility or on any County grounds.

#### 1.12 JOB SITE ADMINISTRATION

- A. Contractor shall have project superintendent on site minimum of eight (8) hours per week during progress of the Work.
- B. Contractor shall not change their project superintendent or project manager for duration of the Work without written permission of Public Works Project Manager.
- C. Architect / Engineer shall have representative on site regularly during progress of the Work.

#### 1.13 SUBMITTAL PROCEDURES

- A. Submittal form to identify Project, Contractor, Subcontractor or supplier; and pertinent Construction Documents references.
- B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with requirements of the Work and Construction Documents.
- C. Identify variations from Construction Documents and Product or system limitations that may be detrimental to successful performance of completing the Work.
- D. Revise and resubmit submittals as required; identify all changes made since previous submittal.

#### 1.14 PROPOSED PRODUCTS LIST

- A. Within fifteen (15) business days after date of Award of Contract, submit complete list of major Products proposed for use, with name of manufacturer, trade name, and model number of each Product.

#### 1.15 SHOP DRAWINGS

- A. Submit number of copies that Contractor & Architect / Engineer require, plus one (1) copy that shall be retained by Public Works Project Manager.

#### 1.16 PRODUCT DATA

- A. Submit number of copies that Contractor requires, plus one (1) copy that shall be retained by Public Works Project Manager.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to this Project.

#### 1.17 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of Product.
- B. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Public Works Project Manager's & Architect / Engineer's selection.

#### 1.18 MANUFACTURERS' INSTRUCTIONS

- A. When specified in individual Specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

#### 1.19 MANUFACTURERS' CERTIFICATES

- A. When specified in individual Specification sections, submit manufacturers' certificate to Public Works Project Manager for review, in quantities specified for Product Data.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

#### 1.20 QUALITY ASSURANCE / QUALITY CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply fully with manufacturers' instructions.
- C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

#### 1.21 REFERENCES

- A. Conform to reference standard by date of issue current as of date for receiving bids.
- B. Should specified reference standard conflict with Construction Documents, request clarification from Public Works Project Manager before proceeding.



1.22 INTERIOR ENCLOSURES

- A. Provide temporary partitions as required to separate work areas from Owner occupied areas, to prevent distribution of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.

1.23 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual Specification sections.

1.24 PARKING

- A. Arrange for temporary parking areas to accommodate construction personnel. One & only one parking stall for General Contractor shall be available at the Work site.
- B. All contractors and their employees shall cooperate with General Contractor and others in parking of vehicles to avoid interference with normal operations and construction activities.
- C. Do not obstruct existing service drives and parking lots with equipment, materials and / or vehicles. Keep accessible for Owner's use at all times.

1.25 STAGING AREAS

- A. Coordinate staging areas with Public Works Project Manager prior to starting the Work.
- B. On-site space for use as staging areas and storage of materials is limited and will be apportioned among various Contractors as their needs dictate with due regard for storage requirements of each Contractor. Each Contractor shall be responsible for safety of equipment and materials that are stored on site.

1.26 OCCUPANCY DURING CONSTRUCTION AND CONDUCT OF WORK

- A. All construction material and salvage material shall be removed from facility or secured at day's end.
- B. Contractors are asked to not work at facility if they are ill with something contagious.
- C. All contractors are expected to leave work areas in conditions; such that area can be occupied immediately upon leaving area.
- D. Smoking is prohibited on Dane County property.
- E. Owner reserves right at any time to dismiss from premises any Contractor or construction personnel that do not uphold requirements of this Section.

- F. Owner shall not be held liable for any lost time, wages, or impacts to construction schedule by any Contractor or construction personnel dismissed for failure to uphold requirements of this Section.
- G. Areas of existing facility will be occupied during period when the Work is in progress. Work may be done during normal business hours (8:00 am to 4:30 pm), but confer with Owner, schedule work and store materials so as to interfere as little as possible with normal use of premises. Work performed on Saturday shall be by permission of Owner. Notify Owner when coring or similar noise making work is to be done and obtain Owner's written approval of schedule. If schedule is not convenient for Owner, reschedule and resubmit new times for Owner approval. Coring of floor along with other noisy work may have to be done on second and third shifts.
- H. Work shall be done and temporary facilities furnished so as not to interfere with access to any occupied area and so as to cause least possible interference with normal operation of facility or any essential service thereof.
- I. Contractor shall, at all times, provide approved, safe walkways and facility entrances for use by Owner, employees and public.
- J. Contractor shall provide adequate protection for all parts of facility, its contents and occupants wherever the Work under this Contract is to be performed.
- K. Each Contractor shall arrange with Owner to make necessary alterations, do new work, make connections to all utilities, etc., and at such times as will not cause interruption of utility services to facility. Contractor doing this work shall protect, cap, cut off and / or replace and relocate existing pipes, electrical work and other active utilities encountered which may interfere with new construction work.
- L. New work in extension of existing work shall correspond in all respects with that to which it connects or similar existing work unless otherwise indicated or specified.
1. Existing work shall be cut, altered, removed or replaced as necessary for performance of Contract obligations.
  2. Work remaining in place, damaged or defaced by reason of work done under this Contract shall be restored equal to its condition at time of Award of Contract.
  3. If removal of work exposes discolored or unfinished surfaces or work out of alignment, such surfaces shall be refinished or materials replaced as necessary to make continuous work uniform and harmonious.
- M. Contractor is not responsible for providing & maintaining temporary toilet facilities.
- N. Contractor & subcontractors shall follow all current *Public Health - Madison & Dane County* procedures & recommendations (see [publichealthmdc.com/documents/office\\_space\\_checklist.pdf](http://publichealthmdc.com/documents/office_space_checklist.pdf) and [publichealthmdc.com/coronavirus/forward-dane/current-order](http://publichealthmdc.com/coronavirus/forward-dane/current-order)). Dane County reserves right to mandate safe physical distancing & use of facemasks by all personnel while inside any County facility or on any County grounds.

## 1.27 PROTECTION

- A. Contractor shall protect from damage / injury all trees, shrubs, hedges, plantings, grass, mechanical, electrical & plumbing equipment, walks and driveways and pay for any damage to same resulting from insufficient or improper protection.
- B. Contractor shall provide and maintain barricades & signage to prohibit public access to construction site.
- C. Contractor shall provide and maintain guard lights at all barricades, railings, obstructions in streets, roads or sidewalks and at all trenches adjacent to public walks or roads.

## 1.28 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

## 1.29 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.
- B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by Construction Documents.

## 1.30 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

- A. Transport, handle, store and protect Products in accordance with manufacturer's instructions.

## 1.31 PRODUCT OPTIONS

- A. Where definite material is specified, it is not intentional to discriminate against "equal" product made by another manufacturer. Intention is to set definite standard of material quality. Should bidder choose to bid materials other than those specified, bidder shall submit said materials specifications to Public Works Project Manager for approval at least seven (7) business days prior to Bid Due Date.
- B. Products and materials that are not specified, but have been approved for use by Public Works Project Manager shall be identified in addenda to all bidding contractors.
- C. Requests for material or product substitutions submitted after Bid Due Date may be considered. Owner reserves right to approve or reject substitutions based on Specification requirements and intended use.

### 1.32 SUBSTITUTIONS

- A. Public Works Project Manager shall consider requests for Substitutions only within fifteen (15) calendar days after date of Public Works Construction Contract.
- B. Document each request with complete data substantiating compliance of proposed Substitution with Construction Documents.
- C. Limit each request to one (1) proposed Substitution for Public Works Project Manager's consideration.
- D. Substitutions shall not change contract price established at Bid Due Date.

### 1.33 STARTING SYSTEMS

- A. Provide written notification prior to start-up of each equipment item or system.
- B. Ensure that each piece of equipment or system is ready for operation.
- C. Execute start-up under supervision of responsible persons in accordance with manufacturers' instructions.
- D. Submit written report that equipment or system has been properly installed and is functioning correctly.

### 1.34 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.
- C. Owner may choose to photograph or videotape demonstration session; demonstration and demonstrator shall be to level of satisfaction of Owner.

### 1.35 CONTRACT CLOSEOUT PROCEDURES

- A. Submit written certification that Construction Documents have been reviewed, the Work has been inspected, and the Work is complete in accordance with Construction Documents and ready for Public Works Project Manager's inspection.
- B. Submit final Application for Payment identifying total adjusted Contract Sum / Price, previous payments, and amount remaining due.

### 1.36 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.

- B. Clean interior and exterior surfaces exposed to view.
- C. Remove waste and surplus materials, rubbish, and construction facilities from site.

#### 1.37 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

#### 1.38 OPERATION AND MAINTENANCE MANUAL

- A. Provide two (2) bound, hard-copy operation and maintenance manuals that include all systems, materials, products, equipment, mechanical and electrical equipment and systems supplied and installed in the Work. Provide electronic version of operation and maintenance manual also.

#### 1.39 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide Products, spare parts, maintenance and extra materials in quantities specified in individual Specification Sections.
- B. Deliver to the Work site and place in location as directed.

#### 1.40 AS-BUILT AND RECORD DRAWINGS AND SPECIFICATIONS

- A. Contractor-produced Drawings and Specifications shall remain property of Contractor whether Project for which they are made is executed or not. Contractor shall furnish Architect / Engineer with original marked up redlines of Construction Documents' drawings and specifications that shall include all Addendums, Change Orders, Construction Bulletins, Field Directives, on-site changes, field corrections, etc. These are project As-Built Drawings & Specifications.
- B. Architect / Engineer shall update original Construction Documents to include all Addendums & any other changes including those provided by Contractor in As-Built Drawings & Specifications. These updates are project Record Drawings & Specifications.
- C. Architect / Engineer shall furnish Public Works Project Manager with Record Drawings as detailed in Professional Services Agreement.

### PART 2 PRODUCTS

Not Used.

### PART 3 EXECUTION

Not Used.

END OF SECTION

## SECTION 01 74 19

### CONSTRUCTION WASTE MANAGEMENT, DISPOSAL & RECYCLING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Summary
  - 2. Waste Management Goals
  - 3. Construction and / or Demolition Waste Management
  - 4. Waste Management Plan
  - 5. Reuse
  - 6. Recycling
  - 7. Materials Sorting and Storage On Site
  - 8. Lists of Recycling Facilities Processors and Haulers
  - 9. Waste Management Plan Form
- B. Related Sections:
  - 1. Section 01 00 00 - General Requirements
  - 2. Section 01 41 19 – Selective Demolition

##### 1.2 WASTE MANAGEMENT GOALS

- A. Dane County requires that as many waste materials as possible produced as result of this project be salvaged, reused or recycled in order to minimize impact of construction waste on landfills and to minimize expenditure of energy and cost in fabricating new materials. Additional information may be found in Dane County Green Building Policy, Resolution 299, 1999-2000.

##### 1.3 CONSTRUCTION AND / OR DEMOLITION WASTE MANAGEMENT

- A. All construction and demolition waste suitable for recycling may go to Dane County Construction & Demolition Recycling Facility located at 7102 US Hwy 12, Madison, located across from Yahara Hills Golf Course. This facility can receive mixed loads of construction and demolition waste. For complete list of acceptable materials, see [landfill.countyofdane.com/services/construction](http://landfill.countyofdane.com/services/construction).
- B. Dane County Landfill, also at 7102 US Hwy 12, Madison, must receive all other waste from this project. [landfill.countyofdane.com/services/landfill](http://landfill.countyofdane.com/services/landfill).

##### 1.4 WASTE MANAGEMENT PLAN

- A. Contractor shall develop Waste Management Plan (WMP) for this project. Contact the Dane County Special Projects & Materials Manager with questions. Outlined in RECYCLING section of this specification are examples of materials that can be recycled or reused as well as recommendations for waste sorting methods.
- B. Contractor shall complete WMP and include cost of recycling / reuse in Bid. Submit WMP to Public Works Project Manager within fifteen (15) business days

of Bid Due date. Copy of blank WMP form is in this Section. Submittal shall include cover letter and WMP form with:

1. Information on:
  - a. Types of waste materials produced as result of work performed on site;
  - b. Estimated quantities of waste produced;
  - c. Identification of materials with potential to be recycled or reused;
  - d. How materials will be recycled or reused;
  - e. On-site storage and separation requirements (on site containers);
  - f. Transportation methods; and
  - g. Destinations.

#### 1.5 REUSE

- A. Contractors and subcontractors are encouraged to reuse as many waste materials as possible. Investigate salvage for materials not reusable on site.

#### 1.6 RECYCLING

- A. These materials may be recycled at Dane County Construction & Demolition Recycling Facility:
  1. Wood.
  2. Wood Pallets.
  3. PVC Plastic (pipe, siding, etc.).
  4. Asphalt & Concrete.
  5. Bricks & Masonry.
  6. Vinyl Siding.
  7. Cardboard.
  8. Metal.
  9. Unpainted Gypsum Drywall.
  10. Shingles.
- B. These materials can be recycled elsewhere in Dane County area:
  1. Fluorescent Lamps.
  2. Foam Insulation & Packaging (extruded and expanded).
  3. Carpet Padding.
  4. Barrels & Drums.
- C. All materials must be recycled at WDNR permitted waste processing facilities that adhere to all State Statutes.

#### 1.7 MATERIALS SORTING AND STORAGE ON SITE

- A. Contractor shall provide separate containers for recyclable materials. Number of containers will be dependent upon project and site conditions.
- B. Contractor shall provide on-site locations for subcontractors supplied recycling containers to help facilitate recycling.
- C. Dane County allows mixed loads of recycled materials only per instructions at [landfill.countyofdane.com/services/construction](http://landfill.countyofdane.com/services/construction).



## 1.8 LISTS OF RECYCLING FACILITIES PROCESSORS AND HAULERS

- A. Refer to [landfill.countyofdane.com/services/construction](http://landfill.countyofdane.com/services/construction) for information on Dane County Construction & Demolition Recycling Facility.
- B. Web site [landfill.countyofdane.com/recycle-locations](http://landfill.countyofdane.com/recycle-locations) lists current information for Dane County Recycling Markets. Contractors can also contact Allison Rathsack, 608/266-4990, or local city, village, town recycling staff listed at site [landfill.countyofdane.com/resources/local-contacts](http://landfill.countyofdane.com/resources/local-contacts). Statewide listings of recycling / reuse markets are available from UW Extension at [uwgb.edu/solid-hazardous-waste-education-center/](http://uwgb.edu/solid-hazardous-waste-education-center/).

### PART 2 PRODUCTS

Not Used.

### PART 3 EXECUTION

Not Used.

END OF SECTION

## WASTE MANAGEMENT PLAN FORM



Contractor Name: \_\_\_\_\_

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

Phone No.: \_\_\_\_\_ Recycling Coordinator: \_\_\_\_\_

MATERIAL	ESTIMATED QUANTITY	DISPOSAL METHOD (CHECK ONE)	RECYCLING / REUSE COMPANY OR DISPOSAL SITE
Salvaged & reused building materials	_____ cu. yds. _____ tons	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Wood	_____ cu. yds. _____ tons	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Wood Pallets	_____ units	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
PVC Plastic	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Asphalt & Concrete	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Bricks & Masonry	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Vinyl Siding	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Cardboard	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Metals	_____ cu. yds. _____ tons	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Unpainted Gypsum / Drywall	_____ cu. yds. _____ tons	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Shingles	_____ cu. yds. _____ tons	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Fluorescent Lamps	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Foam Insulation	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Carpet Padding	_____ cu. ft. _____ lbs.	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Barrels & Drums	_____ units	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____
Glass	_____ cu. yds. _____ tons	____ Recycled    ____ Reused ____ Landfilled    ____ Other	Name: _____

**WASTE MANAGEMENT PLAN FORM**

Other	_____	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Other	_____	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Other	_____	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Other	_____	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Other	_____	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	

# SECTION 013300 SUBMITTAL PROCEDURES

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Administrative and procedural requirements for Submittal Schedule, Shop Drawings, Product Data, Samples, and other submittals.

### 1.2 DEFINITIONS

- A. Required submittals are specified in each technical specification Section and identified as either Action Submittals, Informational Submittals, Sustainable Design Submittals or Closeout Submittals.
  - 1. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
  - 2. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.
  - 3. Closeout Submittals: Operation and maintenance manuals, warranties, and project record documents required at project closeout.
- B. Deferred Submittals: Submittals used for vendor-designed systems and components that have not been permitted under the based building application.

### 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order and coordinated with Construction Schedule, List of Subcontracts, Schedule of Values, and with performance of construction activities.
- B. Preparation: Prepare and submit Submittal Schedule within 10 working days after award of Contract, and prior to execution of Contract.
- C. Format: Arrange the following information in a tabular format:
  - 1. Specification Section number and title.
  - 2. Submittal Type: Product Data, Shop Drawing, Sample, or other.
  - 3. Submittal Category: Action, Informational, Sustainable Design, Closeout.
  - 4. Scheduled date for first submittal.
  - 5. Scheduled date for Architect's final release or approval.
  - 6. Name of subcontractor.
  - 7. Description of the Work covered.
- D. Grouping: Schedule transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination. Identify and schedule groups of related items, including but not limited to:
  - 1. Submittal schedule, list of materials, list of subcontractors, schedule of values
  - 2. Air barrier system.
  - 3. Glazing systems and glass.
  - 4. Doors, hardware and electronic access.
  - 5. Custom fabrications.
  - 6. Integrated systems.
  - 7. Prefabricated assemblies involving components from multiple specification Sections.
  - 8. Submittals that need to be routed to multiple disciplines and consultants.
  - 9. Other submittals identified by Architect.
- E. Review and Processing Time: Allow at least 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
  - 1. Include additional time for making corrections or revisions to submittals noted by Architect and for handling and reviewing submittals required by those corrections.

2. Allow extra review time for large groups of related submittals transmitted at one time, and for submittals requiring sequential review by multiple parties such as Architect's consultants or Owner.
3. Resubmittal Review: Allow 10 working days for review of resubmittal.

#### 1.4 SUBMITTAL ADMINISTRATIVE PROCEDURES

- A. Submittal Procedures, General: Refer to General Conditions for Contractor's scope of submittal review and acceptance.
  1. Substitutions or contract modifications shall not be made in submittals.
    - a. Approval of a submittal alone does not constitute acceptance of the substitution or modification within the submittal and Contractor will be responsible for exceptions or variations not in compliance with Contract Documents.
    - b. If an exception, variation or change is being proposed, clearly indicate so on submittal and comply with product substitution and contract modification procedures for approval. See Section 012600 - Contract Modification Procedures and Section 016000 - Product Requirements and Substitution Procedures.
  2. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal approval until the respective submittal has been approved by the Architect.
  3. Partial Submittals: Partial submittals for only a portion of the Work will be reviewed with prior approval from Architect.
  4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
- B. Submittal Coordination: Submit Shop Drawings, Product Data, Samples, and Informational Submittals as individual packages, each with its own transmittal. Send all required submittals of a single specification Section concurrently, but as separate packages under separate transmittals.
- C. Electronic Submittals: Prepare and submit submittals as specified in individual Specification Sections, and as follows:
  1. Post electronic submittals as PDF electronic files directly using Architect's internet-based project information management software, Newforma.
    - a. Architect will return stamped and annotated PDF file using the same software.
  2. File Format: Assemble each submittal package into a single PDF file.
    - a. Filename: Incorporate submittal number or other unique identifier, including revision identifier.
    - b. Submit unlocked, editable PDF file to accommodate electronic annotation and stamps.
    - c. Index PDF file with bookmarks enabling navigation to each item requiring Architect's action.
  3. Transmittal Form: Include completed transmittal form. Submittals sent without completed Submittal Transmittal Form will be considered incomplete, marked NOT ACCEPTED, and returned without review. See Section 013310 - Submittal Transmittal Form.
  4. Stamp Page: Include a page specifically intended for Contractor and Architect stamps.
  5. Signatures for Electronic Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Digital Signature: Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    - b. Notarized Certificates: Provide a notarized statement on original paper copy certificates and certifications where indicated.
- D. Contractor's Review: Prior to submitting to Architect, review each submittal for clarity, coordination with other Work and compliance with the Contract Documents; note corrections, clarifications and field dimensions and insert Contractor's approval stamp.
  1. Contractor's Approval Stamp: Stamp each submittal with a uniform approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
- E. Architect's Review:
  1. Architect will review each submittal, annotate to indicate required corrections or revisions, insert action stamp and mark stamp appropriately to indicate action, as follows:

- a. APPROVED: Submittal has no exceptions noted.
  - b. CONDITIONALLY APPROVED: Submittal has exceptions noted, but resubmission is not required.
  - c. NOT APPROVED: Submittal is incomplete and/or need corrections. Complete and/or correct and resubmit until final acceptance is obtained.
  - d. RECEIVED: Submittal is for information only.
  - e. NOT REVIEWED: Submittal was not required and has not been reviewed.
2. Architect will advise Contractor when a submittal being processed must be delayed for coordination. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- F. Final Submittals: Stamped APPROVED or CONDITIONALLY APPROVED.
- 1. Distribute final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for coordination and performance of construction activities. Show distribution on transmittal forms. Provide copies to Owner if Owner requests copies during construction.
  - 2. Use for Construction: Retain copies of submittals Record Set on Project site.

## 1.5 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of material, product or equipment, describing product properties and performance, and indicating compliance with Contract Documents.
- 1. Identifying Information:
    - a. Include Architect's material identification abbreviation or equipment number as indicated in the Contract Documents.
    - b. Indicate products and options applicable to Project.
    - c. Indicate options requiring Architect's selection.
    - d. Description of intended use, application, or location for Project.
  - 2. Technical Information:
    - a. Manufacturer's catalog cuts.
    - b. Statement of compliance with specified referenced standards.
    - c. Testing reports by recognized testing agency.
    - d. Application of testing agency labels and seals.
    - e. Coordination requirements.
    - f. Wiring diagrams showing factory-installed wiring.
    - g. Printed performance curves.
    - h. Operational range diagrams.
    - i. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
    - j. Where color charts are required in lieu of color samples, provide original hard copy color charts.
  - 3. Not Acceptable as Product Data Submittal: The following types of data are not suitable for technical review and will be marked NOT APPROVED or NOT REVIEWED, and returned. Unless indicated otherwise in technical specification Sections, do not submit the following:
    - a. Product Data not reviewed by Contractor, or without Contractor's stamped approval.
    - b. PDF's with internet hyperlinks requiring Architect to navigate websites for information or to download documents.
    - c. Manufacturer's non-technical marketing literature, or other documents that are inadequate as technical information.
    - d. Illegible scans of hard copies.
    - e. Product Safety Data Sheets (SDS) or Material Safety Data Sheets (MSDS), unless otherwise required as part of a sustainability documentation requirement.
    - f. Electronic color chart files, scanned PDF of color chart, or photocopied hard copies of color charts.
- B. Shop Drawings: Submit in PDF electronic file format. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Use of Architect's Drawings: Do not reproduce Architect's drawings (whether CADD files, electronic files, hard copy drawings or other publication method) to serve as shop drawings until Architect's written permission is received and then only under the following conditions:
    - a. Use is subject to terms and conditions included in written permission.
    - b. Use only where necessary to indicate general location of a specific fabricated item.
    - c. Remove extraneous notes and information from Drawing before inclusion in submittal. Only show information related to fabrication, erection, installation, application of components, products or systems being produced. Do not include Architect's title block or other information identifying Architect.
    - d. Submitted drawing shall only include information intended to be reviewed and accepted.
    - e. Refer to Summary of Work for additional information on Electronic files.
  2. Layout Drawings: Provide where necessary for field use or as required by Architect.
  3. Shop Drawings:
    - a. Number in submittal sequence.
    - b. Include contractor's stamp of approval, as evidence that drawings are approved in accordance with General Conditions, except that field dimensions must be verified prior to approval and submittal.
    - c. Provide clear space on each drawing of not less than 40 square inches for Architect's stamp.
    - d. Show field verified dimensions on final shop drawings and identify verified dimensions.
    - e. Show adjacent construction and how each item coordinates with other subcontractors, trades and suppliers.
  4. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  5. Not Acceptable as Shop Drawing Submittal: The following types of drawings are not suitable for technical review and will be marked NOT APPROVED or NOT REVIEWED, and returned. Unless indicated otherwise in technical specification Sections, do not submit the following:
    - a. Shop drawings not reviewed by Contractor, or without Contractor's stamped approval.
    - b. Shop drawings without requested information.
- C. Samples: Submit physical Samples materials and products; for review of quality, kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Electronic Transmittal: For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
  2. Transmit Samples that contain multiple, related components together in one submittal package.
  3. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.
  4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples not incorporated into the Work or otherwise designated as Owner's property, are the property of Contractor.
    - b. Delivery: As required by specifications to Architect/Engineer with delivery costs prepaid.
    - c. Removal: At Architect's/Engineer's direction, remove samples after approval.
  5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

- a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.
    - b. Architect will return submittal with options selected.
  - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected.
    - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
      - 1) Assembly Sample: Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) Range Samples: If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
  - 7. Other Samples: Provide samples for other purposes as specified, such as for testing or for transmittal to other entities for matching.
  - 8. Not Acceptable as Samples Submittal: The following types of samples are not suitable for review or for final selections and will be marked NOT APPROVED or NOT REVIEWED, and returned. Unless indicated otherwise in technical specification Sections, do not submit the following:
    - a. Electronic color chart files, PDF of scanned of color chart, or photocopied hard copies of color charts.
- D. Product Schedules: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
- 1. Format: Submit in form of a searchable PDF electronic file format.
  - 2. Include the following information in tabular form:
    - a. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
    - b. Manufacturer and product name, and model number if applicable.
    - c. Number and name of room or space.
    - d. Location within room or space.
- E. Certificates:
- 1. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
  - 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  - 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  - 4. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  - 5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- F. Test Reports:
- 1. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  - 2. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.



3. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
  4. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
  5. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- G. Product Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
  2. Date of evaluation.
  3. Time period when report is in effect.
  4. Product and manufacturers' names.
  5. Description of product.
  6. Test procedures and results.
  7. Limitations of use.
- H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- I. Deferred Submittals: Where specifically required by the Contract Documents all deferred submittal items shall be submitted to the Architect/Engineer for review for stated design criteria and general compliance to the specified requirements. The Contractor shall submit these reviewed documents to the Authority Having Jurisdiction. The deferred submittal items shall not be installed until the deferred submittal documents have been approved by the Authority Having Jurisdiction.

## 1.6 DELEGATED DESIGN SERVICES

- A. Delegated Design Submittal and Shop Drawings: Where professional design services or certifications by a qualified Professional Engineer are specifically required of the Contractor by the Contract Documents, prepare and incorporate the following delegated design requirements into the shop drawings submittal package.
1. Shop drawings shall be signed and sealed by a qualified Professional Engineer or contain an attached certificate, signed and sealed by a qualified Professional Engineer, indicating that the products and systems comply with performance and design criteria in the Contract Documents.
  2. Shop drawings or certificate shall clearly define the design criteria and applied loads for which the system components and connections have been designed. If design criteria indicated in the Contract Documents are not sufficient to perform services or certification required, submit a written request for additional information to Architect/Engineer.
    - a. Include list of design criteria, codes, standards, loads, and other factors used in performing these services.
  3. Shop drawings shall clearly indicate magnitude and location of all forces transferred to the supporting building structure by the product or system in which it is connected to. Forces shall be provided as unfactored values determined in accordance with the applicable building codes.
- B. Calculations: Upon request from the Architect/Engineer only, Contractor shall submit signed and sealed engineering calculations prepared by a qualified Professional Engineer. Submitted calculations that have not been requested by the Architect/Engineer will be returned without review.
1. Calculations shall indicate structural integrity of members, anchors, fasteners and connections to supporting building structure, in accordance with performance and design criteria in Contract Documents. Provide load calculations, summary of loads and any applicable load diagrams.
  2. Calculations will be reviewed by Architect/Engineer for stated design criteria, general compliance to specified requirements, and forces imposed on supporting structure only. The accuracy of the design calculations is the sole responsibility of the Contractor's Professional Engineer.

- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the systems, assemblies, or products that are similar in material, design, and extent to those indicated for this Project.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

**END OF SECTION**



**SECTION 013310  
SUBMITTAL TRANSMITTAL**

**To:** Hammel Green and Abrahamson, Inc.                      **From:** (Contractor)  
7475 Hubbard Avenue, Suite 201  
Madison, Wisconsin 53562-3146                                              (City, State)

**Email:** SMorner@hga.com

**Owner:** Dane County

**Project:** Emergency Generator Replacement                      **Submittal Date:** \_\_\_\_\_

**HGA No.:** 2407-004-00                                              **Previous Submittal Date:** \_\_\_\_\_

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Incomplete submittals will be returned "Not Accepted." See General Conditions and 013300 for requirements.

The following submittal(s) is (are) attached for your review as required by the Contract Documents.

---

**SHOP DRAWINGS**

\_\_\_ No. copies submitted. Submit minimum 1 PDF per 013300; complete the following information:

Partial     Complete     Preliminary     Final     LEED

List of Drawings: \_\_\_\_\_

Specification Section: \_\_\_\_\_ Article & Paragraph: \_\_\_\_\_

Description of Item: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Supplier's Name: \_\_\_\_\_ Telephone Number: \_\_\_\_\_

**PRODUCT DATA AND QUALITY CONTROL**

\_\_\_ No. copies submitted. Submit minimum 1 PDF per 013300; complete the following information:

Partial     Complete     Preliminary     Final     LEED

List of Items: \_\_\_\_\_

Specification Section: \_\_\_\_\_ Article & Paragraph: \_\_\_\_\_

Description of Item: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Supplier's Name: \_\_\_\_\_ Telephone Number: \_\_\_\_\_

**SAMPLES**

\_\_\_ No. copies submitted. Submit minimum 3 copies per 013300; complete the following information:

Partial     Complete     Preliminary     Final     LEED

List of Items: \_\_\_\_\_

Specification Section: \_\_\_\_\_ Article & Paragraph: \_\_\_\_\_

Description of Item: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Supplier's Name: \_\_\_\_\_ Telephone Number: \_\_\_\_\_

---

**Submitted By: Company Name:** \_\_\_\_\_

**Phone:** \_\_\_\_\_

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

**Send to: SMorner@hga.com**



**SECTION 016210  
PRODUCT OPTIONS AND SUBSTITUTION REQUIREMENTS**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Procedures, requirements and limitations for considering substitutions.
  2. Criteria for selecting product options and substitutions.

**1.2 DEFINITIONS**

- A. "Product" means material, equipment, assembly, system, manufacturer, brand, trade name, element, item or similar as applicable.
1. Provide new products free from defects and deficiencies unless otherwise noted.
  2. Provide components and accessories necessary for a complete system by same manufacturer unless otherwise specified.
- B. Terms such as "approved substitute", "equal to", "accepted by", "approved by", or other synonymous terms mean that acceptance of proposed product is subject to approval by Architect after submittal requirements are met. Architect's decision is final and binding.
- C. Available Manufacturers: See below.
- D. Except where "no substitutions", "same as existing" or "match existing" are noted, term "or approved substitute" is implied throughout, subject to prior approval conditions specified including where the term "Available Manufacturers" is included.

**1.3 SUBMITTALS**

- A. Submit requests for substitution in writing to Architect at least 10 calendar days prior to bid date and hour. Requests received after this time will not be considered.
- B. Clearly define and describe proposed substitute product including following items:
1. Fully completed Section 016211 - Substitution Request Form.
  2. Manufacturer's printed information supporting claim that proposed product meets specified requirements. Provide following as applicable:
    - a. Literature Specifications Drawings Cut Sheets Performance data List of reference projects of similar size, value and complexity Model numbers Other information necessary to completely describe item.
  3. Provide a point by point comparison between key features of specified Basis of Design item and proposed substitution.
  4. Provide submitted materials marked with Article and Paragraph references from Specification using highlighter, marker and flags on pages to facilitate review and show that substitution meets specified requirements.
  5. Provide a letter indicating requestor has reviewed Contract Documents and examined site (if needed) and that proposed substitution meets specified requirements.
- C. Accepted substitutions will be published in writing. No information or indication of acceptance will be provided by means other than written Addendum during bidding or Architect's written construction administration document following bidding. Refer to "Limitations on Substitutions after Bids or During Construction" in this Section.
- D. Bid and construct according to Contract Documents unless approval of substitution is provided in writing.
- E. Architect is not obligated to state reasons for rejecting substitution.

## 1.4 LIMITATIONS ON SUBSTITUTIONS AFTER BIDS OR DURING CONSTRUCTION

- A. Intent is to limit unnecessary substitutions after bids. Changes will not be allowed to accepted list of products, except when specified or accepted product subsequently is determined as not meeting requirements of Contract Documents or product becomes unavailable, and then only under following conditions:
1. Orders were placed in timely manner as required after list of materials is accepted. No excuse or proposed substitution will be considered for products due to unavailability unless proof is submitted that firm orders were placed in a timely manner.
  2. Reason for unavailability is beyond control of Contractor: prolonged strikes or lockouts which will delay Project to an extent unacceptable to Owner, bankruptcy, discontinuance of a product, delays or Acts of God or other similar reasons.
  3. Request for substitution is submitted in writing within 10 days after date Contractor becomes aware product does not comply with specifications or has become unavailable, accompanied by supporting evidence.
  4. No extra cost to Owner.
  5. Substitution does not compromise design intent or quality required.
  6. Substitute product is acceptable to Owner and Architect.
  7. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  8. Requested substitution does not require revisions to Contract Documents.
  9. Requested substitution is consistent with the Contract Documents and will produce intended and indicated results.
  10. Substitution request is fully documented and properly submitted.
  11. Requested substitution will not adversely affect Contractor's Construction Schedule.
  12. Requested substitution has received necessary approvals of authorities having jurisdiction.
  13. Requested substitution is compatible with other portions of Work.
  14. Requested substitution has been coordinated with other portions of Work.
  15. Requested substitution provides specified warranty.
  16. If requested substitution involves more than one trade, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to installers involved.

## PART 2 MATERIALS

### 2.1 PRODUCTS

- A. Architect and Owner reserve right to accept or reject proposed product. Should a proposed product be unable to meet requirements to satisfaction of Architect, product shall not be used. No additional compensation will be allowed for required Work resulting from use of product accepted by Addendum.
- B. Use only one brand, manufacturer, source or type for like products unless otherwise approved or specified. Contractor is obligated to do so unless otherwise approved in writing.
- C. Provide pricing based on products listed in Contract Documents. Contract award is based on use of specified products or substitutions approved prior to bidding or pricing.
1. By execution of Contract, Contractor agrees and understands Work will be accomplished with products specified or accepted by substitution.
- D. Basis of Design Products:
1. Reference to "Basis of Design" and a named specific product or manufacturer is intended to establish criteria for use of that product and manufacturer based on that products published information whether or not those criteria are explicitly stated in Specifications.

2. Criteria may establish higher performance requirement than specified reference or performance standards. Such reference is intended to establish minimum level of quality, standard of design, function, appearance, type, strength, durability, construction, efficiency, sound level, finish, appearance, availability, service and similar characteristics determined necessary for Project.
  3. Specification criteria including basis of design products are considered as a whole.
  4. Other products or manufacturers listed meet features, performance, appearance and other criteria established by that product or manufacturer even if product must be customized to meet those criteria.
  5. When other products are listed in a Section those products may be used if they meet entire specification criteria including criteria implied by product listed as basis of design. Meeting some requirements but not meeting criteria established by basis of design product does not qualify as meeting specified requirements.
  6. Products or manufacturers accepted for substitution will be acceptable provided they fully comply with requirements and match basic and essential criteria of product used for basis of specification or design, including level of fabrication quality, as determined by Architect.
- E. Reference Standards for Products:
1. When references to Federal Specification, ASTM Standard, American National Standards Institute (ANSI) or similar association standards are listed for product quality, provide an acceptable affidavit certifying that proposed substitution for this Project meets with same standard.
  2. Submit supporting test data to substantiate compliance.
- F. Substitute products shall:
1. Be available in same range of colors, textures, dimensions, gauges, types, and finishes as specified product.
  2. Be equal to specified item in strength, durability, efficiency, serviceability, ease and cost of maintenance.
  3. Be compatible with building design.
  4. Not necessitate design modifications.
  5. Not impose additional work or require changes in work of Prime Contractor, or other Subcontractor, vendor, or materials supplier.
  6. Not add cost to Owner.
  7. Be similar in essential fabrication features.
- G. Contractor, supplier or manufacturer providing accepted substitute product shall bear cost of required modifications to spaces, services, utilities and other features as result of accepting substitute products, including but not limited to:
1. Larger capacity mechanical or electrical service, devices or utilities resulting from acceptance of product for bidding purposes.
  2. Modification to pipes, conduits, ducts, and controls for conveying, distributing, and controlling those services or utilities.
  3. Modification to insulation, wrappings, coatings, or other integral features of lines or items conveying those lines.
- H. Timely Placement of Product Orders: Place product orders in a timely manner, within ten days after acceptance of submitted list of materials.

## **2.2 LABELS, NAMEPLATES AND TRADEMARKS**

- A. Provide permanent nameplate on each item of service-connected or power-operated equipment. Locate nameplate on easily accessible surface.
1. Nameplate shall indicate manufacturer, model number, serial number, capacity, speed, electrical characteristics and similar essential operating data.
- B. UL fire rating labels and other labels which must be visible after installation shall be located on inconspicuous surfaces.
1. Other labels and trademarks shall be located on concealed surfaces or shall be removable without damaging surfaces.



2. Do not permanently attach or imprint labels or trademarks on surfaces which will be exposed to view in occupied spaces.
- C. Do not paint, deface or conceal required nameplates or labels.

**PART 3 EXECUTION**

Not Used.

**END OF SECTION**

**SECTION 016211  
SUBSTITUTION REQUEST FORM**

**To:** **Hammel, Green and Abrahamson, Inc.**  
7475 Hubbard Avenue, Suite 201  
Madison, Wisconsin 53562-3146  
Attention: Svein Morner

**Project:** Dane County  
**Emergency Generator Replacement**  
**HGA Comm. No.: 2407-004-00**

**Date Received:** \_\_\_\_\_

**Specification Section Number and paragraph:** \_\_\_\_\_

**Drawing and details affected:** \_\_\_\_\_

**Proposed Substitution:** \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Product (model, pattern, etc.): \_\_\_\_\_

**WHY IS SUBSTITUTION BEING SUBMITTED?** (Select one of the following):

- Pre-Bid Substitution (Prior Approval) Bid Date:
- Specified product is not available. Explain.
- Cost savings to Owner. Indicate comparative cost analysis.
- Other: Explain.

**EFFECTS OF PROPOSED SUBSTITUTION:** Answer the following questions and attach explanations.

Does substitution affect dimensions indicated on Drawings?

- NO       YES, explain:

Does substitution affect Work of other Sections?

- NO       YES, explain:

Does substitution require modifications to design, changes to Drawings, or revisions to specifications to be incorporated into the Project?

- NO       YES, explain:

Attach list of at least 3 projects where proposed substitution has been used within past 12 months; include name, address, and telephone number of Owner and Architect.

**CONTRACTOR'S / BIDDER'S REPRESENTATION**

Undersigned accepts responsibility for coordination of proposed substitution and accepts all additional costs resulting from the incorporation of proposed substitution into the Project per Section 016210.

**SUBMITTED BY:**

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

**Fax No:** \_\_\_\_\_

**For Architect's use:**

- Accepted       Not Accepted  
 No Action Required  
 Submission: Incomplete  
 Too Late

Reviewed by/date: \_\_\_\_\_

Comments: \_\_\_\_\_

**Subcontractor's signature and date:** \_\_\_\_\_

**Contractor's signature and date:** \_\_\_\_\_



## **SECTION 017329 CUTTING AND PATCHING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Cutting, demolition, removal, patching and restoration of Work to accomplish and complete Work under this Contract.
  - 2. Relocation or reuse of existing materials, equipment, systems, or other work, as well as disposition of salvaged materials or debris.
  - 3. This Section applies to each subcontractor under this Contract.
- B. Related Sections:
  - 1. Section 024119 – Selective Demolition.

#### **1.2 DESCRIPTION**

- A. Drawings show design intent for scope of demolition, removals, relocations and cutting. Drawings may not show or indicate each Work item needed and may not indicate each condition or detail encountered to accomplish Work of this Contract.
  - 1. Examine spaces to determine actual conditions and requirements. Perform removal, demolition, cutting, restoration, new installations and other Work to accomplish new conditions required under Contract including connection of new to existing.
- B. Each trade is to perform demolition, cutting, removals, relocations, patching and restoration required to accomplish Work under each Subcontract.
  - 1. Mechanical Subcontractor removes or relocates piping, ductwork and other items typical to its trade.
  - 2. Electrical Subcontractor removes or relocates panelboards, conduit, lighting and other items typical to its trade.
  - 3. General Construction demolishes and removes abandoned or unwanted electrical or mechanical materials and other general construction items in space.

#### **1.3 SUBMITTALS**

- A. Schedule: Submit schedule indicating proposed sequence of operations for demolition work to Owner's Representative for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.
  - 1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
  - 2. Coordinate with Owner's continuing occupation of portions of existing building and with Owner's partial occupancy of completed new addition.

#### **1.4 QUALITY ASSURANCE**

- A. Skilled Mechanics: Accomplish all work of cutting, removal, demolition, relocation, patching and other restoration by using only mechanics skilled in the trade. If necessary, sublet the work to skilled contractors or subcontractors.
- B. Structural Work: Where Work of removals, demolition, cutting and similar work involves structural consideration, avoid damage and preserve safety of structure and persons.
  - 1. Particular care must be taken where demolition or removals occur adjacent to occupied areas. Employ if necessary competent and qualified technical assistance to develop safe methods and techniques to accomplish the work, including for temporary shoring and supports, methods of removal and other considerations.

2. Each permanent or temporary supports shall be so designed and placed by considering each loads and shall be carried down to sound bearing.
- C. Hazardous Substances: If removals, demolition, cutting and similar work results in discovery or impact to possible hazardous substances and/or harmful physical agents, such as lead paint, asbestos fibers, or polychlorinated biphenyl (PCB), avoid damage to hazardous substance and protect safety of persons. Immediately notify Owner and Architect in accordance with provisions of AIA General Conditions.

## **1.5 COORDINATION**

- A. Coordination: Coordinate Work of this Section with each subcontractors so Work will progress without interruption and minimum delays. Contractor must also coordinate and schedule Work with Owner where possible disturbance may occur and where relocations or other potential disruptions of Owner's functions and services may occur. Work affecting Owner's functions and services shall be performed at times acceptable to Owner.

## **PART 2 DISPOSITION OF MATERIALS**

### **2.1 UNSALVABLE MATERIALS**

- A. Remove unsalvable materials in a manner that will avoid damage to materials or equipment which will remain. Completely remove and legally dispose away from the site.

### **2.2 SALVABLE MATERIALS TO BE RE-USED IN THE WORK**

- A. Salvable materials and items designated for reuse or relocation shall be removed by the applicable trades and relocated to the new location. If the new location is not ready to receive the relocated item, it shall be stored and protected from damage until incorporated into the new work or remodeled area. If the Owner is unable to forego the use of any existing items at the normal time for relocation until other facilities are available to the Owner, make all preparations for the item and delay relocation until a time approved by the Owner.
- B. Carefully remove, salvage, clean and preserve materials, equipment and other items indicated to be reused, or which will be needed for reuse to match existing work. Exercise extreme care in removals to prevent damage or to make materials unsuitable to reuse. For materials shown or called for to be reused and which are damaged, replace with equivalent and matching work.
- C. Where brick from existing building is required for patching, exercise care in removing brick from existing building to preserve for reuse. Do not reuse broken brick. After removal clean all mortar from all sides of brick, carefully stockpile and protect to insure brick is available for reuse. Stockpile off site, if space is not available at site, and cover or otherwise protect from soil or damage. Stockpile on suitable platform (not on earth).

### **2.3 SALVABLE MATERIALS TO BE STORED BY THE OWNER**

- A. The Owner will mark or tag existing materials, equipment or other items Owner wishes to retain. Salvable materials and items designated or marked to remain the property of the Owner shall be carefully removed by the applicable trades, protected from damage and stored adjacent to the removal area as directed.
- B. Consult the Owner for any salvage the Owner may wish to retain and the salvageability of all items. Carefully remove and salvage any materials the Owner wishes to retain. Remove finish hardware from the item or material taken out of the building and turn over to Owner. Cleaning or restoration of the Owner's salvage materials is not required.
- C. Removal from the area and the site to the Owner's storage will be by the Owner.

## **PART 3 EXECUTION**

### **3.1 INSPECTION**

- A. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- B. After uncovering, inspect conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

### **3.2 TEMPORARY PROTECTION**

- A. Provide temporary bracing, shoring, needling and support during demolition, cutting, remodeling and related new construction as necessary for the execution of the Work and the protection of persons and property. Perform all work with appropriate supports, protection and methods to prevent collapse, settling or damage to property or persons. Provide adequate supports for the loads to be carried, with loads properly distributed, including to lower levels and sound bearing, if necessary.
- B. Provide protective coverings and enclosures necessary to prevent damage to existing spaces and materials to remain. Protect openings in exterior walls and roofs so as to prevent damage from water and the elements and prevent excessive heat loss from the existing buildings. Coordinate work and removals at exterior, including roof, by scheduling and performing to maintain watertight installation. Seal areas left temporarily unfinished to prevent damage to existing roof or other materials and furnishings of existing building.
- C. Provide dustproof temporary enclosures (including above ceilings) separating areas under demolition and remodeling from the remainder of the building as well as temporary filters at duct work. Provide temporary hinged doors in temporary enclosures where necessary. Temporary and permanent doors shall be completely sealed with tape or other suitable material during demolition work and shall remain sealed until dust has settled.
- D. Provide protection from elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water.

### **3.3 DEMOLITION AND CUTTING**

- A. Demolish and remove existing construction as shown, indicated or required to be removed to accomplish the Work. Where new Work is to be installed in or adjacent to existing construction or existing work is to be replaced, remove or cut the existing construction as necessary to complete the Work of the Project.
- B. Execute work with care. Existing construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of the Work and is unsuitable for use intended shall be removed and replaced at no additional cost to the Owner.
- C. Debris from upper levels shall be transported to ground in covered chute or other approved means. No free-fall debris removal is permitted. Moisten debris with spray where practical. Take all precautions to minimize dust.
- D. Clean demolition areas and remove debris, waste and rubbish from the building at the conclusion of each day's work. Transport debris and rubbish in such a manner so as to prevent spread of dust. Do not store or permit debris storage at site. Do not burn debris, rubbish or waste at the site. Keep adjacent areas unencumbered and clean. Keep walks and similar areas broom clean.

### **3.4 PATCHING, REMODELING, REPLACEMENTS AND RESTORATION**

- A. Patch or otherwise restore disturbed existing construction as indicated on Drawings and schedules, or as otherwise required to restore the work and surfaces. Patching or restoration shall be carried to natural breaks (i.e., corners) wherever possible. Where existing construction is removed, cut or otherwise disturbed by Work of the Project, patch defective and incomplete surfaces. Repair damage to existing construction which is to remain.

- B. Patching work shall be done by skilled mechanics experienced in the particular type of work involved. Patching work shall conform to the standards of the Specifications where applicable and where not specified, work shall conform to the highest standards of the trade.
- C. Patch existing construction to match existing work (unless otherwise called for) except provide new materials and accomplish as for new work. Examine existing surfaces to be patched before proceeding with the work. Report all conditions where existing materials, colors and finishes cannot be matched to the Architect and Owner, and do not proceed until instructions have been given.
- D. Existing construction that has been damaged as a result of the Work shall be repaired to an extent and as required to match adjacent existing undamaged construction.
- E. Thoroughly clean and prepare all surfaces to receive new finish or covering. Completely remove dirt, dust, grease, oil, paint, loose materials and soil. Clean, etch where necessary, and place surfaces in most suitable condition for the finish.

### **3.5 ADJUSTMENTS**

- A. Where partitions are removed, patch floors, walls, and ceilings, with finish materials to match existing.
  - 1. Where removal of partitions results in adjacent spaces becoming one, rework floors and ceilings to provide smooth planes without breaks, steps, or bulkheads.
  - 2. Where extreme change of plane of two inches or more occurs, request instructions from Architect as to method of making transition.
- B. Trim and refinish existing doors as necessary to clear new floors.

### **3.6 MECHANICAL AND ELECTRICAL WORK EXPOSED**

- A. Where unknown mechanical piping, ductwork or electrical conduit is exposed during removal of partitions, walls or floors and ceilings, the removal or rerouting shall be accomplished by the Mechanical or Electrical Subcontractor as applicable. Locate mechanical and electrical work where directed and connect to maintain all functions in proper operation. Abandoned piping may be left in place where it is concealed in floors or walls, providing that it is disconnected from its source and capped. There shall be no "dead end" water, sewer, gas, or vent piping existing in the completed work.
- B. Accomplish removals, capping or otherwise terminating services which are abandoned or need to be abandoned, and rerouting of mechanical and electrical work without additional cost to the Owner, whether shown or noted on drawings or otherwise encountered.

### **3.7 WORK AT EXISTING ROOF**

- A. Verify with the Owner to ascertain the existence of an existing roof bond or guarantee. Cutting and patching of existing building roof shall be performed with compatible materials using methods so as not to invalidate any current bond or guarantee. Cutting of all openings through roof shall be done by manufacturer's licensed or approved roofing contractor. Arrange with the manufacturer who furnished the roof bond or with the roofer who provided the roof guarantee for an examination of the complete work and provide two copies of an acknowledgement and/or approval to the Owner indicating that such bond or guarantee (if any) will remain in effect.
- B. Spud off gravel about 4 feet back from roof penetration at areas indicated on roof plan and/or details at existing roof construction. Remove and patch materials to extent indicated. Feather roofing plies back, down to existing insulation; remove cut or damaged insulation and provide new insulation where required. New felts shall overlap each other and stagger back onto existing roof at successive plies. Provide at least four (4) plies. Flood coat new roof membranes and regravels where required.
- C. At existing membrane roof system, cut and patch membrane and insulation as required at penetrations. Remove and patch materials to extent indicated. Remove cut or damaged insulation and provide new insulation where required. Regravels where required.

### **3.8 WORK OF EACH CONTRACT**

- A. The Contractor and each subcontractor must carefully review the Contract Documents including those primarily for other trades with respect to the coordination of the demolition, removal and remodeling work and perform such removals normal to their trades as may be shown, noted or otherwise required. Cutting and patching incidental to demolition, removal and/or remodeling of general construction work shall be construed as the work of the General Contractor when shown or indicated on the general construction drawings or schedules or specifically noted or called for on documents primarily for other trades as being accomplished by the General Contractor. Other subcontractors (mechanical or electrical) are responsible for such other cutting, demolition, patching, replacement and restoration as may be required to accomplish their part of the Work.

### **3.9 PAINTING**

- A. Each major subcontractor (mechanical, electrical) shall be responsible for painting or repainting of patched or remodeled areas where they have performed work, except for those areas shown or required to be remodeled under the general construction drawings, specifications or schedules, in which case, the new, patched and remodeled paintable surfaces shall be repainted by the General Contractor. It is the intent that the mechanical and electrical subcontractors are responsible to paint or repaint surfaces at locations where demolition, cutting and patching has been accomplished only for their work.
- B. Painting, including preparation, materials, workmanship and number of coats shall comply with Section 099000 - Painting. Painting of surfaces patched shall extend to natural breaks, such as corners, as approved by the Architect and Owner.

### **3.10 FLOOR PREPARATION (EXISTING SLABS)**

- A. Prepare existing concrete slabs for the installation of various floor finish materials, i.e., VCT, ceramic and quarry tile, carpet (glue-down), concrete topping.
- B. Roughen surfaces which are glossy or which have loose surface material or curing sealers by sanding, scarifying or acid etching as required. Remove surface material that is not compatible with adhesive. Clean thoroughly to remove all oil, dirt, sealer materials and dust.

### **3.11 CLEANING**

- A. Perform periodic and final cleaning as specified in Section 017700 - Closeout Procedures.
  - 1. Clean Owner-occupied areas daily.
  - 2. Clean spillage, overspray, and heavy collection of dust in Owner- occupied areas immediately.
- B. At completion of work of each trade, clean area and make surfaces ready for work of successive trades.
- C. At completion of alterations work in each area, provide final cleaning and return space to a condition suitable for use by Owner.

**END OF SECTION**





# SECTION 024119 SELECTIVE DEMOLITION

## PART 1 GENERAL

### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of site elements.
  - 3. Salvage of existing items to be reused or recycled.
- B. Related Sections:
  - 1. Section 017329 – Cutting and Patching.

### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and re-install them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

### 1.3 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.
  - 5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
  - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
  - 7. Means of protection for items to remain and items in path of waste removal from building.
- B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

### 1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Pre-Demolition Conference: Conduct conference at Project site to review methods and procedures related to selective demolition including, but not limited to, the following:
  - 1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

## **1.5 PROJECT CONDITIONS**

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
  1. Comply with requirements specified in Division 1 Section "Summary."
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  1. Maintain fire-protection facilities in service during selective demolition operations.

## **1.6 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### **3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS**

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 1 Section "Summary."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated 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 indicated utilities with utility companies.
  3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
    - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: 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. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  3. Cover and protect furniture, furnishings, and equipment that have not been removed.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

### 3.4 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, to minimize disturbance of adjacent surfaces. 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. 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 fire watch and portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  8. 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. Paint equipment to match new equipment.
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 and soiling during selective demolition.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. 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. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.7 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**

# SECTION 042000 UNIT MASONRY

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Concrete masonry units (CMU).
  - 2. Setting and Anchoring materials.
  - 3. Miscellaneous masonry accessories (MA).

### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Reinforcing Steel: Detail bending, lap lengths, and placement of reinforcing bars. Comply with ACI 318. Show elevations of reinforced walls.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
  - 1. CMU: For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units. Include data on material properties and material test reports substantiating compliance with requirements.
  - 2. Mortar Materials: Include name of manufacturer, brand name, and type. Include description of type and proportions of ingredients, including admixtures and preblended products.
- B. Mix Designs and Preconstruction Test Data: Include description of type and proportions of ingredients and state building components in which each will be used.
  - 1. Mortar: Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  - 2. Grout: Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
    - a. Use proportion specification of ASTM C476 as a minimum criterion and design for minimum compressive strength of 3,000 psi when tested in accordance with ASTM C1019.
  - 3. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver dry preblended mortar mix and other cementitious materials in moisture-resistant containers and store on elevated platforms in a dry location or in covered weatherproof dispensing silos, on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.5 FIELD CONDITIONS

- A. Protection of Masonry, General:
  - 1. Provide temporary bracing of masonry during erection. Do not remove bracing until building structure provides permanent bracing.
  - 2. Protect masonry and prevent damage by construction activities. Provide and maintain protective boards at exposed external corners.
  - 3. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- B. Moisture Protection: Protect completed and partially completed masonry from rain and moisture at all times. Cover tops of completed and partially completed walls, projections and sills with waterproof sheeting at end of each work day and whenever possible during work hours. Extend cover a minimum of 48 inches down both sides of wall and hold cover securely in place.
- C. Stain Prevention: Prevent grout, mortar and soil from staining the face of masonry to be left exposed.
  - 1. Protect sills, ledges and projections, as well as installed materials with painted and integral finishes, from mortar droppings.
  - 2. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
  - 3. Protect base of walls from rain-splashed mud and from mortar splatter. Provide coverings on ground and at face of wall, extend out to minimum of 48 inches from face of wall and minimum of 48 inches up from grade, or as required due to site conditions and weather. Hold cover securely in place.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops net-area compressive strengths at 28 days as indicated on Drawings.
  - 1. Unit Strength Method: Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types according to TMS 602/ACI 530.1/ASCE 6.

### 2.2 PRODUCT REQUIREMENTS

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source for each different product required.
- C. Appearance Requirements of Exposed Masonry: Provide masonry units of uniform color and texture matching the range represented by Architect's sample, as determined by the Architect, unless indicated otherwise. Architect's decision is final on whether or not a proposed product matches. Architect reserves the right to reject unit masonry materials and manufacturer if unit quality, color or texture is unacceptable with design intent. Appearance requirements may be waived by Architect for concealed units.
- D. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated. Where required by Authorities Having Jurisdiction, units shall be listed and labeled by a qualified testing agency acceptable to Authorities Having Jurisdiction.

### 2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated on Drawings and as follows, with exposed surfaces matching exposed faces of adjacent units, unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  2. Provide square-edged units for outside corners, unless indicated otherwise on Drawings.
  3. Concrete Building Brick: ASTM C 55.
- B. (CMU-1) Concrete Masonry Units: ASTM C 90, load-bearing units of size as shown on Drawings.
1. Unit Compressive Strength: Provide units that comply with the compressive strength of masonry indicated on the contract documents.
  2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
  3. Density Classification: Medium weight or Normal weight.
- C. (CMU-2) Solid Units: ASTM C 90, load-bearing units of size as shown on Drawings.

## 2.4 LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.5 MORTAR AND GROUT

- A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
1. Color: Provide natural color or white cement as required to produce mortar color matching Architect's sample.
  2. Alkali Content: Not more than 0.1 percent when tested according to ASTM C 114.
- C. Hydrated Lime: ASTM C 207, Type S without air-entrainment.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Mortar Cement: ASTM C 1329.
- F. Masonry Cement: Not allowed.
- G. Premixed Colored Cement Products: Packaged, pre-mixed blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients. Formulate blend as required to produce color indicated.
1. Color Basis of Design: Custom to match Architect's sample.
  2. Manufacturers:
    - a. Davis Colors.
    - b. Spec Mix, LLC.
    - c. Solomon Colors, Inc..
- H. Aggregate for Mortar (Sand): ASTM C 144, and as follows:
1. For joints less than 1/4 inch use aggregate graded with 100 percent passing No. 16 sieve.
  2. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  3. Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
- A. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.



- B. Water: Potable.

## 2.6 REINFORCEMENT

- A. Reinforcing Bars:
  - 1. Uncoated-Steel: ASTM A 615 or ASTM A 996, Grade 60.
  - 2. Bar Positioners: 0.148-inch steel wire units, hot-dip galvanized after fabrication; designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells.
- B. (HZRE-1) Masonry-Joint Reinforcement at Single-Wythe CMU Walls: ASTM A 951, ladder or truss type with single pair of side rods; minimum 0.148-inch wire, hot-dip galvanized carbon steel or stainless steel; cross rods and cross ties spaced not more than 16 inches o.c.. Provide in lengths of not less than 10 feet. Provide prefabricated corner and tee units.

## 2.7 ANCHORS AND TIES

- A. Manufacturers: Subject to compliance with specified requirements, provide Basis of Design or equivalent products as approved by Architect, by one of the following manufacturers:
  - 1. Fero Corporation.
  - 2. Heckman Building Products.
  - 3. Hohmann & Barnard Inc..
  - 4. Wire-Bond.
- B. Anchors and Ties, General: Provide ties and anchors specifically designed to be used together; sized to extend at least halfway, but not less than 1-1/2 inches, through masonry unit and with at least 5/8-inch mortar cover on outside face; and made of materials that comply with the following, unless otherwise indicated:
  - 1. Steel Sheet: ASTM A 1008, Commercial Steel; 0.074-inch minimum thickness; with ASTM A 153, Class B coating applied after fabrication.
  - 2. Steel Wire: ASTM A 82; 0.187-inch minimum diameter; with ASTM A 153, hot-dip galvanized Class B-2 coating applied after fabrication.
  - 3. Stainless Steel Sheet: ASTM A 240 or ASTM A 666, Type 304; 0.078-inch minimum thickness.
  - 4. Stainless Steel Wire: ASTM A 580, Type 304; 0.187-inch minimum diameter.
- C. Adjustable Anchors for Connecting CMU to Structural Steel Framing: Wire tie and weld-on anchor section fabricated from steel sheet or wire, that allows vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
- D. CMU Partition Top Anchors: 0.105-inch- thick metal plate, ASTM A 36, with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication or stainless steel.
- E. Trim Unit Anchors: Provide anchors or dowels of type and size indicated, fabricated from stainless steel complying with ASTM A 276 or ASTM A 666, Type 304.
- F. Tapping Screws for Concrete and CMU: Stainless steel self-tapping screws with specially designed threads for anchoring into masonry and concrete, with hex washer head 1/4-inch diameter by length as required to embed 1-1/2-inch into substrate material.
  - 1. Basis of Design: Tapcon; TCHS by Tapcon.
  - 2. Basis of Design: Tapper by Powers Fasteners.

## 2.8 MASONRY ACCESSORIES

- A. (MA-1) Preformed Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
  - 1. Basis of Design: RS Series Rubber Control Joints by Hohmann & Barnard, Inc..
- B. (MA-2) Compressible Filler: Pre-molded compressible filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

1. Basis of Design: NS Closed Cell Neoprene Sponge by Hohmann & Barnard, Inc..
- C. (MA-3) Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226, Type I, No. 15 asphalt felt.
- D. Other Joint Protection: In accordance with Section 079100 - Preformed Joint Seals and Section 079200 - Joint Sealant.
- E. Masonry Cleaner: Clean all exposed masonry work. Use cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer, manufacturer of masonry units and colored mortar being cleaned.
  1. Approved Manufacturers: Prosoco Inc.; Diedrich Technologies, Inc..

## 2.9 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
  1. Use portland cement-lime mortar, unless otherwise indicated.
  2. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, or other admixtures unless otherwise indicated.
  3. Do not use anti-freeze compounds to lower freezing point of mortar.
  4. Do not use calcium chloride in mortar or grout.
  5. Use mortar ingredients that will not produce efflorescence.
  6. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.
  7. Colored Mortar:
    - a. Pigments shall not exceed 10 percent of portland cement by weight.
    - b. Mix to match Architect's sample.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar Mixes:
  1. Mortar for Loadbearing Unit Masonry (indicated on structural drawings): ASTM C270, type as scheduled using Property specification.
- D. Schedule of Mortar Types: Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry:
  1. Interior load-bearing walls: Type N or S.
  2. Interior non-load-bearing partitions: Type N or S.

## 2.10 GROUT MIX

- A. Grout for Unit Masonry: Comply with ASTM C476. For use in filling bond beams, concrete unit masonry cells with reinforcing bars, and other cells or cavities as indicated.
  1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 7 in TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  2. Use fine aggregate size No. 2 for fine grout and coarse aggregate size No. 8 for coarse grout in accordance with ASTM C404.
  3. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2.1 for specified 28-day compressive strength indicated, but not less than 3000psi when tested in accordance with ASTM C1019.
  4. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION AND PREPARATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
  - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Examine rough-in and built-in construction for piping systems to verify actual locations of piping connections. Verify that items built-in by other trades are properly located and sized.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 MIXING MORTAR AND GROUT**

- A. Mixing Masonry Mortar: Thoroughly mix in accordance with TMS 602-11 / ACI 530.1 / ASCE 6-11 in quantities needed for immediate use,
  - 1. Admixtures: Add in accordance with manufacturer's recommendations. Ensure uniformity of mix and colorations.
    - a. Consult with and follow manufacturer's directions on use, mix designs and procedures, quantity and mixing of admixtures and various conditions affecting mixing and pouring. Show proposed admixtures on mix designs and do not use unless shown.
  - 2. Ensure that sand is uniformly damp immediately before mixing
  - 3. Maintain workability of mortar by remixing or re-tempering. Discard mortar which has begun to stiffen or is not used with 2 1/2 hours after initial mixing.
- B. Mixing Masonry Grout: Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for Fine or Course grout.
  - 1. Unless otherwise required, mix grout other than self-consolidating grout to a consistency that has a slump between 8 and 11 inches.
  - 2. Proportioning of self-consolidating grout at the project site is not permitted. Do not add water at the project site in accordance with the self-consolidating grout manufacturer's recommendations.
  - 3. Add admixtures in accordance with manufacturer's instructions. Mix thoroughly.

### **3.3 INSTALLATION, GENERAL**

- A. Layout: Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets.
  - 1. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
  - 2. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
  - 3. Place masonry in accordance with lines and levels indicated on drawings. Lay from exposed side, plumb, level and true to modular dimensions.
  - 4. Thickness: Build masonry walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
  - 5. Build chases and recesses to accommodate items specified in this and other Sections.
  - 6. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- B. Bond Pattern: Unless otherwise indicated, lay exposed masonry in running bond, lapping not less than 4 inches. Bond and interlock each course of each wythe at corners.
  - 1. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- C. Exposed Units: Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- D. Built-In Work: As work progresses, build-in items as indicated and required, including, hollow metal frames, window frames, steel angle lintels, nailing strips, anchor bolts, plates, sleeves, hangers, supports, and other items supplied by other trades.
  - 1. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
  - 2. Wherever bolts, brackets and similar anchor items are cast-in masonry, fill voids in masonry with mortar to adequately anchor and transmit loads.
  - 3. Build-in items plumb and true.
  - 4. Do not build-in organic materials which will be subjected to rot or deterioration.
  - 5. Fill in solidly with masonry around built-in items.
- E. Anchoring Masonry to Structure: Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
  - 1. Provide an open space between masonry and structural steel or concrete as shown, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.
- F. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- G. Reinforced Masonry:
  - 1. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
  - 2. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
    - a. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
    - b. Limit height of vertical grout pours to not more than 60 inches.
  - 3. Grout Placement: Place grout at intervals not to exceed 4 feet of wall height during construction of walls, unless cleanouts are provided in which case 8 foot lifts may be used.
    - a. Rod or vibrate grout to insure complete filling of cells.
    - b. Allow at least 15 minutes between successive pour lifts to permit settlement.
    - c. Stop intermediate pours at least 1-1/2 inches below mortar joint.
    - d. Exercise care during filling of cells to insure reinforcement is properly positioned. Tie vertical bars to joint reinforcement at 32 inches centers to maintain their proper location.
    - e. Use care to prevent mortar droppings from accumulating at base of cells. Provide temporary cleanout openings, if necessary, at base of cells in order to remove droppings prior to placement of grout.
  - 4. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Non-Load-Bearing Interior Partitions: Carry masonry partitions up to structure above, unless otherwise noted.
  - 1. Joint to Structure Above: Provide 3/8 inch joint between masonry and over-structure and pack solidly to form dense and effective barrier to sound transmission. Fill of voids shall permit movement and deflection.
    - a. Install compressible filler in joint between top of partition and underside of structure above.
    - b. Secure top of non-load bearing cmu partitions to structure above as indicated in drawings.
    - c. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 - Fire-Resistive Joint Systems.
  - 2. Openings Through Walls: Except as otherwise indicated, where piping, conduit or similar features pass through walls, carefully fill spaces to block sound. Fill voids to permit movement and deflection. Fill solid around obstructions and voids to form effective closures.
- I. Isolate masonry partitions from vertical structural framing members with control joint, with mortar raked back 1/4 inch regardless of joint treatment.

- J. Cut and fit concrete block for chases, pipes, conduit, sleeves, and grounds. Cooperate with other sections of work to ensure correct size, shape and location. Provide not less than 8 inches of masonry between chase or recess and jamb of openings. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges.
  - 1. Where piping and conduit run in masonry, work with other trades to coordinate work.
  - 2. Cut out center bridges in block to create voids for pipes or conduit.
  - 3. Where pipes or conduit exit from wall, drill neat holes to provide neat unpatched walls.
  - 4. Obtain Architect's review prior to cutting or fitting any area not indicated on drawings, or which may impair appearance or strength of masonry work.
- K. At Hollow Metal Door and Window Frames:
  - 1. Fill space between hollow metal frames and masonry solidly with mortar.
  - 2. Bed anchors of hollow metal frames in mortar joints.
  - 3. Fill frame voids solid with mortar.
  - 4. Fill masonry cores at jambs with grout for full projection at frame anchors.

### 3.4 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. Dimensions in Cross Section or Elevation: Do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. Location of Elements in Plan: Do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. Location of Elements in Elevation: Do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. Bed Joints and Top Surfaces of Bearing Walls: Do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
  - 2. Conspicuous Horizontal Lines (such as lintels, sills, parapets, and reveals): Do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 3. Vertical Lines and Surfaces: Do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
  - 4. Conspicuous Vertical Lines (such as external corners, door jambs, reveals, and expansion and control joints): Do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 5. Lines and Surfaces: Do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
  - 6. Vertical Alignment of Exposed Head Joints: Do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
  - 7. Faces of Adjacent Exposed Masonry Units: Do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
  - 8. Concrete Block to Receive Direct-Applied Finishes: Lay block plumb, with flush mortar joints and with maximum surface variation of 1/8 inch in 10 feet.
- C. Joints:
  - 1. Bed Joints: Do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
  - 2. Exposed Bed Joints: Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  - 3. Head and Collar Joints: Do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
  - 4. Exposed Head Joints: Do not vary from thickness indicated by more than plus or minus 1/8 inch.
  - 5. Exposed Head Joints and Bed Joints of Stacked Bond: Do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Laying CMU:
1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  3. Bed webs in mortar in grouted masonry, including starting course on footings.
  4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
  5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
  6. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
  7. Install joint reinforcing, anchors and ties in full mortar surround and where necessary fill voids in blocks to provide full bed to completely imbed items.
- B. Laying Solid CMU: Lay with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Mortar Joint Tooling:
1. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  2. Unless otherwise indicated, strike joints flush where:
    - a. below grade and where indicated to receive waterproofing.
    - b. cavity wall insulation.
    - c. air or moisture barriers.
    - d. for masonry walls to receive plaster or other direct-applied finishes (other than paint).
    - e. Joints behind ceramic tile.
    - f. Joints to receive resilient wall base.
  3. Strike flush and then tool to dense sealed surface mortar joints that will be covered by earth.
  4. Rake out mortar in preparation for application of sealants, where required.
- D. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

### 3.6 MASONRY JOINT REINFORCEMENT

- A. Joint Reinforcement: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space continuous joint reinforcement not more than 16 inches o.c vertically.
  2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  3. Provide reinforcement not more than 8 inches above and below wall openings and extending 36 inches beyond openings in addition to continuous reinforcement.
  4. Place joint reinforcement at bed joint at top course of wall or partition, continuous full length of wall.
  5. At foundation walls with earth on both sides, provide reinforcement only at top 2 courses.
  6. Refer to Structural Drawings for locations of reinforcement bars within concrete masonry wall section.
  7. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

### 3.7 CONTROL AND EXPANSION JOINTS

- A. Control Joints and Expansion Joints, General: Provide as indicated and where shown on Drawings, or if not shown, review locations with Architect prior to start of installation.
1. Install control- and expansion-joint materials in unit masonry as masonry progresses.
  2. Form joints in CMU and face brick straight and true.
  3. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
  4. Unless otherwise shown on Structural Drawings, end reinforcing approximately one inch either side of joints.

- B. Control Joints at CMU:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  2. Install preformed control-joint gaskets designed to fit standard sash block.
  3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
  5. Keyed Control Joint in Bond Beams: At continuous bond beams, provide keyed control joint at construction joints.
    - a. Extend rebar beyond joint minimum of 18 inches.
    - b. Use 2X wood block drilled to allow rebar to pass through wood block.
    - c. Set block inside of bond beam and coat with form release agent.
    - d. Secure block in place before pouring bond beam.
- C. Joint Fillers and Deflection Material: Install fillers in accordance with manufacturer's printed instructions. Compressible fillers shall be 50 percent larger than joint size.
1. Set at proper depth or position in joint to coordinate with other work, including installation of bond breakers, backer rods and sealants.
  2. Do not leave voids or gaps between ends of joint filler units.
  3. Recess exposed edges or faces of compressible fillers slightly behind adjoining surfaces so that compressed units will not protrude from joint.

### 3.8 LINTELS

- A. Provide reinforced concrete block lintels over openings where indicated on drawings.
1. Construct lintels and bond beams using concrete and reinforcing steel as specified on drawings. Erect on full even beds of mortar with reinforced grout filled jambs as indicated on the Drawings.
  2. For lintels, use reinforcement bars of full lengths only.
  3. Place and consolidate grout without disturbing reinforcing. Construct lintels on plank, adequately supported, joints equally spaced. Do not support lintels with hollow metal door frames. Fill spaces around built-in items solid with masonry and mortar unless otherwise indicated. Clean out spaces prior to pouring grout.
  4. Allow lintel to reach 90 percent design strength or 28 days before removing temporary supports. Remove units that show evidence of cracking.
  5. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

### 3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage qualified special inspectors. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
1. Quality Assurance: Level C in TMS 402/ACI 530/ASCE 5.
  2. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  3. Place grout only after inspectors has verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  4. Place grout only after inspectors have verified proportions of site-prepared grout.
- B. Testing Method:
1. Unit Strength Method:
    - a. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
    - b. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
    - c. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

- d. Mortar Test (Property Specification): Perform tests of mortar and mortar materials for each mix provided, according to ASTM C 780.
  - 1) Compressive Strength: ASTM C 109
  - 2) Water Retention: ASTM C 1506
  - 3) Air Content: ASTM C91
- e. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- 2. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.
- C. Testing Frequency:
  - 1. Preconstruction Testing: One set of tests.
  - 2. During Construction: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

### 3.10 REPAIRING AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
  - 7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
  - 8. Clean stone trim to comply with stone supplier's written instructions.
  - 9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

### 3.11 INSTALLED WORK

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
- B. Adequately brace all work to prevent damage of any kind. Mask, barricade or similarly protect work as required from damage during building operations. Protect installed material as necessary to prevent staining or damage from the elements.
- C. Provide temporary bracing of masonry during erection. Do not remove bracing until building structure provides permanent bracing.
- D. During erection, keep all walls dry by covering the top with a strong, waterproof membrane at each shutdown and the end of each day. Cover partially completed walls at all times when work is not in progress. Extend cover a minimum of 2 feet down both sides, and securely hold in place.

**END OF SECTION**





# SECTION 055000 METAL FABRICATIONS

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Miscellaneous metal, except structural steel framing as specified in Section 051200 and defined as structural steel in AISC "Code of Standard Practice":
    - 1. Metal Fabrications:
      - a. Metal Grating (GRT-1).
    - 2. Fabrication.
    - 3. Surface preparation and priming for finishes on ferrous metal, performed in shop:
      - a. Surface preparation;
      - b. Galvanizing;
      - c. Shop primer for paint;
      - d. Shop primer for high-performance coatings;
    - 4. Engineering required to comply with specified performance requirements.

### 1.2 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: Indicate dimensions, description of materials and finishes; include plans, elevations, sections, and details of metal stairs and ladders and their connections and reactions to building structure. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections, and installation procedures, including specific requirements indicated.
  - 1. Indicate design criteria and applied loading for which metal fabrications have been designed.
  - 2. Clearly indicate magnitude and location of all forces transferred to the primary building structure by metal fabrications. Loads shall be provided as unfactored values determined in accordance with ASCE 7-10.
  - 3. Construction details, sizes of metal sections, thickness of metals, profiles, attachments, dimensions and field joints, method of support from structure, and finishes.
  - 4. Work to be built-in or provided by other Sections.
  - 5. Welding: Indicate welded connections, both shop and field, using standard AWS welding symbols. Indicate net weld lengths.
  - 6. Shop drawings shall be signed and sealed by the qualified professional engineer responsible for their preparation.
  - 7. Deferred-Design Submittal: Submit shop drawings to Authority Having Jurisdiction for approval prior to commencing with this work on-site.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Calculations: Signed engineering calculations shall be submitted upon written request from the Architect/Engineer. Calculations shall indicate structural integrity of members, anchors, fasteners and connections to building structure, in accordance with specified criteria.

1. Engineering Responsibility: Calculations shall be reviewed for stated design assumptions, general compliance to specified requirements, and forces imposed on structure. The accuracy of the design calculations shall be the sole responsibility of the Contractor's Professional Engineer.
2. Submitted calculations that have not been requested by the Architect/Engineer shall be returned without review.

## 1.5 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Professional engineer who is legally qualified to practice in the State of Minnesota and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of metal stairs and ladders (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent
- B. Fabricator Qualifications: Firm experienced in producing metal stairs similar to those indicated for this Project and with record of successful in-service performance, as well as sufficient production capacity to product required units.
- C. Installer Qualifications: Arrange for metal stairs specified in this Section to be fabricated and installed by same firm.
- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code-Sheet Steel."

## 1.6 HANDLING AND STORAGE

- A. Load, unload, handle and store work in manner that will not bend, deform or otherwise damage metal. Store so metal and shop coats will not be subject to weather or moisture, store off ground and provide covering for metal in storage.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 STRUCTURAL DESIGN REQUIREMENTS

- A. Engineering Responsibility: Engage a qualified Professional Engineer to provide delegated design services in accordance with Section 013300 - Submittal Procedures.
- B. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding following structural loads without exceeding allowable design working stress of materials for handrails, railings, anchors, and connections:
  1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied at any point and in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.

### 2.3 MATERIALS

- A. Materials, General:
  1. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2. Recycled Content of Ferrous Metals: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel:
1. Rolled-Steel Floor Plate: ASTM A 786 rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
  2. Sections, Plates, Sheet and Bars: Structural quality steel; ASTM A36 and ASTM A440 where high strength steel is required.
  3. Steel Plates, Shapes and Bars: ASTM A36.
  4. Steel Tubing: ASTM A501 or ASTM A500.
  5. Steel Pipe: ASTM A53, Type S, Grade A, standard weight and extra-strong as required, galvanized and plain.
  6. Galvanized Sheet Metal: ASTM A526 or A527, G-90 coating designation with both sides of metal prime painted.
  7. Galvanizing: ASTM A123, hot dip galvanizing, thickness Grade 55 unless otherwise indicated.
- C. Welding Materials: Applicable AWS D1.1, type required for materials being welded.
- D. Fasteners: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required
1. Bolts, Nuts and Washers: High strength steel hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
  2. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, load equal to 6 times load imposed when installed in unit masonry and equal to 4 times load imposed when installed in concrete, as determined by testing per ASTM E488, conducted by qualified independent testing agency.
    - a. Material: Carbon-steel components zinc-plated to comply with ASTM B633, Class Fe/Zn 5.
  3. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329
- E. Concrete Materials and Properties: Comply with requirements in Section 033000 - Cast-in-Place Concrete for normal-weight, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi, unless higher strengths are indicated.

## 2.4 METAL FABRICATIONS AND ASSEMBLIES

- A. (GRT-1) Metal Grating:
1. Serrated Carbon Steel Bar Grating, Galvanized Steel, Hot Dipped, Serrated Surface Texture, Bearing Bar Thickness: 0.188 inches, Bearing Bar Spacing: 1.188 inches, Cross Bar Spacing: 4 inches, Grating Height: 2 inches.
    - a. Basis of Design Product: Grainger Item # 38MG18.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.
- J. Miscellaneous Framing and Supports: Fabricate from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
  2. Furnish inserts for units installed after concrete is placed.

## 2.6 FINISHING

- A. Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Stainless Steel:
1. Finish designations prefixed by AISI shall conform with the system established by the American Iron and Steel Institute for designating finishes for stainless steel sheet.
  2. Bright, Directional Polish: AISI No. 4 finish.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
1. Hot Dip Galvanizing for Shapes and Plates: ASTM A123, for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strips 0.0299 inch thick and heavier.
  2. Hot Dip Galvanizing for Bolts and Similar Threaded Fasteners: ASTM A153, for galvanizing steel and iron hardware.
  3. Galvanizing Touch-Up Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
  4. At railings to be hot-dipped galvanized after fabrication: Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed products:
1. Exterior (SSPC Zone 1B): SSPC SP 6/NACE No. 3, "Commercial Blast Cleaning."
  2. Interior (SSPC Zone 1A): SSPC SP 3, "Power Tool Cleaning."
  3. Do not apply primer to galvanized surfaces.
- E. Shop-Applied Primer and Field-Applied High-Performance Coating (HPC): Coordinate with Section 099600 - High-Performance Coatings.

- F. Shop-Applied Primer and Field-Applied Paint (PT) or Epoxy Paint (PTE): Coordinate with Section 099000 - Painting.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions under which miscellaneous metal items are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Provide setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
- C. Perform cutting, drilling and fitting required for installation of miscellaneous metal items. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
- D. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch up shop paint coat. Do not weld, cut or abrade surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- F. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 2 mils.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.
- H. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- I. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- J. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- K. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

**END OF SECTION**

# **SECTION 061000 ROUGH CARPENTRY**

## **PART 1 GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Concealed wood blocking and nailers.
  - 2. Preservative treatment.
  - 3. Fire-retardant treatment.
  - 4. Anchors nails, bolts, and screws.

### **1.2 DEFINITIONS**

- A. The following definitions apply to this section as they pertain to rough carpentry items.
  - 1. Rough Carpentry: Carpentry work not specified in other Sections and not used as exposed work.

### **1.3 DESCRIPTION**

- A. Concealed wood framing, blocking, sheathing, anchors, fasteners, adhesives, and related items, including accessories furnished and installed as specified herein.

### **1.4 SUBMITTALS**

- A. Product Data: Submit for carpentry in accordance with Section 013300.
  - 1. Submit for sheathing, tapes, sealants, and miscellaneous products specified.
- B. Certification:
  - 1. Submit letter certifying that lumber is kiln-dried to 15 - 19 percent moisture content, well seasoned, grade marked, trade marked and free from warp.
  - 2. Submit letter from treatment plant certifying that chemicals and process used and net amount of salts retained are in conformance with specified standards
  - 3. Submit letter certifying that fire-retardant treatment materials comply with requirements herein stated and local authorities having jurisdiction and that treatment will not bleed through finished surfaces.

### **1.5 QUALITY ASSURANCE**

- A. Lumber Standard:
  - 1. Comply with U.S. Dept. of Commerce Product Standard PS 20, including moisture content and actual sizes related to indicated nominal sizes.
  - 2. Comply with Standard Grading Rules No. 16 for West Coast Lumber.
  - 3. Comply with American Softwood Lumber Standard and with application grading rules of inspection agencies certified by American Lumber Standard Committee's (ALSC) Board of Review.
  - 4. Comply with lumber producer's inspection agency grading rules certified as conforming to "National Grading Rules for Dimension Lumber" established under Section 10 of PS 20 and local code standard.
- B. Plywood Standard: Comply with U. S. Product Standard PS 1-74/ANSI A199.1; and Grades and Specifications, Performance-Rated Panels and Specifications by APA – The Engineered Wood Association local code standard. Each construction and industrial panel shall bear APA trademark and appropriate identification.
- C. Lumber: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying agency, grade, species, moisture content at time of surfacing and mill.



1. Seasoning: Kiln-dry lumber to 15 - 19 percent moisture content, well-seasoned, grade marked, trade marked and free from warp.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- A. Inspect wood materials for conformance to specified grades, species, and treatment at time of delivery to Project site.
  1. Reject and return unsatisfactory wood materials.
- B. Provide facilities for handling and storage of materials to prevent damage to edges, ends and surfaces.
- C. Keep carpentry materials dry.
  1. Store lumber and plywood in stacks with provision for air circulation within stacks.
  2. Protect bottom of stacks against contact with damp surfaces. Protect exposed materials against weather.
  3. Stack materials minimum 12 inches off ground, or if on concrete slab-on-grade, minimum 1-1/2 inches, fully protected from weather.
  4. Provide for air circulation within and around stacks and under temporary coverings.
- D. Place spacers between each bundle of pressure treated materials treated with waterborne chemicals to provide air circulation.

## **1.7 PROJECT CONDITIONS**

- A. Environmental Impact: Products containing following materials will not be permitted:
  1. Urea Formaldehyde.
  2. Chromium in wood pressure treatment products.
  3. Arsenic.

## **1.8 COORDINATION**

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit, show location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.
  1. Coordinate work directly with other subcontractors as necessary to insure proper fitting, joining or to clearances of other work. Obtain templates as required to insure proper fitting.

## **PART 2 PRODUCTS**

### **2.1 LUMBER**

- A. Dimension Lumber: Finished 4 sides, 15 percent maximum moisture content. Mark lumber "S-DRY".
  1. Light Framing: Construction grade Douglas Fir or Southern Pine, appearance grades where exposed.
  2. Boards: Construction grade.
- B. (WD BLKG-1) Miscellaneous Lumber: Lumber for support or attachment of other construction, including equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members.
  1. Moisture content of 19 percent maximum for lumber items not specified to have wood preservative treatment.
  2. Grade: No. 3 or standard grade.

### **2.2 PRESERVATIVE TREATMENT**

- A. Preservative Chemicals: Acceptable to authorities having jurisdiction.
  1. Do not use chemicals containing arsenic or chromium.

- B. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
- C. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a
- D. Ammoniacal, or amine, Micronized Copper Azole MCA: AWPA P61-18.
- E. (PPT-1) Extent of Treatment:
  - 1. Wood nailers and blocking in contact with cementitious materials.
- F. Coat cut surfaces after treatment with brush coat of same preservative treatment. Allow preservative to dry prior to placing members.

### **2.3 FIRE-RETARDANT TREATMENT**

- A. (FRT-1) Fire Retardant Treatment: Pressure impregnation with fire-retardant chemicals.
- B. Manufacturers:
  - 1. Dricon by Arch Wood Products,
  - 2. Pyro-Guard by Hoover Treated Wood Products,
- C. Lumber and Plywood Treatment:
  - 1. Each piece to bear:
    - a. UL FR-S rating (flame spread and smoke developed less than 25),
    - b. Complying with extended 30-minute tunnel test, ASTM E84 or UL 723
    - c. Meet interior Type A requirements in AWPA Standard C-20 for lumber and C-27 for plywood.
    - d. And shall be registered for use as a wood preservative by the U.S. Environmental Protection Agency.
  - 2. Treatment to provide protection against:
    - a. Termites,
    - b. Fungal decay
  - 3. Treatment to be free of:
    - a. Hologens
    - b. Sulfates,
    - c. Ammonium phosphate,
    - d. Formaldehyde.
- D. After treatment: Material shall be dried to an average moisture content of 15 percent or less for plywood and 19 percent or less for other lumber.
- E. Complete fabrication prior to treatment to minimize cutting and jointing after treatment.
  - 1. Coat surfaces cut after treatment with heavy brush coat of same fire-retardant chemical.
- F. Do not use twisted, warped, bowed or otherwise damaged or defective pieces.
- G. Extent of Treatment: Wood materials as part of fire-rated assemblies shall be fire retardant treated, and as indicated, with (FRT-1).

### **2.4 ROUGH HARDWARE, FASTENERS AND ANCHORAGE DEVICES**

- A. Extent: Provide rough hardware required, including nails, screws, bolts, lag screws, cinch anchors, toggle bolts, shot anchors and similar items.
  - 1. (Joist Hangers: Sized and profiled to suit applications, galvanized.)
- B. General: Provide proper size and type for use intended and for materials to be fastened.
  - 1. Install adequate hardware to insure substantial and positive anchorage.
  - 2. Use galvanized for exterior locations and high humidity locations and treated wood, plain finish for other interior locations.
  - 3. Fasteners, hangers and bearing plates used on or in connection with treated wood shall comply with IBC 2304.9.
- C. Nails: Conform to materials standards established under FS FF-N-105.

1. At exterior work, use galvanized steel nails.
2. Refer to IBC Nailing Schedule for quality and size.

## **2.5 TAPES, SEALANTS AND MISCELLANEOUS**

- A. Adhesive: As recommended by manufacturer of product to be applied for surface material to give permanent adhesion, with material remaining flat to back surface. Comply with local code standards.
1. Comply with APA AFG-01 for adhesive for use with type of construction panel indicated.
  2. Exterior: Phenolic resin waterproof glue.
  3. Interior: Water-resistant casein and other adhesives suited for particular use.
- B. Expansion Material: Dow Chemical Ethafoam. Use where expansion joint material is indicated and not installed under other sections.
- C. Concealed Sealants: Polyisobutylene sealant
1. Tremco's Curtainwall Sealer.
- D. Soft Gasket or Urethane Insulation:
1. Product: Ester 72PP from American Convertors; flexible semi- closed cell urethane.
    - a. Distributor: Brock-White Company, Minneapolis, Minnesota.
  2. Provide 1/2 inch thicker than joint where foam tape, foam gasket and urethane insulation is indicated and not provided under other sections.
  3. Location: At gaps between framing and other materials.
- E. Sill Sealer Gaskets:
1. Glass-fiber resilient insulation, fabricated in strip form for use as a sill sealer.
  2. Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

## **PART 3 EXECUTION**

### **3.1 FRAMING, NAILERS, BUCKS, CANT STRIPS**

- A. Install plumb, level, true and square to dimensions shown and required. Allow for finishes and proper clearances where necessary.
- B. Provide sound bearing, square cuts, and full bearing surfaces. Set crown up for horizontal members. Shim and block where required.
- C. Eliminate crooked, twisted, cupped or bowed framing where required.
- D. Anchorage: Adequately anchor, fasten and support members to form secure, substantial and accurate anchorage and to hold required dimensions and prevent twist.
1. Use bolts and screws to eliminate loosening up of joints, sagging or similar movement.
  2. Use nailers for securing gravel stops, cornices, and where otherwise shown or required.

### **3.2 FURRING, STRIPPING, GROUNDS AND BACKING**

- A. Install plumb, level, true and square. Anchor substantially for permanent installation. Set and shim to straight edge so finish wall is true and straight.
- B. Provide grounds and backing as shown or required. Blocking as required or shown on drawings for plumbing fixtures, brackets, drapery rods, window and door frames, built-in furniture and other woodwork, both interior and exterior.
- C. Allow for finishes and shim out to form level surfaces. Verify ground sizes and locations before installation.

### **3.3 FACTORY WOOD TREATMENT**

- A. Shop pressure treat and deliver to site ready for installation, wood materials requiring UL fire rating or pressure impregnated preservatives.

- B. Provide UL approved identification on fire resistant treated materials.
  - 1. Deliver fire retardant treated materials cut to required sizes so as to eliminate necessity of field cutting.
- C. Ensure exposed materials requiring stain or paint finish do not exceed 15 percent moisture content before applying wood preservative treatment.

### **3.4 SITE TREATMENT OF WOOD MATERIALS**

- A. Apply preservative treatment in accordance with manufacturer's printed instructions.
- B. Brush apply 2 coats of preservative treatment on wood in contact with cementitious materials and roofing and related metal flashings. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.
- D. Ensure exposed materials requiring stain or paint finish do not exceed 15 percent moisture content before applying wood preservative treatment.

**END OF SECTION**



# SECTION 078400 FIRESTOPPING

## PART 1 GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Firestop joint sealant and backing, including intumescent elastomeric compounds and sealants.
2. Rigid boards, forms, wraps and accessories.
3. Fiber packing and fiber fill.
4. Wool fiber insulation and fire safing insulation.
5. Other firestopping as indicated.

#### B. Related Requirements:

1. Section 078443 – Fire-Resistant Joint Sealants.
2. Section 079200 – Joint Sealants: Other sealants.
3. Division 21 – Fire Suppression: Firestopping of penetrations caused by fire suppression services.
4. Division 22 – Plumbing: Firestopping of penetrations caused by plumbing services.
5. Division 23 – Heating, Ventilating and Air Conditioning: Firestopping of penetrations caused by mechanical services.
6. Division 26 – Electrical: Firestopping of penetrations caused by electrical services.
7. Division 27 – Communications: Firestopping of penetrations caused by communications services.
8. Division 28 – Electronic Safety and Security: Firestopping of penetrations caused by safety and security services.

### 1.2 REFERENCES

- A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops".
- B. Test Requirements: UL 1479, "Fire Tests of Through-Penetration Firestops".
- C. Test Requirements: UL 2079, "Tests for Fire Resistance of Building Joint Systems".
- D. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
  1. UL Fire Resistance Directory:
    - a. Firestop Devices (XHJI).
    - b. Fire Resistance Ratings (BXRH).
    - c. Through-Penetration Firestop Systems (XHEZ).
    - d. Fill, Voids, or Cavity Material (XHHW).
    - e. Forming Materials (XHKU).
    - f. Joint Systems (XHBN).
    - g. Perimeter Fire Containment Systems (XHDG).
  2. Alternate Systems: "Omega Point Laboratories Directory" (updated annually).
- E. Test Requirements: ASTM E 1966, "Standard Test Method for Fire Resistive Joint Systems".
- F. Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus".
- G. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops".
- H. ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials".
- I. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- J. All Major Building Codes: ICBO, SBCCI, BOCA, IBC and Building Code of the City of New York.
- K. NFPA 101 - Life Safety Code.
- L. NFPA 70 - National Electric Code.

### 1.3 DEFINITIONS

- A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.
- B. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.
- C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gases, and smoke.
- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
- E. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, and structural floors or roof decks; and gaps between adjacent sections of structural floors and at wall tops between top of wall and ceiling.
- F. System: Specific products and applications, classified and numbered by Underwriters Laboratories Inc., to close specific barrier penetrations.
- G. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other Sections and may or may not be required.
- H. Manufacturer's Engineering Judgment: Firestopping systems derived from other UL Systems/ Designs or other tests, and acceptable to code enforcing authorities.

### 1.4 SYSTEM DESCRIPTION

- A. Fire Rated Construction Design Requirements: Maintain barrier fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- B. Through-Penetration Fire Stopping Schedule: Assembly designs are specified generally under UL system categories by penetrating item. Manufacturers' product applications must have specific UL system designations. The schedules on the following page indicate which Series of UL Classified Through Penetration Fire Stopping (TPFS) assemblies are acceptable for this Project based on barrier type, construction and penetrant type. The TPFS Series listed are generic in nature; example: Series C-AJ-2000 includes all designs from 2001 through 2999 from all Manufacturers; note that each Manufacturer has its own number for tested assemblies. Select appropriate TPFS assemblies for each condition encountered.
- C. Refer to Schedule at the end of this section.

### 1.5 SUBMITTALS

- A. Product Data: Manufacturer's specifications and technical data for each material including the following.
  - 1. Composition and limitations.
  - 2. Manufacturer's installation instructions.
  - 3. Furnish sleeve size schedule indicating size of penetrating item, insulation thickness (where applicable), and minimum annular space requirements.
- B. Proposed UL System Drawings - Special Installation Drawings: Prior to starting installation of firestopping, firestopping Manufacturer and Installer shall review specific conditions applicable for Project, and identify each condition for firestopping and prepare individual UL Designs or Manufacturer's Engineering judgment identification numbers, and Installation Drawings for each condition.
  - 1. Submit 3 Special Installation Drawings for each condition; 1 set for Owner, 1 set for Architect's File Copy, and 1 set for Building Official.
  - 2. Submit other information as may be requested by Building Official.
- C. Submit Installer qualifications for each person installing firestopping systems.

## 1.6 QUALITY ASSURANCE

- A. Engage experienced Installer who is certified, licensed, or otherwise qualified by the firestopping Manufacturer, with the necessary training to install Manufacturer's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- B. The work is to be installed by a Contractor with at least one of the following qualifications:
  - 1. FM 4991 Approved Contractor.
  - 2. UL Approved Contractor.
  - 3. Hilti Accredited Fire Stop Specialty Contractor.
- C. Firm with not less than 3 years' experience with fire stop installation.
- D. Successfully completed not less than 3 comparable scale projects using similar systems.
- E. Single Source Responsibility for Materials: Obtain firestopping materials from one Manufacturer for entire project.
  - 1. This does not restrict Contractor from subcontracting installation of firestopping to multiple subcontracts, but does require all Installers do use the same Manufacturer throughout the Project and be licensed by that Manufacturer for the installation of firestopping.
- F. Field Samples: First two applications for each firestopping condition will be reviewed by Owner's Representative and the Architect, and Firestop Manufacturer's direct representative (i.e., Fire Protection Specialist, Field Engineer, etc., not authorized distributor representative) and when accepted by the local Building Official shall become a standard of performance for remaining Work.
  - 1. Correct areas, modify method of application/installation, or adjust as directed by local code official to comply with specified requirements.
  - 2. Maintain field samples accessible to serve as a standard of quality for this Section.
- G. Fire-Test Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those of this specification Section:
  - 1. Firestopping tests are performed by a qualified testing and Inspecting Agency. A qualified testing and Inspecting Agency is UL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
  - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
    - a. Through-penetration firestop system products bear classification marking of qualified testing and Inspecting Agency.
    - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
      - 1) UL in "Fire Resistance Directory."
      - 2) ITS in "Directory of Listed Products."

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle to prevent damage, staining and disfigurement in original, new, and unopened packages and containers bearing Manufacturer's name and label identifying contents. Do not freeze.
- B. Where limited shelf life of product is noted by date on container or packing list, take note and do not use out of date material.

## 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Store firestopping materials out of weather, in cool, dry place, out of direct sunlight, at temperatures below 90 deg F, not less than 40 deg F and as recommended by Manufacturer.

## 1.9 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with fireproofing material Manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of fireproofing.



- B. Ventilation Requirements: Comply with fireproofing material Manufacturer's recommendations during and after installation of fireproofing by natural or mechanical means.
- C. Sleeves: Unless otherwise called for, sleeves passing through walls, slabs, beams, bridging, columns, shall be minimum of 1/2 inch greater in inside diameter than external diameter of pipe passing through sleeves, or insulation diameter. Verify sleeve size required with Manufacturer of firestopping used. Pipe insulation shall be continuous through sleeves. Space between sleeve and pipe or duct and annular opening space shall be provided with a firestop system. Notify Contractor immediately of deviation from above sleeving requirements.
- D. Fire Dampers: Place Firestopping of annular spaces around fire dampers before installation of damper's anchoring flanges. Prior to the installation of any firestop system, verify with fire damper Manufacturer the addition of a firestop product will not adversely affect the fire-rating or performance of fire damper.

## 1.10 SEQUENCING

- A. Sequence and coordinate application of firestopping with other related work specified in other Sections to comply with the following requirements:
  1. Provide temporary enclosures to prevent deterioration of firestopping for interior applications due to exposure to unfavorable environmental conditions.
  2. Do not install enclosing or concealing construction until after firestopping has been applied, inspected, tested, and corrections have been made to any defective firestopping.

## 1.11 SYSTEM DESIGN

- A. Design of firestopping described by this Section is responsibility of Contractor. Individual through-penetration systems, construction-gap firestopping, through-penetration smoke-stopping, and construction-gap smoke-stopping will be selected by Contractor to meet requirements of Contract Documents and governing codes. Actual selection of individual designs or systems is responsibility of Contractor, and 'Single Source Responsibility for Materials' is required.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers and Products (FSTOP): Products listed in UL Fire Resistance Directory for UL System involved, that are manufactured by one of the following:
  1. 3M Fire Protection Products.
  2. Hilti, Inc.
  3. Rectorseal Company.
  4. Specified Technologies, Inc.

### 2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system Manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system Manufacturer and approved by the qualified testing and Inspecting Agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
  1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-/rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.

2. Temporary forming materials.
  3. Substrate primers.
  4. Collars.
  5. Steel sleeves.
- C. Mold Resistance: Provide firestopping system sealant with mold and mildew resistance rating of 0 as determined by ASTM G21.

## 2.3 FILL MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E 814, UL 2079, ASTM E 1966, or ASTM E 2307 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and F-rating for each construction assembly.
- B. Pre-installed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors and/or gypsum walls.
- C. Post-install firestop devices for use with noncombustible and combustible pipes (closed and open systems) and conduit penetrating concrete floors.
- D. Re-penetrable cable management device for floor or wall applications.
- E. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- F. Firestop Collars: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- G. Firestop Boards: Ready-to-use firestop board designed for large opening with cable trays and multiple penetrations  
Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- H. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- I. Outlet and Switch Box Protection: Ready-to-use intumescent insert to provide protection to outlet and switch boxes in fire rated assemblies.
- J. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- K. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- L. Pillows/Bags/Blocks: Reusable heat-expanding pillows/bags/blocks designed to seal medium to large size openings. Ideal for re-penetration or new penetrations.
- M. Firestop Plug: Ready-to-use intumescent and reusable plug for small openings.
- N. Two Component Polyurethane Foams: Multi-component, polyurethane based liquid elastomers that, when mixed, expand and cure in place to produce a nonshrinking foam.
- O. Firestop Joint Spray: A sprayable firestop mastic for construction joints where maximum movement is required.
- P. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  1. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
  2. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
- Q. Wiring devices: Hilti CP 653 Speed Sleeve or Ez-Path Fire Rated Pathway by Specified Technologies, Inc.
  1. Fire-rated wiring devices containing intumescent material that allows cable to pass through device F Rating: Equal to rating of barrier in which device is installed.

2. Capable of allowing 0 to 100 percent visual fill of cables.
3. Sufficient size to accommodate quantity and size of electrical wires and data cables required.
4. Provide with steel wall plates allowing for single or multiple devices to be ganged together.
5. Firestop device to provide an L-Rating of 10 CFM/sq.ft. or less OR  $\leq 1$  CFM/device when empty, partially full or completely full (0 percent visual fill, 50 percent visual full and 100 percent visual full).
  - a. Smoke Barrier Assemblies: Wiring devices to provide L-Ratings of a maximum of 5 CFM/sq.ft. or as required by Local Building Codes.

## **2.4 MIXING**

- A. For those products requiring mixing before application, comply with through-penetration firestop system Manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system Manufacturer and the following requirements:
  1. Remove from surfaces of opening substrates and from penetrating items, foreign materials that could interfere with adhesion of through-penetration firestop systems.
  2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
  4. Do not allow caulks containing solvents to come in direct contact with plastic pipe.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system Manufacturer using that Manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### **3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION**

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system Manufacturer's written installation instructions and published Drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
  1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### **3.4 INSTALLATION**

- A. Use methods and materials indicated in firestopping systems shown in Referenced Standards.
- B. Install penetration seal materials in accordance with instructions in UL Building Materials Directory and in accordance with Manufacturer's printed instructions.
- C. Install sealant, including forming, packing and other accessory materials to fill opening around services penetrating floors and walls to provide firestops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs.
  1. Use masking tape to protect finished substrates and products adjacent to sealant materials.
  2. Apply sealant as specified under Section 079000 - Joint Protection.
  3. Forming to be left in place until foam is cured, or as recommended by Firestop Manufacturer.
- D. At sleeved pipes or other sleeved penetration, firestop annular space between sleeve and its contained pipe or duct with resilient firestopping sealant system to permit movement of pipe or duct without damage to firestopping sealant.
- E. Seal holes and voids made by penetrations to ensure effective fire and smoke barrier.
- F. Patch penetrations caused by cutting or presence of unused or abandoned openings or boxes using materials compatible with barrier construction and with fire rating equal to or greater than barrier rating.
- G. For plumbing sleeves, construct time rated walls after placement of penetrating materials if possible, and to fit rated construction materials tightly to or directly upon material of penetration.
- H. Large Openings: Close unused portions of large openings (annular spaces) made for later installation of pipes and ducts with solid fill equal to barrier rating or with applicable firestopping sealant system.
  1. Where both horizontal dimensions exceed 4 inches in structural floor openings, firestop annular spaces with concrete, or other rated assembly. Provide dowels and reinforcement, within such fill, equal to that specified for slab.
  2. In rated concrete or masonry wall openings where both height and width exceed thickness of rated materials, firestop annular spaces with masonry or other solid fill.
  3. Use fiber fill, solid fill or fiber packing to make up remainder of barrier thickness where required width of firestopping sealant system is less than barrier.
- I. Install firestopping materials capable of supporting same loading as floor at floor openings more than four inches in width without penetrating item and subject to traffic or loading.
- J. Install firestopping at least equal to barrier fire rating in and around penetrations of floor structures, exterior walls and interior walls noted as time rated fire barriers or smoke barriers.
- K. Unused or abandoned openings or boxes or penetrations caused by cutting shall be patched with materials compatible with barrier construction and with fire rating equal to or greater than barrier fire-rating.
- L. Use firestopping sealant systems at narrow spaces and at spaces with dimensions less than barrier thickness.
- M. Fill void spaces completely with firestopping material.
- N. Protect materials from damage on surfaces subject to traffic. Provide firestopping in floors flush with top of slab, sleeve or housekeeping pad.

### **3.5 IDENTIFICATION**

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

<p><b>Warning – Firestop System</b></p> <p><b>DO NOT DISTURB</b></p> <p><b>Notify Building Management of Any Damage</b></p> <p><b>Manufacturer’s System No.:</b> _____</p> <p><b>UL System No:</b> _____</p> <p><b>Contractor:</b> _____</p> <p><b>Date Installed:</b> _____</p> <p><b>Manufacturer:</b> _____</p>
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**3.6 FIELD QUALITY CONTROL**

- A. Inspecting Agency: Per IBC 2015, Article 1705.17 the Owner is to engage a qualified independent inspecting agency to inspect through-penetration firestop systems in compliance with ASTM E2174 and to prepare inspection report.
  - 1. Inspecting agency will state in each report whether inspected firestop systems comply with or deviate from requirements.
  - 2. Report to be included in closeout documents.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.
- C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- D. Manufacturer's Field Services: Firestopping Manufacturer's technical representative (not Authorized Distributor representative) shall provide the following field services during application.
  - 1. Perform a pre-installation examination and acceptance of substrate and voids scheduled for firestopping. Issue report.
  - 2. Be present at initial start-up for each process. Confirm application techniques. Issue report.
  - 3. Issue a summary report at completion of installation indicating Manufacturer's acceptance of installed system and compliance with UL Design requirements.

**3.7 ADJUSTING AND CLEANING**

- A. Clean up spills of liquid components.
- B. Neatly cut and trim materials.
- C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

**3.8 SCHEDULE (NEXT PAGE)**

## SCHEDULE

### THROUGH-PENETRATION UL CLASSIFICATION SYSTEM

	<u>UL Classification System</u>		
	<u>Construction Penetrated</u>	<u>Type Of Construction</u>	<u>System Identification</u>
<b><u>Fire-Stopping Systems</u></b>			
1. No Penetrating Items	F, W, C	A, B, J, K, L	0001-0999
2. Metallic Pipes, Conduit or Tubing	F, W, C	A, B, J, K, L	1001-1999
3. Nonmetallic Pipe, Conduit or Tubing	F, W, C	A, B, J, K, L	2001-2999
4. Electric Cables	F, W, C	A, B, J, K, L	3001-3999
5. Cable, Trays with Electric Cables	F, W, C	A, B, J, K, L	4001-4999
6. Insulated Pipes	F, W, C	A, B, J, K, L	5001-5999
7. Electrical Bus Duct Penetrations	F, W, C	A, B, J, K, L	6001-6999
8. Mechanical Ductwork Penetrations	F, W, C	A, B, J, K, L	7001-7999
9. Multiple Penetrations Through Common Openings	F, W, C	A, B, J, K, L	8000-8999

#### **Construction Penetration**

- F Floor Penetration
- W Wall Penetration
- C Either Wall or Floor Penetration

#### **Type of Construction**

- A Concrete Floors equal to or less than 5 inches thick
- B Concrete Floors greater than 5 inches thick
- J Concrete or Masonry Walls equal to or less than 8 inches thick
- K Concrete or Masonry Walls greater than 8 inches thick
- L Framed Walls

### JOINT UL CLASSIFICATION SYSTEM

	<u>UL Classification System</u>		
	<u>Joint System</u>	<u>Movement Capability</u>	<u>Joint Width Range</u>
<b><u>Fire-Resistant Joint System</u></b>			
1. Floor-to-Floor	FF	S/D	0000-4999
2. Wall-to-Wall	WW	S/D	0000-4999
3. Floor-to-Wall	FW	S/D	0000-4999
4. Head-to-Wall	HW	S/D	0000-4999
5. Wall-to-Wall as Corner Guards	CG	S/D	0000-4999
6. Bottom of Wall	BW	S/D	0000-4999

#### **Movement Capability**

- S No movement (Static)
- D Allows movement (Dynamic)

#### **Joint Width**

- 0000-0999 Less than or equal to 2 inches
- 1000-1999 Greater than 2 inches and less than or equal to 6 inches
- 2000-2999 Greater than 6 inches and less than or equal to 12 inches
- 3000-3999 Greater than 12 inches and less than or equal to 24 inches
- 4000-4999 Greater than 24 inches

**END OF SECTION**



# SECTION 079200 JOINT SEALANTS

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Exterior and interior sealants (SLNT).

### 1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
  - 1. Submit Manufacturer's certifications that products comply with specified requirements and with local regulations for VOC content.
- B. Color Samples:
  - 1. Samples for Initial Selection: Manufacturer's color charts consisting of actual strips of cured sealants showing the full range of colors available for each product exposed to view.
  - 2. Samples for Verification: For each kind and color of joint sealant selected, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Schedule: Cross-reference products using "SLNT" designation in Part 2 of this Section, with Sealant Schedule in Part 3 of this Section, to locations and applications. Indicate proposed product, product type and color.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Sample Warranties: For special warranties.
- C. Quality Control Submittals:
  - 1. Product Test Reports: For each kind of joint sealant.
  - 2. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
  - 3. Statement of qualification for manufacturers and installers.
  - 4. Statement of compliance for compatibility of sealant with adjacent materials and coatings.
  - 5. Field-Adhesion-Test Reports: For each sealant application tested.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with record of successful in-service performance.
- B. Provide materials for exterior envelope from a single manufacturer.
- C. Compatibility: Verify compatibility of silicone sealant with materials in contact with sealant. Provide list of stone materials and verify that silicone sealant will not stain or damage work.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

### 1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  - 2. Conduct field tests for each kind of sealant and joint substrate.
  - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.



4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
  - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193.
    - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to project site in original unopened containers or bundles with labels informing about 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 to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

## **1.7 PROJECT CONDITIONS**

- A. Weather Conditions: Do not proceed with installation of sealant under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
  1. Proceed with work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength.
  2. Wherever joint width is affected by ambient temperature variation, apply elastomeric sealant only when temperatures are in lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
- B. Joint Width Conditions: Do not proceed with installation of joint sealers when joint widths are less than allowed by joint sealer manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.
- D. Compatibility and Adhesion Testing: Ascertain sealant compatibility and adhesion with adjacent materials using laboratory testing procedures.

## **PART 2 PRODUCTS**

### **2.1 SEALANT, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Sealant Colors: In accordance with approved sealant color schedule.
  1. Colors as selected by Architect from manufacturer's standard colors. Acceptance of sealant will depend on range of standard colors available for selection.
  2. Custom Color:
- C. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weather-proofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  1. Architectural Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.

## 2.2 POLYURETHANE SEALANT

- A. (SLNT-1) 1-Part Polyurethane Sealants: Polyurethane based one part elastomeric sealant, complying with FS- TT-S-00230C, Type II Class A, with elongation and compression of not less than 25 percent. ASTM C920, Type S, Class 25, Grade NS.
1. Manufacturers and Products:
    - a. Sika Chemical Corporation: Sikaflex-1a.
    - b. Master Builders Solutions: Masterseal.
    - c. Tremco Incorporated: Dymonic.
    - d. Pecora Corporation: Dynatrol I.
    - e. Tremco Incorporated: Vulkem 116.
- B. (SLNT-2) 2-Part Polyurethane Sealant for Horizontal Applications: Self-leveling polyurethane based 2 part elastomeric sealant, complying with FS-TT-S-00227E, Type I, Class A, with shore A hardness of not less than 30 and elongation and compression of not less than 25 percent. ASTM C920, Type M, Class 25, Grade P, Slope Grade.
1. Manufacturers and Products:
    - a. Tremco Incorporated: THC900.
    - b. BASF Building Systems: Sonolastic SL-2.
    - c. Pecora Corporation: Urexpan NR-200.
  2. Location/Use:
    - a. Joints in horizontal surfaces subject to traffic.
    - b. Isolation joints in cast-in-place concrete slabs.
    - c. Other joints as indicated.
- C. (SLNT-5) Single-Component, Nonsag, Urethane Adhesive and Sealant: ASTM C 920, Type S, Grade NS, Class 35, Use NT, M, A, T, O and I, FS TT-S-00230C, Type II, Class A.
1. Manufacturers and Products:
    - a. MasterSeal NP-1, by Master Builders Solution, BASF Corporation

## 2.3 SILICONE SEALANT

- A. (SLNT-3) Low-Modulus Silicone Rubber Sealant: Silicone rubber based, one part neutral cure elastomeric sealant with plus 50 percent to minus 50 percent movement complying with FS-TT-S-001543, Class A, and recommended by manufacturer for joints.
1. Manufacturers and Products:
    - a. General Electric: Silpruf SCS 2000.
    - b. Dow Corning Corporation: 795 Building Sealant.
    - c. Pecora Corporation: 864 Silicone.
    - d. Tremco Construction Division: Spectrem 3.
- B. (SLNT-4) Medium-Modulus Silicone Rubber Sealant: Silicone rubber based, specifically designed for weatherproofing stone or other porous materials, two part moisture cure elastomeric sealant with plus 50 percent to minus 50 percent movement and recommended by manufacturer for stone joints.
1. Manufacturers and Products:
    - a. General Electric: Silpruf SCS 2000.
    - b. Dow Corning Corporation: 756 Building Sealant.
    - c. Tremco Construction Division: Spectrem 2.
- C. (SLNT-5) Ultra-Low-Modulus Silicone Rubber Sealant: Silicone rubber based, one part neutral cure elastomeric sealant with plus 100 percent to minus 50 percent movement complying with FS-TT-S-001543, Class A.
1. Manufacturers and Products:
    - a. Dow Corning Corporation: 790 Building Sealant.
    - b. Tremco Construction Division: Spectrem 1.
- D. (SLNT-6) Silyl-Terminated Polyurethane Joint Sealant (STPU): ASTM C920, Type S, Grade NS, Class 12.5, for Us NT.

1. Product and Manufacturer:
    - a. Dymonic FC, by Tremco Incorporated
    - b. Dyanflex SC, by Pecora Corporation
    - c. MasterSeal NP 100.
  2. Application: Adhering joint dowel pins at stonework.
- E. (SLNT-8) Silicone Sealant, Mildew-Resistant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
1. Products and Manufacturers:
    - a. Dow Corning Corporation; Dow Corning 786.
    - b. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
    - c. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
    - d. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
    - e. Tremco Incorporated; Tremsil 600 White.
  2. Location/Use:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Joints subject to water and high moisture areas.
    - d. Other joints as indicated.
- F. (SLNT-9) Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT; field-tintable; non-staining.
1. Field-Tinted: Provide at locations as directed by Architect.
    - a. Basis of Design: Pecora Corporation; 890FTS.
    - b. Color: As selected by Architect to match <INSERT>.
  2. Field-Tinted and Textured: Provide at locations as directed by Architect.
    - a. Basis of Design: Pecora Corporation; 890FTS-TXTR.
    - b. Color: As selected by Architect to match <INSERT>.

## 2.4 BUTYL SEALANT

- A. (SLNT-\_\_\_) Concealed Sealant; Butyl Sealant: Non-skinning, non-drying, flexible synthetic butyl sealant.
1. Manufacturers and Products:
    - a. Tremco Construction Division; TremPro JS-773.
    - b. Pecora Corporation; BA-98.
  2. Location/Use: concealment locations, such as flashing backpane joints, coping joints, roof edge joints, setting aluminum storefront windows, window sills, etc. and where called for in other assemblies.

## 2.5 ACRYLIC SEALANT

- A. (SLNT-7) Acrylic Sealants: General purpose, paintable acrylic-emulsion sealant. Caulk with approximately 12-1/2 percent elongation complying with ASTM C834.
1. Products and Manufacturers:
    - a. Tremco Incorporated: Acrylic Latex 834.
    - b. MasterSeal NP 520.
    - c. Pecora Corporation: AC-20.
  2. Location/Use:
    - a. Joints in vertical surfaces and in horizontal surfaces not subject to traffic.
    - b. Control and expansion joints on exposed interior surfaces of exterior walls.
    - c. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls, and partitions.
    - d. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
    - e. Joints between plant-precast structural concrete units.
    - f. Other joints as indicated.

## 2.6 JOINT SEALANT BACKING

- A. Joint Sealant Backer Rod Manufacturers:
  - 1. Denver Foam, Backer Rod Manufacturing, Inc.
  - 2. Master Builders Solutions: MasterSeal 921.
  - 3. Construction Foam Products, Nomaco Inc..
- B. General: Provide sealant backings of material that 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.
- C. Sealant Backing Material: Nonstaining, sealants, primers, and other joint fillers; compatible with joint substrates; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- D. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- E. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.7 PREPARATORY MATERIALS

- A. Joint Primer: Non-staining type recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive type recommended by sealant manufacturer; compatible with joint forming materials.
- C. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- D. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine joint surfaces, backing, and anchorage of units forming sealant rabbet, and conditions under which sealant work is to be performed. Do not proceed with sealant work until unsatisfactory conditions have been corrected.

### 3.2 JOINT SURFACE PREPARATION

- A. Preparation: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
  - 1. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
  - 2. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that 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.
- B. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant.

- C. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5 percent solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant application.
- D. Roughen joint surfaces on vitreous coated and similar non-porous materials, wherever sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce dull sheen.
- E. Ensure that joint forming materials are compatible with sealant.
- F. Examine joint dimensions and size materials to achieve required width/depth ratios. Use joint filler to achieve required joint depths, to allow sealants to perform properly.

### 3.3 SEALANT APPLICATION

- A. Installation:
  - 1. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
  - 2. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
  - 3. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 4. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 5. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- B. Apply sealant in accordance with manufacturer's printed instructions. Perform work in accordance with ASTM C804.
- C. Prime or seal joint surfaces. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
- D. Install sealant backer rod for liquid elastomeric sealant, except where recommended to be omitted by sealant manufacturer for application shown.
- E. Install bond breaker tape wherever required by manufacturer's recommendations to ensure that elastomeric sealant will perform properly.
- F. Employ only proven installation techniques, which will ensure that sealant will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.
  - 1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.
- G. Install sealant to depth as shown or, if not shown, as recommended by sealant manufacturer but within following general limitations, measured at center (thin) section of bead:
  - 1. For sidewalks, pavements and similar joints sealed with elastomeric sealant and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.
  - 2. For normal moving joints sealed with elastomeric sealant, but not subject to traffic, fill joint to depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.
- H. Interior joints not subject to movement, these are:
  - 1. Gypsum board to masonry joints.
  - 2. Gypsum board to hollow metal joints.
  - 3. Gypsum board to concrete joints.

- I. Do not allow sealant or compounds to overflow or flow onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough texture surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either primer/sealer or sealant.
- J. Remove excess and spillage of sealant promptly as work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes.
- K. Rope Wicks: Where wicks for weeping masonry cavity occur in sealant, cut wick flush with sealant face and do not seal wick ends.

### 3.4 PROTECTION AND CLEANING

- A. Protect joint sealers during and after curing period from contact with contaminating operations or other causes so that they are without deterioration or damage at time of Substantial Completion.
  - 1. 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.
- B. 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 JOINT-SEALANT SCHEDULE

- A. General: Provide sealant where indicated (SLNT) or as required to achieve a weather-tight assembly.
  - 1. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.
  - 2. The following schedule is not intended to be all-inclusive and some may not be applicable to this Project.
- B. Exterior Joints:
  - 1. Horizontal Surfaces Subject to Traffic:
    - a. Joint Locations:
      - 1) Isolation and contraction joints in cast-in-place concrete slabs.
      - 2) Joints between plant-precast architectural concrete paving units.
      - 3) Joints in stone paving units, including steps (where applicable).
      - 4) Tile control and expansion joints.
      - 5) Joints between different materials listed above.
      - 6) Other joints as indicated.
    - b. (SLNT-2): 2-Part polyurethane sealant, self-leveling, or slope grade, traffic grade, Class 25
  - 2. Horizontal Surfaces Subject to Traffic and Water Immersion:
    - a. (SLNT- ): Polyurethane sealant, submersible, multi-component, self-leveling traffic grade.
  - 3. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic:
    - a. Joint Locations:
      - 1) Construction joints in cast-in-place concrete.
      - 2) Control and expansion joints in unit masonry.
      - 3) Joints between metal panels.
      - 4) Joints between different materials listed above.
    - b. (SLNT-3): Silicone single component, nonsag, neutral curing, Class 25
    - c. (SLNT-4): Silicone multicomponent, nonsag, neutral curing.
  - 4. Perimeter joints between materials listed above and frames of doors, windows, and louvers:
    - a. (SLNT-4): Silicone multicomponent, nonsag, neutral curing.
  - 5. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic:
    - a. Joint Locations:
      - 1) Unit Masonry Glazed Aluminum Framing System.
      - 2) Metal Panel to Glazed Aluminum Framing System.
    - b. (SLNT-5) Silicone Ultra Low-Modulus Silicone Rubber Sealant.
  - 6. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic:
    - a. Joint Locations:

- 1) Stone to Stone
- 2) Stone to Masonry
- b. (SLNT-9): Silicone Single-Component, Nonsag, Neutral-Curing.

C. Interior Joints:

1. Horizontal Surfaces Subject to Traffic:
  - a. Joint Locations:
    - 1) Isolation joints in cast-in-place concrete slabs.
    - 2) Other joints as indicated.
  - b. (SLNT-2): 2-Part polyurethane sealant, self-leveling, traffic grade, Class 25 .
2. Vertical Surfaces and Horizontal Surfaces Not Subject to Traffic (SLNT-7): Acrylic-based.
  - a. Control and expansion joints on exposed interior surfaces of exterior walls.
  - b. Perimeter joints of exterior openings where indicated.
  - c. Tile control and expansion joints.
  - d. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls, and partitions.
    - 1) (CMU) to (CMU): Low modulus silicone sealant.
  - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
  - f. Joints between plant-precast structural concrete units.
  - g. Other joints as indicated.
3. Mildew-Resistant Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone (SLNT-8):
  - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
  - b. Tile control and expansion joints where indicated.
  - c. Other joints as indicated.

**END OF SECTION**

# SECTION 081113 HOLLOW METAL DOORS & FRAMES

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pressed steel hollow metal doors and frames.
  - 2. Fire-rated hollow metal doors and frames.
  - 3. Rough bucks, frame reinforcing, door reinforcing, door insulation, closure panels, clip angles and anchorage.
  - 4. Factory prime paint finish.

### 1.2 COORDINATION

- A. Anchorages: Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Preparation for Hardware: Reinforced and machine hollow metal work for hardware specified in Sections 087100 and automatic door operators specified Division 08.
  - 1. Obtain templates, shop drawings, jigs, or materials, and a copy of the accepted Hardware Schedule from the hardware distributor.
  - 2. Templates: Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
  - 3. Reinforcing: Reinforce the work of this Section to meet requirements for anchoring hardware using concealed fasteners.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule, in electronic PDF format, of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.



## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
- D. Handle hollow metal with care to prevent damage to hollow metal and to factory-applied primer and galvanized coatings.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105. Provide smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
  - 2. Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.
  - 3. Temperature Rise Rating: At stair enclosures, provide doors with Temperature Rise Rating of 450 degrees F maximum in 30 minutes of fire exposure.
- B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- C. Exterior Door and Frame Assemblies: Openings to be fabricated and tested as fully operable assembly, including thermally insulating door and thermal break weatherstripped frame assemblies.
- D. Thermal Performance: Independent testing laboratory certification for exterior door and frame assemblies tested in accordance with ASTM C1363 and meet or exceed the following requirements:
  - 1. Including insulated door, thermal-break and weatherstripped frame and threshold.
  - 2. Thermally-Broken Frame and Threshold:
    - a. U-Factor: 0.29
    - b. R-Value: 3.4
- E. Air Infiltration: Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:
  - 1. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

### 2.2 MANUFACTURERS

- A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door Products; an Assa Abloy Group company.
  - 2. Curries Company; an Assa Abloy Group company.
  - 3. Deansteel Manufacturing.

4. Door Components, Inc..
5. Hollow Metal Xpress.
6. Pioneer Industries, Inc..
7. Republic Doors and Frames.
8. Steelcraft; an Ingersoll-Rand company.

## 2.3 MATERIALS AND COMPONENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Sheets:
  1. Cold-Rolled Steel Sheet: ASTM A1008, Commercial Steel (CS), Type B; suitable for exposed applications.
  2. Hot-Rolled Steel Sheet: ASTM A1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
  3. Galvanized Steel Sheet: ASTM A653, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
    - a. Provide galvanized steel sheets for exterior hollow metal doors, door and window frames, frame anchors and reinforcements, and louvers.
- C. Fastenings: Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide Jackson head screws, or flatter. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with #8 FHSMS.
- D. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- E. Steel Reinforcing: ASTM A36.

## 2.4 FABRICATION, GENERAL

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Construct doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
  1. Refer to Openings Schedule on Drawings for openings and locations.
  2. Door Thickness: 1-3/4 inches, unless otherwise indicated.
  3. Door Edge Construction: Model 2, Seamless.
  4. Minimum Thickness: Construct from base metal without coatings according to NAAMM-HMMA 803 and SDI A250.8. Provide heavier gage if required by details or specific condition. Entire frame and sidelight shall be of same gage.
- C. Interior Doors and Frames:
  1. Provide ANSI/SDI A250.4, Level A; 0.053 inch (18 ga.) minimum steel thickness, typical.
  2. Provide Maximum-Duty Doors and Frames, ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A; 0.067 inch (16 ga.) minimum thickness, at the following conditions:
    - a. Single Door Openings Exceeding 48 inches Wide.
    - b. Pair of Doors with Either Door Exceeding 48 inches Wide.
    - c. Openings with Nominal Door Opening Height of 120 inches or more.
- D. Exterior Doors and Frames: Provide Maximum-Duty Doors and Frames, ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A; 0.067 inch (16 ga.) minimum thickness.
  1. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
  2. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.

## 2.5 HOLLOW METAL FRAMES

- A. General: Provide frames as full profile welded unless otherwise indicated. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods.
1. Clearances: Provide and be responsible for proper clearances at metal frames, including for weatherstripping, sound stripping and smoke gasketing. Glass clearance shall be thickness of glass plus clearance each side (1/8 inch minimum exterior - 1/16 inch minimum interior), adjust for installation, glass thickness to allow for glazing and sealant. Where sealed double glazing is indicated, provide rebates minimum of 3/4 inch and provide 1/4 inch clearance at glass edges. Where units fit around concrete blocks (blocks built into frames) obtain actual dimensions of blocks being used to establish minimum clearances.
  2. Fire-Rated and Smoke-Rated Frames: Construct in accordance with requirements for labeled work. Attach proper U.L. label, Warnok Hersey. "B" labeled frames shall be 1-1/2 hour construction.
- B. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
- C. Mullions: Provide mullions, continuously reinforced, straight and without twist, of tubular design. For removable mullions provide fastenings of non-ferrous bolts at bottom, with sleeves at head of frame for mullion to clip over.
- D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow-metal work.
  5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
- E. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- F. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.
- G. Fasteners:
1. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153.
  2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

## 2.6 HOLLOW METAL DOORS

- A. Flush Doors: Reinforce, stiffen and sound deaden. Provide cut-outs for glass and louvers with stops as shown.
  - 1. Provide flush steel closure at top of exterior and interior doors and at bottom of exterior doors with drain holes in bottom closure. Following door construction types are acceptable.
  - 2. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 3. Seamless Vertical Edges: Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Tack weld door edge seams, fill with body putty and grind smooth.
  - 4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
  - 5. Bottom Edge Closures: Close bottom edges with end closures or channels of same material as face sheets.
    - a. Exterior doors where required for attachment of weather stripping
    - b. Interior doors to receive sound gasket.
- B. Fire-Rated Doors: Insulate as required by Underwriters Laboratories. Build in special hardware and provide astragals as indicated.
  - 1. At one hour and at 1-1/2 hour doors at enclosures, maximum transmitted temperature end point shall not exceed 450 degrees F above ambient at end of 30 minutes of fire exposure specified in NFPA 252 and UL 10 as applicable.
  - 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
  - 3. Astragals: Provide Z-style overlapping astragals as required by hardware application on one leaf of door pairs where required by NFPA 80 for fire-performance rating, and as indicated on other doors. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency. Flat bar astragals are not allowed.

## 2.7 FINISHES

- A. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting structure and conditions under which hollow metal is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install hollow metal in accordance with reviewed shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship. Set hollow metal plumb, level, square to proper elevations, true to line and eye. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.
- B. Placing Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
  - 1. At acoustic rated metal stud and gypsum board partitions, install insulation within frames.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.

3. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
  4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Place fire-rated frames in accordance with NFPA Standard #80.
- D. Door Installation: Fit hollow metal doors accurately in their respective frames, within following clearances: Jambs and head 3/32 inch, meeting edges pair of doors 1/8 inch, sill where no threshold or carpet 1/4 inch above finished floor, sill at threshold 3/4 inch maximum above finished floor, sill at carpet 1/4 inch above carpet. Place fire-rated doors with clearances as specified in NFPA Standard #80.
1. Provide undercut no greater than 3/8-inch at doors equipped with automatic sound seal door bottoms.

### **3.3 INSTALLED WORK**

- A. Remove grout and other bonding material from hollow-metal work immediately after installation.
- B. Touchup: Sand and clean rusted or abraded surfaces and apply compatible touchup finish:
1. Primer: Apply air-drying, rust-inhibitive primer.
  2. Metallic-Coated Surface: Repair with galvanizing repair paint according to manufacturer's written instructions.
  3. Painting: As specified in Section 099000 - Painting.
- C. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.
- D. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

**END OF SECTION**

# SECTION 087100 DOOR HARDWARE

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section includes:
  - 1. Commercial door hardware for the following:
    - a. Swinging doors.
    - b. Sliding doors.
    - c. Other doors to the extent indicated.
  - 2. Cylinders for doors and locking devices specified in other Sections.
  - 3. Electrified door hardware.
- B. Related Sections:
  - 1. Section 081113 – Hollow Metal Doors and Frames.
  - 2. Division 26: Electrical.

### 1.2 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. Existing Conditions: Where hardware components are reused or where modifications to existing hardware is required, field verify existing conditions and coordinate installation resulting in proper door operation.
- E. Coordination Meeting: When requested by Architect and/or Owner, the Contractor will schedule a meeting prior to the installation of electrified hardware to review and coordinate functions and connections. Participants to include representatives and-suppliers of all applicable electrified hardware components. Advise Architect/Owner of scheduled date, time, place, and attendees.

### 1.3 PREINSTALLATION MEETINGS

- A. Pre-Installation Conference: Prior to the installation of hardware, manufacturers' representatives must arrange and conduct a jobsite meeting to instruct Installers on the proper installation. A letter of compliance must be sent to the Architect and Owner.
- B. Refer to Keying article for keying conference requirements.

### 1.4 ACTION SUBMITTALS

- A. Hardware Schedule: Submit hardware schedule per Section 013300 in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules, which do not comply, will be returned for correction before review. Hardware schedule shall clearly indicate architect's hardware group and manufacturer of each item proposed. The schedule shall be reviewed prior to submission by a certified Architectural Hardware Consultant, who shall affix his or her seal attesting to the completeness and correctness of the schedule.
  - 1. Provide illustrations from manufacturers' catalogs and data in brochure form.
  - 2. Check specified hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in the hardware schedule submittal.

3. When requested, provide listing of manufacturers' template numbers for each item of hardware in the hardware schedule submittal.
  4. Furnish associated Contractors and Subcontractors with copies of final approved hardware schedule. Submit necessary templates and schedules as soon as possible to hollow metal, wood, aluminum, and other door & frame fabricators in accordance with schedule they require for fabrication.
  5. Samples; if requested by Architect, provide for each exposed product in each finish specified, in manufacturer's standard size
    - a. Tag Samples with full product description to coordinate Samples with door hardware schedule.
  6. List of related door devices specified in other Sections for each door and frame.
- B. Closer Mounting: Indicate mounting description for each closer included in the submittal's hardware groups.
- C. Existing Hardware Conditions: Refer to PART 1 - Coordination.
1. Advise Hardware Supplier and Architect of any existing conditions which would prevent utilization of specified hardware.
- D. Provide keying schedule, prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents. Keying schedule to be coordinated with and approved by Owner.
- E. Electrified Hardware Coordination:
1. List all hardware specified in groups and identify items not in your scope as "by Others" or other means of identification.
  2. Provide "operational descriptions" for each electrified hardware group including operation for exit, entry, and fire alarm conditions.
    - a. Refer to operational descriptions in electrified hardware groups. Part 3 - Hardware Groups.
  3. Wiring Diagrams: When requested after final approval of the hardware schedule submittal, provide wiring diagrams for each opening that requires electrified hardware.
    - a. Exception: groups where only magnetic hold-opens or door position switches are specified.
    - b. Approved diagrams to be sent with hardware delivery to the jobsite.
- F. Sustainable Design Submittals:
1. For materials with recycled content, provide letter from manufacturer indicating percentages of post-consumer and pre-consumer recycled content. Include statement indicating material cost (exclude labor and markups) for each product provided under this Section.
  2. Provide letter from manufacturer indicating location of manufacture, extraction and harvest of all materials provided under this Section. Include statement indicating material cost (exclude labor and markup) for each product provided under this Section.
  3. Building Product Disclosure and Optimization – Environmental Product Declarations: Provide One of the following:
    - a. Provide details of industry wide or product specific third party environmental product declarations ISO 14025, 14040, 14044, EN 15804 or ISO 21930. Indicate type of third party certification.
    - b. Provide details of critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope.
  4. Provide a third party verified manufacturer's report that demonstrates an impact reduction below industry average in at least three of the following categories:
    - a. Global warming potential (greenhouse gases), in CO<sub>2</sub>e;
    - b. Depletion of the stratospheric ozone layer, in kg CFC-11;
    - c. Acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;
    - d. Eutrophication, in kg nitrogen or kg phosphate;
    - e. Formation of tropospheric ozone, in kg NO<sub>x</sub>, kg O<sub>3</sub> eq, or kg ethene; and
    - f. Depletion of nonrenewable energy resources, in MJ.
  5. Building Product Disclosure and Optimization – Raw Material Source and Extraction Reporting:

- a. Provide a verified manufacturers report from their raw material suppliers which include raw material supplier extraction locations, a commitment to long-term ecologically responsible land use, a commitment to reducing environmental harms from extraction and/or manufacturing processes, and a commitment to meeting applicable standards or programs voluntarily that address responsible sourcing criteria.
  - 1) Acceptable CSR frameworks include the following:
    - (a) Global Reporting Initiative (GRI) Sustainability Report.
    - (b) Organization for Economic Co-operation and Development (OECD). Guidelines for Multinational Enterprises.
    - (c) U.N. Global Compact: Communication of Progress.
    - (d) ISO 26000: 2010 Guidance on Social Responsibility.
- G. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for finish hardware. Send installation instructions to site with hardware.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Contract Closeout Submittals: Comply with Section 017800 including specific requirements indicated.
  - 1. Operating and maintenance manuals containing the following:
    - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
    - b. Catalog pages for each product.
    - c. Name, address, and phone number of local representative for each manufacturer.
    - d. Parts list for each product.
  - 2. Copy of final approved hardware schedule, edited to reflect "As installed".
  - 3. Copy of final keying schedule.
  - 4. As installed "Wiring Diagrams" for each opening connected to power, both low voltage and 110 volts.
  - 5. One complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer: Obtain each type of hardware (ie. latch and locksets, hinges, closers) from single manufacturer, although several may be indicated as offering products complying with requirements.
- B. Supplier: Recognized architectural finish hardware supplier, with warehousing facilities, who has been providing hardware for period of not less than 3 years. The supplier shall be, or employ, a certified Architectural Hardware Consultant (AHC), who is registered in the continuing education program as administered by the Door and Hardware Institute. The hardware schedule shall be prepared and signed by a certified AHC.
- C. Installer: Firm with 3 years experience in installation of similar hardware to that required for this project, including specific requirements indicated.
- D. Regulatory Label Requirements: Provide nationally recognized testing agency label or stamp on hardware for labeled openings. Where UL requirements conflict with drawings or specifications, hardware conforming to UL requirements shall be provided. Conflicts and proposed substitutions shall be clearly indicated in hardware schedule.
- E. Accessibility Requirements: Doors to stairs (other than exit stairs), loading platforms, boiler rooms, stages and doors serving other hazardous locations shall have knurled or other similar approved marking of door lever handles or cross bars, if required by local building codes.
- F. Pre-Installation Conference: Prior to the installation of hardware, manufacturers' representatives for locksets, closers, and exit devices shall arrange and conduct a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when this meeting is held and who is in attendance, shall be sent to the Architect and Owner. Refer to Keying article for keying conference requirements.



## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver hardware to jobsite in manufacturer's original packaging, marked to correspond with the approved hardware schedule. Do not deliver hardware until suitable locked storage space is available. Check hardware against reviewed hardware schedule. Store hardware to protect against loss, theft, or damage.
- B. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to the respective manufacturer.

## 1.8 WARRANTY

- A. Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Substantial Completion.
- B. Provide a minimum ten year factory warranty on door closer body against defects in material and workmanship from date of occupancy of Project.
- C. Replace shortages and incorrect items with correct material at no additional cost to Owner.
- D. At completion of project, qualified factory representative shall inspect closer installations. After this inspection, letter shall be sent to Architect reporting on conditions, verifying that closers have been properly installed and adjusted.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Confirm acceptable manufacturers and models of all hardware products with Owner. Specified products are listed only to establish function and a level of quality.
- B. Specified manufacturers and models are based on the best information available at the time of this printing to establish function and level of quality, but are subject to change as additional information becomes available. Changes will be advised in future documentation.
- C. Acceptable manufacturers and models of particular products will be determined by hardware distributor/supplier who has been contracted and directed by the Owner. Specified products are listed only to establish function and a level of quality.

### 2.2 BUTTS AND HINGES

- A. Acceptable Manufacturers: Hager product numbers used for design intent.
  - 1. Bommer, Hager, McKINNEY, Stanley.
- B. Types:
  - 1. Type 1 (BB1262): heavy-weight, swing-clear
  - 2. Type 2 (BB1279): standard-weight, ball-bearing
  - 3. Type 3 (BB1191): standard-weight, rust-resistant/ non-ferrous (brass, bronze, or stainless-steel base metal), ball-bearing
  - 4. Type 4 (BB1168): heavy-weight, ball-bearing
  - 5. Type 5 (BB1199): heavy-weight, rust-resistant/ non-ferrous, ball-bearing

	Type 1	Type 2	Type 3	Type 4	Type 5
Bommer:	BB5024	BB5000	BB5001/BB5002	BB5004	BB5005/BB5006
Hager:	BB1262	BB1279	BB1191	BB1168	BB1199
Ives (base metal)		5BB1SCHW		5BB1	(base metal) 5BB1HW
McKINNEY:	T4A3795	TA2714	TA2314	T4A3786	T4A3386

PBB:	SC4B81	BB81	BB21/BB51	4B81	4B21/4B51	
Stanley:		FBB268	FBB179	FBB191	FBB168	FBB199

C. Types per Application:

1. Types Exterior out-swinging doors Type 5 x NRP
2. Exterior in-swinging doors and vestibule doors Type 4
3. Interior doors with closers Type 2 or 4
4. Interior doors over 36 inches wide Type 4
5. Interior doors 36 inches or less without closer Type 2
6. Provide NRP (non-removable pins) at out-swinging doors that are lockable or locked and at other doors when specifically indicated.

D. Size:

1. 2-1/4 inch Doors 5 inch by 5 inch
2. 1-3/4 inch Doors 4-1/2 inch by 4-1/2 inch
3. 1-3/8 inch Doors 3-1/3 inch by 3-1/2 inch

E. Quantity:

1. 2 – hinges per leaf for openings through 60 inches in height.
2. 1 – additional hinge per leaf for each additional 30 inches in height or fraction thereof.
3. 1 – additional hinge per leaf for openings 40 inches wide and wider.
4. [4 – hinges for Dutch doors up to 90 inches in height.]

F. Drill 5/32 inch hole and use No. 12, 1-1/4 inch steel threaded to the head wood screws for hinges on wood doors.

## 2.3 EXIT DEVICES

- A. Provide Heavy-Duty Manufacturers and Models as listed below. SARGENT is included in the hardware groups as a basis of design and function. Provide ONLY manufacturers and models as listed below.
  1. Von Duprin 35A/98 Series, No Substitution.
- B. All exit devices shall be UL listed for panic. Exit devices for labeled doors shall be UL listed as "Fire Exit Hardware".
- C. Where lever trim is specified, provide lever design to match locksets specified in previous articles.
- D. Provide cylinder dogging feature for non-rated heavy-duty exit devices with pull or locked lever outside trim.
- E. Cylinders: Provide cylinders as required for specified locking function and cylinder dogging. Refer to Part 2 – KEYING.
- F. When “less bottom rod” configuration is specified in the assigned hardware group, provide appropriate fire bolts/thermal pins, as required by the door manufacturer to attain the specified fire-rating/label. Also include appropriate strike to receive bolt/pin when projected. Dustproof type when required at floor/threshold location.
- G. Provide keyed removable mullions, including keyed cylinders, as specified in the Hardware Groups.
- H. Door supplier to coordinate exit device mounting location to be mounted below half-height glazing to keep exit device from obstructing vision panel.

## 2.4 DOOR CLOSERS

- A. Acceptable Manufacturers and Types of Exposed Closers:
  1. Heavy-Duty - cast aluminum bodies:
    - a. LCN 4050, No Substitution.
- B. Provide heavy-duty non-sized closers with heavy-duty closer arms, unless indicated otherwise in Hardware Groups, adjustable to meet maximum opening force requirements of ADA.
- C. Provide heavy-duty drop plates, brackets, or adapters for arms as required to suit details.

- D. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors, unless indicated otherwise.
- E. Provide back-check for closers.
- F. Provide heavy-duty mechanical holder arms where holder function is indicated.
- G. Provide closers for doors as noted in Hardware Groups and, in addition, provide closers for labeled doors whether or not specifically noted in group.
- H. Provide closers meeting the requirements of UBC 7-2 and UL 10C positive pressure tests.
- I. No through bolting of closers will be accepted.

## 2.5 GASKET

- A. Acceptable Manufacturers: Provide Pemko products as indicated, or equivalent products by Hager, National Guard Products, Reese Enterprises, or Zero. Refer to drawings for special details. Provide accessories, shims and fasteners.
- B. Provide gaskets for doors designated for "smoke and draft control" as required by local codes and/or door manufacturer. Include astragal and/or gasket as required for meeting edges of pairs. Refer to Architectural Life-Safety plans and/or Opening Schedule.
  - 1. Where smoke gasket is specified or required by fire-rating criteria, provide S88BL, unless detailed otherwise.
- C. Provide gaskets for fire labeled doors as required by local codes and/or door manufacturer tested assembly. Also include astragal and/or gasket as required for meeting edges of pairs.
- D. Where frame-applied intumescent seals are required by the wood door manufacturer, provide gaskets that comply with NFPA 252 and UL-10C positive-pressure testing.
- E. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

## 2.6 FASTENERS

- A. Including, but not limited to; wood or machine screws, special screws, bolts, special bolts, nuts, expansion shields, anchors, and other accessory items of proper type, material, and finish required for complete operational installation of hardware.
- B. Use phillips head for exposed screws. Do not use aluminum screws to attach hardware.
- C. Provide self-tapping, TEC, screws for attachment of sweeps and stop-applied weatherstripping.

## 2.7 TYPICAL FINISHES AND MATERIALS

- A. Finishes, unless otherwise specified:
  - 1. Butts: Outswinging Exterior Doors - US32D/BHMA 630on Stainless Steel.
  - 2. Butts: Interior Doors and Inswinging Exterior Doors - US26D/BHMA 652 on Steel.
  - 3. Continuous Geared Hinges - US28/BHMA 628 on Aluminum.
  - 4. Continuous Stainless Steel - US32D/BHMA 630on Stainless Steel.
  - 5. Pivots - US26D/BHMA 626 on Brass or Bronze.
  - 6. Flush Bolts: US26D/BHMA 626 on Brass or Bronze.
  - 7. Exit Devices: US32D/BHMA 630 on Stainless Steel.
  - 8. Locks and Latches: US26D/BHMA 626 on Brass or Bronze.
  - 9. Push Plates, Pulls and Push Bars: US32D/BHMA 630 on Stainless Steel.
  - 10. Coordinators: USP/BHMA 600 on Steel.
  - 11. Kick Plates, Armor Plates, and Edge Guards: US32D/BHMA 630 on Stainless Steel.
  - 12. Overhead Stops and Holders: US26D/BHMA 626 on Brass or Bronze.
  - 13. Closers: Surface mounted. Sprayed Lacquer or Powder Coat to Match.
  - 14. Latch Protectors: US32D/BHMA 630 on Stainless Steel.
  - 15. Miscellaneous Hardware: US26D/BHMA 626 on Brass or Bronze.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine doors, frames, and related items for conditions that would prevent the proper application of finish hardware. Do not proceed until defects are corrected.

### **3.2 INSTALLATION**

- A. Install finish hardware in accordance with reviewed hardware schedule and manufacturer's printed instructions. Prefit hardware before finish is applied, remove and reinstall after finish is completed. Install hardware so that parts operate smoothly, close tightly and do not rattle.
- B. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.
- C. Set units level, plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.
- D. Screws for hinges and lock fronts in wood doors shall have pilot holes pre-drilled to avoid splitting doors. Do not over-drill pilot holes or over-torque installation of screws.
- E. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. For doors with door pulls and push plates, install door pulls with through bolted fasteners countersunk and flush with door face. Then install push plates over countersunk through bolts so they are concealed by push plate.
- G. [Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant, forming tight seal between threshold and surface to which set. Securely and permanently anchor thresholds, using countersunk non-ferrous screws to match color of thresholds; stainless steel screws at aluminum thresholds.]
- H. [Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates with 3M adhesive #1357, as recommended by 3M Co., on lead-lined doors.]
- I. [Installation of sound seals shall include the following:
  - 1. Silencers shall not be installed on doors specified with sound seals.
  - 2. Installation of sound seals shall be coordinated with all other specified and scheduled hardware.
  - 3. Sound seals shall be adjusted to provide a "light tight" seal at the entire perimeter of each door leaf.
  - 4. Closers shall be adjusted to operate as quietly as possible under normal operation.
  - 5. Apply a continuous bead of non-hardening, paintable sealant between the seal housing and door frame. Do not paint acoustic seals.
  - 6. Acoustic seals shall be continuous when installed. Do not cut seals to accommodate other hardware for any reason.]

### **3.3 FIELD QUALITY CONTROL**

- A. After installation has been completed, provide services of qualified hardware consultant to check Project to determine proper application of finish hardware according to schedule. Also check operation and adjustment of hardware items.
- B. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

### **3.4 ADJUSTING AND CLEANING**

- A. At final completion, hardware shall be left clean and free from disfigurement. Make final adjustment to door closers and other items of hardware. Where hardware is found defective repair or replace or otherwise correct as directed.
- B. Adjust door closers to meet opening force requirements of Uniform Federal Accessibility Standards.

1. Force Requirements:
  - a. Interior hinged doors and gates: 5 pounds maximum.
  - b. Sliding or folding doors: 5 pounds maximum.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of space or area, return to work during week prior to acceptance or occupancy, and make final check and adjustment of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.
- D. Instruct Owner's personnel in proper adjustment and maintenance of door hardware and hardware finishes.
- E. Clean adjacent surfaces soiled by hardware installation.

### 3.5 PROTECTION

- A. Provide for proper protection of hardware items until the Owner accepts Project as complete.

### 3.6 HARDWARE GROUPS

- A. Provide all required door hardware for each specified opening to comply with requirements of this section in its entirety. Included are desired/intended functions, acceptable manufacturers and models, systems coordination, etc. for a complete installed opening.
- B. Refer to the openings schedule for hardware group and modifiers assigned to each door opening. Ignore hardware groups and modifiers not assigned on the openings schedule.

### 3.7 HARDWARE SETS

#### Set: 1

Description: Rim Exit x Passage Lever, Closer x Stop, Rated

3 Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1 Rim Exit (Psg Lvr, Rated)	98/99L-F x 996L-BE-F	626	VD
1 Closer x Stop	4050-CUSH	AL	LC
1 Gasketing	S88BL		PE

**END OF SECTION**

# SECTION 099000 PAINTING

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
1. Painting and finishing of new materials.
  2. Preparation of surfaces for painting and finishing.
  3. Smoke and fire partitions stenciling.

### 1.2 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
1. Material List: Provide inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
  2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing and applying each coating material proposed for use.
  3. Certification by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples: Submit paint and transparent finish samples in accordance with Section 013300, for color selection and finish acceptance.
1. Paint Colors, Surface Treatments and Finishes: As selected by Architect. Submit three 8 inch by 10 inch samples to be reviewed for color and sheen. Architect reserves right to select color or finish from any manufacturer, herein specified, as necessary to achieve desired color or finish.
- C. Schedule: For acceptance, submit 3 copies of complete schedule showing each product by number and brand name proposed to be used at each surface and location. Generally follow specified outline and list number of coats.

### 1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by same manufacturer as finish coats.
- B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- C. Applicator Qualifications: Engage experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with record of successful in-service performance.
- D. Mock-up
1. Job Site Sample Areas: Make sample application of high performance epoxy coating on project surfaces to the extent of one system on one wall of one room as directed by Architect.
    - a. Obtain acceptance of sample field application before making additional applications.
    - b. Accomplish work to equal or exceed standards established by approved samples. Protect and maintain approved field samples through completion of project.

### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver paint materials in sealed original labeled containers, bearing manufacturer's name, type of paint, brand name, color designation and instructions for mixing or reducing.
1. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

- B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45 degrees F in well ventilated area. Restrict storage to paint materials and related equipment.
- C. Take precautionary measures to prevent fire hazards and spontaneous combustion. Comply with health and fire regulations.

### **1.5 PROJECT CONDITIONS**

- A. Environmental Requirements: Comply with manufacturer's recommendations as to environmental conditions under which painting and finishing can be applied. Do not apply finish in areas where dust is being generated.
- B. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture contents of surfaces are below following maximums:
  - 1. Plaster and Gypsum Wallboard: 12 percent.
  - 2. Masonry, Concrete and Concrete Block: 12 percent.
  - 3. Interior Wood: 15 percent.
- C. Ensure surface temperature and surrounding air temperature is above 40 degrees F before applying finishes. Minimum application temperature for latex paints for interior work shall be 45 degrees F and 50 degrees F for exterior work. Minimum application temperature for transparent finish shall be 65 degrees F, or surface and air temperature shall be 5 degrees above dew point.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 45 degrees F for 24 hours before, during and 48 hours after application of finishes.
- E. Provide minimum 25 foot candles of lighting on surfaces to be finished.

### **1.6 EXTRA MATERIALS**

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
  - 1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
    - a. Interior, Paint: 1 gal. of each color applied.
    - b. Exterior, Paint: 1 gal. of each color applied.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Single-Source Responsibility: Provide primer, base and intermediate coats, and finishes produced by a single manufacturer for each system scheduled in Part 3.
- B. National Manufacturers:
  - 1. Sherwin-Williams (Basis of Design)
  - 2. Glidden Professional/Devoe Coatings
  - 3. Benjamin Moore
  - 4. Mythic Paint
  - 5. PPG Paints
  - 6. Valspar

### **2.2 MATERIALS**

- A. Material Compatibility: Provide block fillers, primers, base coat, intermediate coat, and finish coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide factory-formulated paint materials of type as recommended by Manufacturer for substrate indicated.

- C. Painting and Finishing Schedules: Refer to Painting and Finishing Schedules in Part 3 of this Section.
  - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
  - 2. Sheen: When one of following terms is used to denote specific sheen for coating listed, following index shall apply:
    - a. Flat: Less than 15 units based on 85 degrees of sheen.
    - b. Eggshell: 5 to 20 units based on 60 degrees of sheen.
    - c. Satin/Low Lustre: 15 to 35 units based on 60 degrees of sheen.
    - d. Semi-gloss: 30 to 65 units based on 60 degrees of sheen.
    - e. Gloss: Above 65 units based on 60 degrees of sheen.
- D. (PT), (PTE) Paint Colors: Provide specified color in paint type as scheduled in this Section

## **2.3 MIXING AND TINTING**

- A. Deliver paints ready-mixed to job site.
- B. Job mixing and job tinting is not acceptable.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine surfaces to receive paint and transparent finishes for conditions that would adversely affect execution, permanence or quality of work and which cannot be put into acceptable condition through preparatory work. Do not proceed with surface preparation or coating application until conditions are suitable.

### **3.2 PREPARATION OF SURFACES**

- A. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as specified, for each particular substrate condition.
  - 1. Remove mildew, by scrubbing with solution of detergent, bleach and warm water. Rinse with clean water and allow surface to dry completely.
  - 2. Remove surface contamination from aluminum surfaces requiring paint finish by steam, high pressure water or solvent washing. Apply etching primer or acid etch. Apply paint immediately if acid etching.
  - 3. Remove contamination from copper surfaces requiring paint finish by steam, high pressure water or solvent washing. Apply vinyl etch primer or acid etch. Apply paint immediately if acid etching.
  - 4. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of anticipated problems in using specified coating systems with substrate primed by others.
- B. Remove hardware, hardware accessories, plates, lighting fixtures, and similar items in-place and not to be finish painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items by workmen skilled in trades involved.
- C. Clean surfaces to be painted before applying paint or surface treatment. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program cleaning and painting so that dust and other contaminants from cleaning process will not fall in wet, newly painted surfaces.
  - 1. Remove dirt, oil, grease and sand if necessary to provide adhesion key, when asphalt, creosote or bituminous surfaces require paint finish. Apply compatible sealer or primer.
  - 2. Remove dirt, grease and oil from canvas and cotton insulated coverings.



- D. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block and cement plaster to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint.
  - 1. Remove contamination, acid etch and rinse new concrete floors with clear water. Ensure required acid alkali balance is achieved. Allow to thoroughly dry. Repeat procedure if necessary to achieve a medium sandpaper-like profile.
  - 2. Remove dirt, loose mortar, scale, powder and other foreign matter from concrete and concrete block surfaces which are to be painted or to receive clear seal. Remove oil and grease with solution of trisodium phosphate, rinse well and allow to thoroughly dry.
  - 3. Remove stains from concrete and concrete block surfaces caused by weathering of corroding metals with solution of sodium metasilicate after being thoroughly wetted with water. Allow to thoroughly dry.
- E. Gypsum Wallboard: Remove contamination from gypsum wallboard surfaces and prime to show defects, if any. Paint after defects have been remedied.
- F. Galvanized Surfaces: Clean free of oil and surface contaminants with acceptable non-petroleum based solvent.
- G. Ferrous Metals: Clean non-galvanized, ferrous surfaces that have not been shop-coated of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning, complying with Steel Structures Painting Council (SSPC)-SP3.
  - 1. Touch-up shop-applied prime coats which have damaged or bare areas. Wire-brush, solvent-clean, and touch-up with same primer as shop coat.
  - 2. Clean unprimed steel surfaces by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned. Prime surfaces to indicate defects, if any. Paint after defects have been remedied.
  - 3. Sand and scrape shop primed steel surfaces to remove loose primer and rust. Feather out edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. (Prime steel including shop primed steels.)
- H. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off.
  - 1. Prime or seal wood required to be job painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood.
  - 2. When transparent finish is required, back-prime with one coat of same material as used for surface.
  - 3. Seal tops, bottoms and cut-outs of wood doors with coat of surface finish immediately upon delivery to job for field painted doors only.
  - 4. Scrape and clean small, dry, seasoned knots and apply thin coat of white shellac or other recommended knot sealer, before application of priming coat.
  - 5. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
  - 6. Remove dust, grit and foreign matter from exterior wood siding which is to receive paint finish. Seal knots, pitch streak and sappy sections. Fill nail holes with exterior caulking compound after prime coat has been applied.
  - 7. Prior to finishing glue laminated beams, wash down surfaces with solvent and remove grease and dirt.

### 3.3 MATERIALS PREPARATION

- A. Mix and prepare painting materials and transparent finish materials in accordance with manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in clean condition, free of foreign materials and residue.

- C. Stir materials before application to produce mixture of uniform density, and as required during application of materials. Do not stir any film that may form on surface into material. Remove film and, if necessary, strain material before using.

### 3.4 APPLICATION

- A. Do not apply to wet or damp surfaces.
  - 1. Wait at least 30 days before applying to new concrete or masonry.
    - a. Test concrete for moisture content to verify manufacturer's surface moisture requirements are met.
    - b. Follow manufacturer's procedures to apply appropriate coatings prior to 30 days.
  - 2. Wait until wood is fully dry after rain, fog or dew.
    - a. Test wood for moisture content to verify manufacturer's surface moisture requirements are met.
- B. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
  - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
  - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
  - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
  - 4. Apply each coat at proper consistency.
    - a. Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.
  - 5. Each coat of paint shall be slightly darker than preceding coat unless otherwise approved by Architect.
  - 6. Provide finish coats which are compatible with prime paints used.
- C. Do not apply succeeding coats until previous coat has completely dried. Sand between each enamel or varnish coat application with fine sandpaper, or rub surfaces with pumice stone where required to produce even, smooth surface in accordance with coating manufacturer's directions.
  - 1. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by manufacturer.
- D. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive film thickness equivalent to that of flat surfaces.
- E. Finish doors on tops, bottoms, and side edges same as exterior faces, unless otherwise indicated.
- F. Film Thickness: Apply materials in accordance to paint manufacturer's recommendations and spreading rates to provide total dry film thickness as recommended.
  - 1. Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated
  - 2. Use precision instruments designed for measuring and evaluation wet and dry films of paints and coatings.
  - 3. Results measuring less than recommended thickness will require additional material application.
    - a. Regardless of number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.
  - 4. Use of poor hiding colors may require application of additional coats in order to achieve proper coverage and hiding.
- G. Apply first-coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- H. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of undercoat.

- I. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure finish coat with no burn-through or other defects due to insufficient sealing.
- J. Stipple Enamel Finish: Roll and redistribute paint to even and fine texture. Leave no evidence of rolling such as laps, irregularities in texture, skid marks, or other surface imperfections.
- K. Transparent Finish: On exposed portions, use multiple coats to produce glass-smooth surface film continuity of even luster. Provide finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats, unless otherwise indicated.
- L. Repainting of Existing Surfaces: Where repainting of existing surfaces is required, repaint wall and ceiling surfaces in their entirety, patch or spot painting is not acceptable.
- M. Paint surfaces behind movable equipment or furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only.
- N. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### **3.5 MECHANICAL AND ELECTRICAL EQUIPMENT**

- A. Refer to mechanical and electrical documents with respect to field painting and finishing requirements. Painting of mechanical and electrical work is not required in pipe chases, tunnels, and mechanical rooms with unpainted walls.
- B. Remove grilles, covers and access panels for mechanical and electrical systems from location and paint separately.
- C. Finish paint primed equipment to color selected.
- D. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars and supports, except where items are plated or covered with prefinished coating, or where they are not in finished space or room.
- E. Paint interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvers before installation of equipment with 1 coat of flat black paint, to limit of sight line. Paint dampers exposed immediately behind louvers, grilles, convector and baseboard cabinets to match face panels.
- F. Paint exposed piping, insulated piping and conduit occurring in finished areas. Color and texture to match adjacent surfaces.
- G. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

### **3.6 CLEANING**

- A. As work proceeds and upon completion, promptly remove paint where spilled, splashed or spattered. Touch up and restore damaged or defaced painted areas.
- B. During progress of work keep premises free from unnecessary accumulation of tools, equipment, surplus materials and debris. Remove at end of each workday.
- C. Upon completion of work clean window glass and other paint-spattered surfaces and leave premises neat and clean, to satisfaction of Architect.

### **3.7 PROTECTION**

- A. Adequately cover or otherwise protect finished work of other trades and other surfaces from paint and damage. Repair damage as result of inadequate or unsuitable protection as acceptable to Architect.
  - 1. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.

- B. Place cotton waste, cloths and material which may constitute fire hazard in closed metal containers and remove daily from site.
- C. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items shall be carefully stored, cleaned and replaced on completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.
- D. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

### 3.8 EXTERIOR PAINTING AND FINISHING SCHEDULE

- A. Non-Ferrous Metal Surfaces (Galvanized, Aluminum):
  - 1. Surfaces Included:
    - a. Galvanized sheet metal (flashing).
    - b. Steel lintels, lintel plates, relieving angles.
    - c. Hollow metal doors and frames, and window-walls.
    - d. Metal handrails, guardrails, ladders.
    - e. Metal gratings.
    - f. Metal roof hatches
    - g. Aluminum.
  - 2. Waterborne System, Low-VOC: Waterborne Acrylic Gloss Enamel over Waterborne Metal Primer.
    - a. Primer: 1 coat S-W ProIndustrial ProCryl Universal Primer, B66-1310.
    - b. Finish:
      - 1) 2 coats S-W DTM Acrylic Coating Semi-Gloss, B66-1150 Series.
- B. Ferrous Metal Surfaces (Steel, Iron):
  - 1. Surfaces Included:
    - a. Steel lintels, lintel plates, relieving angles.
    - b. Roof ventilators, roof vents.
    - c. Metal roof stacks.
    - d. Exterior ferrous metal.
  - 2. Waterborne System, Low-VOC: Waterborne Acrylic Gloss Enamel over Waterborne Metal Primer.
    - a. Primer: 1 coat S-W ProIndustrial ProCryl Universal Primer, B66-1310.
    - b. Finish:
      - 1) 2 coats S-W DTM Acrylic Coating Semi-Gloss, B66-1150 Series.
- C. Concrete, Precast and Cast-In-Place:
  - 1. Surfaces Included: Walls, beams, columns, posts, ceilings, soffits.
  - 2. Water Based System, Low VOC: 100 percent Acrylic Waterproofing Finish over 100 percent Acrylic Primer.
    - a. Primer: 1 coat S-W Loxon Concrete and Masonry Primer, LX02.
    - b. Finish: 2 coats S-W Loxon XP Waterproofing System, LX11 Series.

### 3.9 INTERIOR PAINTING AND FINISHING SCHEDULE

- A. Concrete Masonry Units (CMU) Surfaces:
  - 1. Surfaces Included: Walls.
  - 2. Water-Based Epoxy System, High Moisture Areas, Non-Immersion: Catalyzed Epoxy Coating over Block Filler.
    - a. 1st Coat: S-W Pro Industrial Heavy Duty Block Filler, B42W150 (16.0-21.0 mils wet, 8.0-10.5 mils dry).
    - b. Finish:
    - c. Finish:
      - 1) 2 Coats: S-W Pro Industrial Water Based Catalyzed Epoxy Eg-Shel, B73-360 Series.
      - 2) 2 Coats: S-W Pro Industrial Water Based Catalyzed Epoxy Gloss, B73-311 Series (5.0-12.0 mils wet, 2.0-5.0 mils dry per coat).
      - 3) Optional Urethane: S-W Acrolon 100 Gloss, B65-720 Series.

3. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic Finish over Latex Block Filler,
  - a. VOC Requirement: Not less than 35 percent solids, ammonia free coating.
  - b. Block Filler: 1 coat S-W Preprite Block Filler, B25W25.
  - c. Finish:
    - 1) 2 coats S-W ProMar 200 Zero-VOC Interior Latex Eg-Shel, B20-2600 Series.

B. Ferrous and Non-Ferrous Metal Surfaces:

1. Surfaces Included:
  - a. Hollow metal doors and frames.
  - b. Pre-painted surfaces.
  - c. Prime painted hardware.
  - d. Fire extinguisher cabinet trim.
  - e. Uninsulated piping and ductwork.
  - f. Metal access panels.
  - g. Metal louvers and grilles.
  - h. Electric panels (over factory finish).
  - i. Exposed and miscellaneous metals.
  - j. Other exposed to view interior ferrous metals not factory finished.
2. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic over Waterborne Metal Primer; not less than 35 percent solids, ammonia free coating.
  - a. VOC Requirement: Not more than 50 grams VOC's per liter,
  - b. Primer: 1 coat S-W DTM Acrylic Primer, B66W1.
  - c. Finish:
    - 1) 2 coats S-W Pro Industrial Acrylic Eg-Shel, B66 W00661 Series
    - 2) 2 coats S-W Pro Industrial Acrylic Semi-Gloss, B66 W00651 Series

### 3.10 SPECIAL SURFACES

A. Metal Ceilings:

1. Coordinate with Division 05 for shop-applied primer.
2. Surfaces Included:
  - a. Bar joist, decking and supports.
  - b. Galvanized ductwork.
  - c. Other overhead metal surfaces.
3. Dry Fall Spray-Applied Waterborne Systems: Waterborne Dryfall over Waterborne Metal Primer
  - a. Primer (touch-up if pre-primed): 1 coat S-W Pro-Cryl Universal Primer, B66-1310 Series.
  - b. Finish: 2 coat S-W Waterborne Acrylic Dry Fall, B42W181.

B. Non-Metal Ceilings and Soffits:

1. Surfaces Included:
  - a. Gypsum board assemblies.
  - b. Acoustical tile ceilings.
2. Dry Fall Spray-Applied Waterborne System: Waterborne Dryfall over latex Primer-Sealer.
  - a. Primer: 1 coat S-W PrepRite ProBlock Interior-Exterior Primer-Sealer B51-600.
  - b. Finish: 2 coat S-W Waterborne Acrylic Dry Fall, B42W181.

C. Spray Applied Fireproofing:

1. Surfaces Included:
  - a. Spray fireproofing (SFRM)
2. Dry Fall Spray-Applied Waterborne System: Waterborne Dryfall.
  - a. Primer: None unless required for adhesion.
  - b. Finish: 2 coat S-W Waterborne Acrylic Dry Fall, B42W150.

D. PVC, Plastic and Fiberglass Ceilings and Soffits:

1. Surfaces Included:
  - a. Pipes.
2. Dry Fall Spray-Applied Waterborne System: Waterborne Dryfall over Adhesion Promoting Primer.
  - a. Primer: 1 coat S-W Extreme Bond Primer, B51W150 Series.

b. Finish: 2 coats S-W Waterborne Acrylic Dry Fall, B42W150.

E. Insulation-Wrapped Piping and Equipment:

1. Surfaces Included: Piping, ducts, tanks, and equipment.
2. Waterborne System: Premium Quality Acrylic Latex finish over -Acrylic Primer.
  - a. Primer: 1 coat S-W Moisture Vapor Barrier Primer, B72W1.
  - b. Finish: 2 coats S-W ProMar 200 Zero-VOC Interior Latex Eg-Shel, B20-2600 Series.

F. Black Enamel Finish:

1. Surfaces Included: Duct throats for visible distance but not less than approximately 24 inches behind supply or return air grilles, registers, louvers.
  - a. Wood blocking exposed at reveals.
2. Water-Based Systems, Low-VOC: Acrylic Latex Finish.
  - a. Finish: 1 coat S-W ProMar 400 Latex Flat Black, B30W400 Series.

### 3.11 SMOKE AND FIRE PARTITIONS

- A. Stenciling: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions to be stenciled with the appropriate Hour-rating/Minute rating, i.e., "SMOKE and/or FIRE (1 HR /2 HR) – Protect All Openings," etc. as indicated on the Life Safety Plan, above ceilings on both sides of walls in letters not less than 3 inches high and 3/8 inch wide stroke. Refer to IBC Article 703 for additional information.
1. Stenciling shall be located above every door and no more than fifteen feet on center.
  2. Stencil every change in direction of rated walls.
  3. Indicate the end of a rated wall with a 2-inch vertical red line with an arrow pointing to the direction of the rated wall.

### 3.12 PAINT SCHEDULE

A. Interior Color Schedule:

PT-X: Manufacturer: Sherwin Williams; Product: Waterborne Zero VOC, Low Ode System:

1. (PT-1): Color: TBD.

**END OF SECTION**



## **SECTION 230500 COMMON WORK RESULTS FOR HVAC**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. HVAC demolition.
  - 3. Equipment installation requirements common to equipment sections.
  - 4. Painting and finishing.
  - 5. Supports and anchorages.

#### **1.3 BASIS-OF-DESIGN**

- A. Equipment manufacturers listed first in the specifications are the basis-of-design. Subsequent manufacturers listed in the specification other than the basis-of design manufacture are acceptable substitutions.

#### **1.4 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Escutcheons.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Equipment startup reports.
  - 1. Reports will indicate equipment was started and tested according to the manufactures recommendations and is operating as specified. Included test data.
- C. Coordination Drawings: Submit one copy for the engineers use. Division 23 coordination drawings will not be returned.



1. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
  - a. Planned piping layout, including specialty locations.
  - b. Planned piping hanger layout including building attachments and building structural coordination.
  - c. Planned ductwork layout, including dampers, duct access doors, control device and specialty locations and damper movement.
  - d. Planned ductwork hanger layout including building attachments and building structural coordination.
  - e. Clearances for installing and maintaining insulation.
  - f. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
  - g. Equipment and accessory service connections and support details
  - h. Exterior wall and foundation penetrations.
  - i. Floor plans, elevations, and details to indicate penetrations in walls and their relationship to other penetrations and installations.
  - j. Access door and panel locations.

### **1.7 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

### **1.8 GUIDELINES, CODES AND STANDARDS**

- A. Refer to the most recently published edition for references to guidelines, and standards (examples: ASHRAE, NFPA, AWWA, ASTM) unless a specific edition is listed.
- B. Installation and materials shall comply with applicable national, state, and local codes and ordinances.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Deliver ducts and air handling equipment with factory or shop applied protective covering. Protective covering shall remain until installation.
- C. Materials and equipment stored on site shall have a protective covering; open ends on equipment connections and ducts shall be covered. Duct liner shall be encapsulated.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## PART 3 EXECUTION

### 3.1 HVAC DEMOLITION

- A. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.

- H. Install piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Sleeves are not required for core-drilled holes through walls.
- K. Verify final equipment locations for roughing-in.
- L. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.3 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.4 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in steel piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### **3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install HVAC equipment according to the equipment manufacturer's installation instructions and as indicated on the drawings. Resolve conflicting instructions, with the architect before mounting equipment.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Refer to equipment shop drawings for rough in locations; do not scale drawings.

### **3.6 PAINTING**

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Section "Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

**END OF SECTION**



## **SECTION 230518 ESCUTCHEONS FOR HVAC PIPING**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

### **PART 2 PRODUCTS**

#### **2.1 ESCUTCHEONS**

- A. One-Piece, 1/8 inch thick, type 316 stainless steel plate.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install escutcheons for exposed piping penetrations of HVAC wall casing.
- B. Install escutcheons with ID to closely fit around pipe yet still allows pipe to freely expand and contract through escutcheon and with OD that completely covers wall opening.

#### **3.2 FIELD QUALITY CONTROL**

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**



**SECTION 230529  
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
- B. Related Sections:
  - 1. Section 233113 "Metal Ducts" for duct hangers and supports.

**1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

**1.6 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

**PART 2 PRODUCTS**

**2.1 METAL PIPE HANGERS AND SUPPORTS**

- A. Stainless-Steel Pipe Hangers and Supports: Type 316 Stainless-steel.
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

**2.2 FASTENER SYSTEMS**

- A. Stainless steel expansion anchors for installation in concrete slabs: Type 316 stainless-steel. Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

**PART 3 EXECUTION**

**3.1 HANGER AND SUPPORT INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58 and MSS SP-89. Install hangers and attachments as required to properly support piping from the building structure.



- B. Fastener System Installation:
  - 1. Install expansion anchors for support of piping from concrete slabs. Pre-drill holes in concrete for anchors.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between supports.
- E. Install building attachments within concrete slabs. Install additional attachments at concentrated loads, including exhaust silencers, piping NPS 2-1/2 and larger and at changes in direction of piping.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- H. Insulated Piping:
  - 1. Piping Operating above Ambient Air Temperature: Hanger to be installed outside insulation. Install MSS SP-58, Type 40, protective shields on piping.
    - a. Shield Dimensions for Pipe: Not less than the following:
      - 1) NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      - 2) NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      - 3) NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

### 3.2 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.3 HANGER AND SUPPORT SCHEDULE

- A. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- B. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- C. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
- D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Stainless-Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
- E. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Stainless-Steel Concrete Expansion Anchors: For upper attachment to suspend pipe hangers from concrete ceiling.
- F. Shields: Install protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

**END OF SECTION**



**SECTION 230553**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pipe labels.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

**PART 2 PRODUCTS**

**2.1 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
  - 1. Pretensioned Pipe Labels: Pre-coiled, semi rigid plastic formed cover full circumference of pipe and to attach to pipe without fasteners. Provide adhesive for labels on vertical piping..
  - 2. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Where applicable, include flow arrow in direction of fluid flow.
    - a. 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.
    - b. Lettering Size: At least 1-1/2 inches high for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

**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 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

**3.3 PIPE LABEL INSTALLATION**

- A. Locate pipe labels where piping is exposed in machine rooms, within area wells and above area wells.
  - 1. Spaced at maximum 25 feet.
- B. Pipe Label Color Schedule:
  - 1. Fuel Oil Fill Piping:
    - a. Background Color: White.
    - b. Letter Color: Black.

2. Fuel Oil Vent Piping:
  - a. Background Color: White.
  - b. Letter Color: Black.

**END OF SECTION**

# SECTION 230719 HVAC PIPING INSULATION

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
  - 1. Engine Exhaust Piping and Silencer, indoors.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### 1.6 COORDINATION

- A. Coordinate sizes and locations of hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," article for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Calcium Silicate:
  - 1. Products: Subject to compliance with requirements provide one of the following:
    - a. Industrial Insulation Group (IIG); Thermo-12 Gold. ([www.iig-llc.com](http://www.iig-llc.com))
  - 2. Thermal conductivity (k-value) at 400 degrees F is 0.49 Btu x in. /h x sq. ft. x degrees F or less.
  - 3. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 4. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 5. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- A. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 degrees F.
  - 1. Products: Subject to compliance with requirements provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H.B. Fuller Company; CP-97. ([www.idccorp.com](http://www.idccorp.com))
    - b. Eagle Bridges - Marathon Industries; 290. ([www.eaglebridges.com](http://www.eaglebridges.com))
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H.B. Fuller Company; 81-27. ([www.fosterproducts.com](http://www.fosterproducts.com))
    - d. Mon-Eco Industries, Incorporated ([www.mon-ecoindustries.com](http://www.mon-ecoindustries.com))
    - e. Vimasco Corporation; 760. ([www.vimasco.com](http://www.vimasco.com))
- B. Metal Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H.B. Fuller Company; CP-76. ([www.idccorp.com](http://www.idccorp.com))
    - b. Eagle Bridges - Marathon Industries; 405. ([www.eaglebridges.com](http://www.eaglebridges.com))
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H.B. Fuller Company; 95-44. ([www.fosterproducts.com](http://www.fosterproducts.com))
    - d. Mon-Eco Industries, Inc.; 44-05. ([www.mon-ecoindustries.com](http://www.mon-ecoindustries.com))
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 degrees F.
  - 5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H.B. Fuller Company; CP-76. ([www.idccorp.com](http://www.idccorp.com))
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 degrees F.
  - 5. Color: White.
  - 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:

1. Products: Subject to compliance with requirements provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems. (www.idccorp.com)
  - b. ITW Insulation Systems; Stainless Steel Jacketing. (www.itwinsulation.com)
  - c. RPR Products, Inc.; Insul-Mate. (www.rprhouston.com)
2. Stainless-Steel Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Flange covers.
    - 4) End caps.
    - 5) Beveled collars.
    - 6) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.4 TAPES

# PART 3 - EXECUTION

## 3.0 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

## 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings and specialties.
- B. Install insulation materials, forms, and jackets of thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.



- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- N. For above-ambient services, do not install insulation to the following:
  1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### **3.3 PENETRATIONS**

- A. Insulation Installation at Exterior Wall Penetrations: Install insulation only up to wall penetration.

### **3.4 GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings and Flanges:
  1. Install insulation over fittings and flanges with continuous thermal integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate flanges using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  5. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install a breather mastic for above-ambient services. Trowel the mastic to a smooth and well-shaped contour.

### **3.5 INSTALLATION OF CALCIUM SILICATE INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure single-layer insulation with stainless-steel bands at 12 inch intervals and tighten bands without deforming insulation materials.
  2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12 inch intervals. Secure outer layer with stainless-steel bands at 12 inch intervals.
  3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- B. Insulation Installation on Pipe Flanges:
  1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
  4. Finish flange insulation same as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
  3. Finish fittings insulation same as pipe insulation.

### **3.6 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation.
1. Draw jacket smooth and tight to surface with 2 inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062 inch thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where metal jackets are indicated, install with 2 inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### **3.7 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

### **3.8 INDOOR PIPING INSULATION SCHEDULE**

- A. Engine Exhaust Piping and Silencer, All Pipe Sizes: Calcium silicate, 4 inches thick.

### **3.9 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Exposed Generator Exhaust Pipe and Silencer:
1. Stainless Steel, Type 316, Smooth 2B Finish: 0.010 inch thick.

**END OF SECTION**



# SECTION 230900 INSTRUMENTATION AND CONTROLS FOR HVAC

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components.
  - 1. Existing building automation system will be modified and extended to provide control of systems indicated in Sequence of Operation for HVAC Controls.
- B. Related Sections include the following:
  - 1. Refer to Division 21, 22, and 23 sections for required control and alarm points.
  - 2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.
- C. Refer to Division-26 Sections for the following work.
  - 1. Power from the power source to the power connection on control panels as indicated on the Electrical Drawings.

### 1.3 DEFINITIONS

- A. Acceptance Date: The date that the installer demonstrates, to the owner or the owner's representative, that all system components are functioning properly. Refer to demonstration article for demonstration requirements.
- B. Application Specific Controller (ASC): A controller that controls specific pieces of complex or custom equipment, such as a cooling tower or rooftop unit, that includes preprogrammed routines prepared by the manufacturer. The user may select the appropriate sequence from a menu. The ASC is typically dedicated to the piece of equipment it controls.
- C. Building Controller: A general purpose term used to describe a variety of controller types, depending on the environment, protocol, vendor, or integrator terms.
- D. Configurable Controller: A flexible controller that can have a variety of uses and can be configured through selectable controls options. A configurable controller lacks the fully programmable features available in a programmable controller.
- E. DDC: Direct digital control.
- F. I/O: Input/output.
- G. LAN: Local area network.
- H. PC: Personal computer.
- I. PICS: Protocol Implementation Conformance Statement.
- J. PID: Proportional plus integral plus derivative.
- K. Programmable Controller: A flexible controller that can have a variety of uses and can be fully programmed by a qualified individual.
- L. RTD: Resistance temperature detector.
- M. TCP/IP: Transmission Control Protocol/Internet Protocol. The standard for transmitting data over networks, typically made up of many different protocols.

#### 1.4 SYSTEM PERFORMANCE

- A. Comply with all aspects of performance of existing building automation system performance.

#### 1.5 SEQUENCE OF OPERATION

- A. Refer to Section 230993 "Sequence of Operation for HVAC Controls"

#### 1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated; and indicate where it will be applied.
  - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for control units, transducers/transmitters, sensors, actuators, relays/switches, control panels, and operator interface equipment.
  - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  - 2. Schematic flow diagrams showing fans, dampers, and control devices.
  - 3. Wiring Diagrams: Power, signal, and control wiring.
  - 4. Details of control panel faces, including controls, instruments, and labeling.
  - 5. Written description of sequence of operation.
  - 6. Schedule of dampers including size, leakage, and flow characteristics.
  - 7. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
  - 8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
  - 9. Controlled Systems:
    - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    - c. Written description of sequence of operation including schematic diagram.
    - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Interconnection wiring diagrams with identified and numbered system components and devices.
  - 2. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  - 3. Calibration records and list of set points.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

- G. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

## **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Startup Personnel Qualifications: Specially trained personnel, in the direct employ of manufacturer or franchise of the primary automatic-control-system provider, who are experienced with the installation and startup of automatic control systems installations similar to those required for this Project.
- D. Codes and Standards: Equipment, materials, and labor; provided as work of this section shall comply with federal, state, and local standards, codes, and ordinances.
- E. Comply with ASHRAE 135 for DDC system components.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Ship temperature control devices and components in clean, dry packaging protected from the elements and corrosion
- B. Store temperature control devices and components in clean, dry location protected from the elements and corrosion.

## **1.9 COORDINATION**

- A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- B. Coordinate the location and installation of automatic control dampers, instruments, and air control accessories. Automatic control dampers, instruments, and air control accessories will be installed according to Division 23 Section Duct Accessories.
- C. Coordinate supply of conditioned electrical branch circuits for control panels.
- D. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

## **1.10 WARRANTY**

- A. Components, parts and assemblies will be guaranteed against defects in materials and workmanship for two years from the acceptance date.
- B. Labor and material to troubleshoot, repair, reprogram, or replace system components will provide, at no charge to the owner during the warranty period.
- C. Corrective software modifications made during warranty service periods will be updated on all user documentation and on user and manufacturer archived software disks. Provide the owner with a new compact disc whenever software changes are required.
- D. The installer will be capable of doing any repairs with factory trained technicians operating out of a local service office.
- E. The installer will furnish the Owner with a local telephone number where a factory-trained technician may be reached at all times.
- F. The factory-trained technician will arrive at the job-site ready to service the system within two hours upon receiving a request for repairs and will prosecute the work continuously until the system is back in proper reliable operating condition.

- G. The installer will keep a permanent maintenance record at the local service office of all repairs performed and all service calls responded to during the warranty period (including labor and material used); copy of record will be presented to Owner's representative at completion of each service call.
- H. Permanent maintenance records will include all service calls made.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Existing building automation system is a Tridium Niagara Platform Framework. All new controllers shall be manufactured by Distech Controls Inc. or approved equal.

### **2.2 INSTALLERS**

- A. Installers: Subject to compliance with requirements, automatic control systems will be installed by one of the following:
  1. CBRE-ESI, 3410 Gateway Rd, Brookfield WI, 53045-5115.
  2. Mechanical Technologies INC, 701 Morley Rd, Green Bay WI 54303.
  3. J F Ahern, 2111 North Sandra Street, Appleton, WI 54911.

### **2.3 CONTROL SYSTEM**

- A. Modification and extension of existing control system for new control work shall consist of sensors, indicators, actuators, control dampers, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers accessible on existing building automation system operator workstation that will include graphics matching type currently existing on operator workstation.

### **2.4 DDC EQUIPMENT**

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
  1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  4. Controller firmware updates must be capable of being pushed to all networked controllers. Physical access to a controller shall not be required to update firmware.
  5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
  1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.

- b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
  - 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  - 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
- 1. Binary Inputs: Allow monitoring of on-off signals without external power.
  - 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  - 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  - 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
  - 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
  - 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
  - 7. Universal I/Os: Provide software selectable binary or analog outputs.
- D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
- 1. Output ripple of 5.0 mV maximum peak to peak.
  - 2. Combined 1 percent line and load regulation with 100-microsecond response time for 50 percent load changes.
  - 3. Built-in over-voltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
- 1. Minimum dielectric strength of 1000 V.
  - 2. Maximum response time of 10 nanoseconds.
  - 3. Minimum transverse-mode noise attenuation of 65 dB.
  - 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.5 OPERATOR WORKSTATION INTERFACE

- A. Basic Interface Description
- 1. All new control work shall interface with existing building automation system operator workstation.

## 2.6 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
- 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72 -hour battery backup.
  - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
  - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
  - 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.



## 2.7 DDC RESIDENT SOFTWARE FEATURES

### A. General:

1. The software programs specified in this section will be provided as an integral part of the DDC and HVAC mechanical equipment controllers and will not be dependent upon any higher level computer (or operator workstation) for execution.
2. All points will be identified by up to 30-character point name and 16 character point descriptor. The same names will be used at the operator workstation.
3. All digital points will have user defined two-state status indication (descriptors with minimum of 8 characters allowed per state (i.e. summer/winter)).

### B. Control Software Description:

1. The DDC and HVAC mechanical equipment controllers will have the ability to perform the following pre-tested control algorithms:
  - a. Two-position control
  - b. Proportional control
  - c. Proportional plus integral control
  - d. Proportional, integral, plus derivative control
  - e. Automatic tuning of control loops

### C. DDC and HVAC mechanical equipment controllers will provide the following energy management routines.

1. Start-Stop Time Optimization (SSTO) will automatically be coordinated with event scheduling. The SSTO program will start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by time of occupancy. The SSTO program will also shut down HVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions.
  - a. The SSTO program will operate in both the heating and cooling seasons.
  - b. It will be possible to apply the SSTO program to individual fan systems.
  - c. The SSTO program will operate on both outside weather conditions as well as inside zone conditions and empirical factors.
  - d. The SSTO program will meet the local code requirements for minimum outside air while the building is occupied.

### D. DDC and HVAC Mechanical Equipment Controllers will be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. A single process will be able to incorporate measured or calculated data from any and all other DDC and HVAC Mechanical Equipment Controllers on the network. In addition, a single process will be able to issue commands to points in any and all other DDC and HVAC Mechanical Equipment Controllers on the network. Database will support 30 character; English language point names, structured for searching, and logs.
2. Processes will be able to generate operator messages and advisories to operator I/O devices. A process will be able to directly send a message to a specified device or cause the execution of a connection to a remote device such as a printer or pager.
3. DDC and HVAC Mechanical Equipment Controller will provide a HELP function key; providing enhanced context sensitive on-line help with task orientated information from the user manual.
4. DDC and HVAC Mechanical Equipment Controller will be capable of comment lines for sequence of operation explanation.

### E. Alarm management will be provided to monitor and direct alarm information to operator devices. Each DDC and HVAC Mechanical Equipment Controller will perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time will the DDC and HVAC Mechanical Equipment Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device, or communications with other panels on the network.

1. All alarm or point change reports will include the point's English language description and the time and date of occurrence.

2. The user will be able to define the specific system reaction for each point. Alarms will be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels will be provided for each point. Point priority levels will be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC and HVAC Mechanical Equipment Controller will automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users will have the ability to manually inhibit alarm reporting for each point.
3. Alarm reports and messages will be directed to a user-defined list of operator devices or PC's based on time (after hours destinations) or based on priority.
4. In addition to the point's descriptor and the time and date, the user will be able to print, display, or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
5. Operator-selected alarms will initiate a notification to a remote operator device.
6. Alarm points will be individually addressed. Do not group alarm points.

## 2.8 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, slab, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
  1. Manufacturers:
    - a. BEC Controls Corporation.
    - b. Ebtron, Incorporated.
    - c. Heat-Timer Corporation.
    - d. I.T.M. Instruments, Incorporated.
    - e. Kele Incorporated.
    - f. MAMAC Systems, Incorporated.
    - g. Precon; Division of Kele, Incorporated.
    - h. RDF Corporation.
    - i. Veris Industries.
  2. Accuracy: Plus or minus 0.36 deg F at calibration point.
  3. Wire: Twisted, shielded-pair cable.
  4. Type (1) Room Sensor Construction: Standard Cover plate size, brushed stainless steel RTD sensor. (Example: Precon ST-S Series)
    - a. Set-Point Adjustment: None.
    - b. Set-Point Indication: None.
    - c. Switched Override: None.
    - d. Finish: Brushed Stainless Steel.
    - e. Orientation: None.

## 2.9 STATUS SENSORS

- A. Electronic Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

## 2.10 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  2. 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.
  3. Non-spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.

4. Spring-Return Motors for Valves Larger than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
  5. Non-spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  6. Spring-Return Motors for Dampers Larger than 25 Sq. Ft.: Size for running and breakaway torque of 150 inches x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
    - a. Belimo Aircontrols (USA), Incorporated
    - b. Or Approved Equal.
  2. Dampers: Size for running torque calculated as follows:
    - a. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
  3. Coupling: V-bolt and V-shaped, toothed cradle.
  4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  6. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  8. Temperature Rating: Minus 22 to plus 122 deg F.
  9. Run Time: 12 seconds open, 5 seconds closed.

## 2.11 DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide control damper products by one of the listed manufacturers:
1. Arrow United Industries
  2. Ruskin Manufacturing Company
  3. Tamco
- B. Construction:
1. Frames: Extruded aluminum hat channels, 0.125-in. minimum thickness.
  2. Blades: Extruded aluminum airfoil type, 6-inch maximum blade width.
  3. Hardware: Molded synthetic bearings. Zinc plated steel axles, linkage brackets, connecting rods, and mounting bolts.
  4. Seals: Flexible metal compression seals on the frame at blade end; extruded vinyl inflatable blade edge seals.
  5. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
- C. Operating Limits:
1. Temperature: -20 to 200 deg F.
  2. Pressure: 6 inches w.g. differential.
  3. Velocity: Up to 4000 FM.
- D. All dampers to have opposed blades for proportional service.
- E. Damper sizes will be provided as indicated on the drawings. Damper sizes may be provided differently from those shown on the drawings, if improved performance can be demonstrated with calculations.

## 2.12 WIRE, CABLE, AND TRANSFORMERS

- A. Refer to Division 26 for conduits and conductors, except as noted.
- B. Wire and cable shall meet the requirements of NFPA 70 and NFPA 90A.
- C. Terminal blocks, which are not integral to other equipment, shall be insulated, modular, feed-trough, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or enclosed sides.
- D. Control wiring for binary sensors shall be 18 AWG copper and shall be rated for 300-volt service.

- E. Wiring for 120-volt circuits shall be 18 AWG or thicker stranded copper and shall be rated for 600-volt service.
- F. Control wiring for analog signals shall be 18 AWG, copper, single or multiple strand, twisted (minimum 50 mm lay of twist), 100% shielded pairs and shall have 300 volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation.
- G. IP Network cable shall meet or exceed Category 6 cable as specified in ANSI/TIA/EAI 568-A.
- H. Transformers shall be UL 1585 approved and shall be sized so that the connected load is no greater than 80% of the transformer rated capacity.
- I. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstations. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of temperature sensors and other exposed control sensors with Drawings and room details before installation.
  - 1. Install temperature sensors 60 inches above the floor.
- E. Install type (1) room temperature sensors where sensors or thermostats are indicated on the drawings; and where required to control room temperature.
- F. Provide fuel oil control system interface and control points.
- G. Install a minimum of one "unitary controller" in each mechanical equipment room.
- H. Install damper motors on outside of duct.
- I. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

### **3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

- A. Comply with all Division 26 Installation Requirements.
- B. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- C. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
  - 1. Wiring exposed to view, or concealed: Run wiring within electric metallic tubing.
  - 2. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  - 3. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
  - 4. Provide enclosures for terminal strips and similar devices.
- E. Provide all other wiring required for the complete operation of the specified systems.
- F. Install power supply wiring in addition to, or different from electrical power supply wiring specifically shown on the electrical drawings. Include disconnects, and required electrical devices. Power supply wiring for controls will extend from separate circuits on emergency power panels located as indicated on the electrical drawings.

- G. Install control wiring between field-installed sensing and control devices controlled equipment and unit control panels. Include disconnects, and required electrical devices.
- H. Where required install all wiring raceway systems complying with the requirements of the National Electrical Code. All required conduit shall be installed in EMT.
- I. Provide electrical disconnecting means for servicing, for each control panel, digital controller, transformer, power supply, and other devices that are served by 120VAC or higher voltage.
- J. Enclosures shall be fabricated of 14ga. steel with sub-panels for component mounting and have removable, hinged doors. Enclosures shall be sized to house the controllers, power supplies, transformers, wire duct and miscellaneous equipment required to support the application. Enclosures shall be provided for all controllers that are not located within an OEM provided mechanical equipment or on a VAV box. Control panels shall be fabricated as UL-508A listed assemblies.
- K. Input/Output Control Wiring
  - 1. Platinum 1k ohms and 10k ohms thermistor type II wiring shall be, stranded, twisted pair, shielded, minimum number 18 wire gauge.
  - 2. Other analog inputs shall be a minimum of number 18 wire gauge, stranded, twisted pair.
  - 3. Digital inputs shall be a minimum of number 18 wire gauge, stranded, twisted pair.
  - 4. Analog outputs shall be a minimum of number 18 wire gauge, stranded, twisted pair.
  - 5. Digital outputs shall be a minimum of number 18 wire gauge, stranded, twisted pair.
- L. All input and output wiring between controllers and field devices shall be splice-free.
- M. Conduit and Fittings
  - 1. Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
  - 2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
  - 3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.
  - 4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.
  - 5. Install low voltage power and LON and LAN communication trunks in conduit in the following locations regardless of local building code allowances otherwise.
    - a. Mechanical rooms.
    - b. Electrical rooms.
    - c. Vertical risers (exception: fire rated continuous closet like a telephone closet).
    - d. Open Areas where the wiring will be exposed to view or tampering.
  - 6. Conceal conduit within finished shafts, ceilings and wall as required. Install exposed conduit parallel with or at right angles to the building walls.
- N. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- O. Plug or cap all unused conduit openings and stub-ups. Do not use caulking compound.
- P. Route all conduit to clear beams, plates, footings and structure members. Do not route conduit through column footings or grade beams.
- Q. Set conduits as follows:
  - 1. Expanding silicone fire stop material sealed watertight where conduit is run between floors and through walls of fireproof shaft.
  - 2. Oakum and lead, sealed watertight penetration through outside foundation walls.
- R. Cap open ends of conduits until conductors are installed.

- S. Where conduit is attached to vibrating or rotating equipment, flexible metal conduit with a minimum length of 18 inches and maximum length of 36 inches shall be installed and anchored in such a manner that vibration and equipment noise will not be transmitted to the rigid conduit.
- T. Where exposed to the elements or in damp or wet locations, waterproof flexible conduit shall be installed. Installation shall be as specified for flexible metal conduit.
- U. Provide floor, wall, and ceiling plates for all conduits passing through walls, floors or ceilings. Use prime coated cast iron, split-ring type plates, except with polished chrome-plated finish in exposed finished spaces.

### **3.3 FIELD EQUIPMENT ENCLOSURES**

- A. Securely mount all control panels and enclosures to wall or structure using bolts, anchors, etc. Mount enclosures and control panels with top at 72 inches above finished floor, unless noted otherwise. Locate enclosures and control panels to ensure full door swing.
- B. Wiring shall be installed in a neat and organized manner. Bundle cables and route cabling within enclosures using fingerduct or channel raceway. Route cables at 90 degree angles throughout the enclosure.
- C. Splicing of cabling using wirenuts is unacceptable. Cable splicing shall take place on screw termination blocks.
- D. Maintain the UL listed environmental rating of each control panel by using the correct fittings and hardware for conduit penetrations into enclosures.
- E. Locate enclosures indoors where possible.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  2. Test and adjust controls and safeties.
  3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  4. Test each point through its full operating range to verify that safety and operating control set points are as required.
  5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  6. Test each system for compliance with sequence of operation.
  7. Test software and hardware interlocks.
- C. DDC Verification:
  1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  2. Check instruments for proper location and accessibility.
  3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  4. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
  5. Verify operation of operator workstation.
  6. Verify local control units including self-diagnostics.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

### **3.5 ADJUSTING**

- A. Calibrating and Adjusting:
  - 1. Calibrate instruments.
  - 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
  - 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
  - 4. Control System Inputs and Outputs:
    - a. Check analog inputs at 0, 50, and 100 percent of span.
    - b. Check analog outputs using milliamperemeter at 0, 50, and 100 percent output.
    - c. Check digital inputs using jumper wire.
    - d. Check digital outputs using ohmmeter to test for contact making or breaking.
    - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
  - 5. Temperature:
    - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    - b. Calibrate temperature switches to make or break contacts.
  - 6. Stroke and adjust control dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
  - 7. Provide diagnostic and test instruments for calibration and adjustment of system.
  - 8. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature set points.

### **3.6 DEMONSTRATION**

- A. Engage a factory service representative to demonstrate, to the owner and engineer, that all system components have been calibrated and adjusted and are functioning properly.

### **3.7 VALIDATION**

- A. A witnessed validation demonstration will be provided if requested.

**END OF SECTION**

# SECTION 230993 SEQUENCE OF OPERATION FOR HVAC CONTROLS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. This Section includes control sequences for HVAC and plumbing systems, subsystems, and equipment.
  - 1. Temperature and pressure set points listed shall be adjustable.
  - 2. Provide the building automation system operator with manual over-ride for automatic control dampers. The over-ride shall allow the operator to command open or close dampers.
  - 3. All control sequences for all systems and equipment described in this section shall be shown graphically on the existing BAS graphics consistent with existing BAS system graphics format.
  - 4. Contractor to insure all systems operate as specified and demonstrate to owner operation.
- B. Related Sections include the following:
  - 1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

### 1.3 DEFINITIONS

- A. Damper full open: Damper or valve will be 100 percent open.
- B. DDC: Direct digital control.
- C. Modulate: Proportionally position.
- D. Set points: Set points will be operator adjustable unless noted as fixed.
- E. Temperature: Air and liquid temperatures are in degrees F.

### 1.4 GENERATOR ROOM COOLING CONTROL SEQUENCES

- A. Generator radiator duct discharge and bypass damper control:
  - 1. Generator room cooling temperature will be controlled from a room temperature sensor and modulating generator radiator discharge and bypass dampers.
  - 2. Whenever generators are off, generator radiator discharge damper shall be open.
  - 3. Whenever generators are off, generator radiator bypass damper shall be closed.
  - 4. Whenever any generator is on, generator radiator discharge and bypass dampers shall modulate together to maintain 80 deg. F (adj.) generator room cooling temperature set point.
  - 5. When generator room temperature drops below cooling temperature set point, modulate discharge damper closed and bypass damper open.
  - 6. When generator room temperature rises above cooling temperature set point, modulate discharge damper open and bypass damper closed.
  - 7. All dampers to have position feedback indicators displayed on the BAS graphics

### 1.5 GENERATOR SYSTEM MONITORING

- A. Generators are to be controlled from generator manufacturers packaged controls and building electrical system. DDC system shall monitor generator on/off status and monitor for generator system alarm condition. Generator and associated monitoring points shall be displayed on existing BAS graphics.



## **1.6 GENERATOR FUEL MAINTENANCE SYSTEM CONTROL SEQUENCES**

- A. Generator fuel maintenance system will operate with fuel maintenance system manufacturers packaged controls. DDC system shall provide start/stop signal based on programmed schedule on the BAS and monitor system operating status and alarm condition.
- B. Contractor shall review fuel maintenance system submitted for installation and confirm all necessary wiring connections are provided with fuel maintenance system.

## **1.7 GENERATOR FUEL TANK MONITORING CONTROL SEQUENCES**

- A. Generator fuel tanks shall come with generator manufacturers packaged fuel level controls on each fuel tank providing BAS a signal from each tank indicating the level of fuel in each tank.
- B. A remote indicator for each tank shall be provided for tank filling purposes at each fuel fill/spill containment box located outdoors. Indicator shall have two LED lights with one light indicating tank full and one light indicating tank is not full.
- C. DDC system shall monitor tank fuel levels.
- D. Contractor shall review fuel level controls submitted for installation and confirm level controls have all necessary components and wiring connections for operation as specified above.

## **PART 2 PRODUCTS**

## **PART 3 EXECUTION**

### **3.1 COMMISSIONING AND DEMONSTRATION OF CONTROL SEQUENCES**

- A. Contractor shall provide commissioning of all control sequences insuring all control sequences operate as specified and demonstrate to owner and/or engineer their operation. Contractor shall schedule with owner a time to perform demonstrations.

**END OF SECTION**

**SECTION 230995  
DATA AND CONTROL POINTS LIST**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes building automation and temperature control partial points list. Additional points maybe required to properly execute a sequence of operation.
- B. Related Sections include the following:
  1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
  2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

**1.3 PERFORMANCE REQUIREMENTS**

- A. The following table is a minimum points list developed to assist the building automation system provider. The BAS manufacturer and installer shall provide any additional points necessary to perform the sequences of control identified in other Division-23 sections.

Point Name	Hardware Points				Software Points					Show on Graphic
	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	
<b>Generator Room Temperature Control</b>										
Generator room temperature	X							X	X	X
Generator room cooling temperature Setpoint		X						X	X	X
Radiator discharge air damper		X								X
Radiator bypass air damper		X								X
<b>Generator Fuel Tank Monitoring</b>										
Generator No. 1 Fuel Tank Level	X								X	X
Generator No. 2 Fuel Tank Level	X								X	X
<b>Generator System Monitoring</b>										
Generator No. 1 on/off status			X						X	
Generator No. 2 on/off status			X						X	

Point Name	Hardware Points				Software Points					Show on Graphic
	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	
<b>Fuel Maintenance System Monitoring</b>										
System Start/Stop				X						X
System Status									X	X

Notes

1. All control damper positions shall be displayed on operator system graphics.

**PART 2 – PRODUCTS (NONE)**

**PART 3 – EXECUTION (NONE)**

**END OF SECTION**

# SECTION 231113 FACILITY FUEL-OIL PIPING

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### **1.2 SUMMARY**

- A. This Section includes fuel-oil distribution systems and the following:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping and tubing joining materials.
  - 3. Piping specialties.
  - 4. Fuel maintenance system.

### **1.3 DEFINITIONS**

- A. AST: Aboveground storage tank.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- E. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

### **1.4 PERFORMANCE REQUIREMENTS**

- A. Maximum Operating-Pressure Ratings: 3-psig fuel-oil supply pressure at oil-fired appliances.

### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 1. Piping specialties.
  - 2. Fuel maintenance system.
- B. Shop Drawings: For facility fuel-oil piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe hangers, supports for multiple pipes, and attachments of the same to building structure.
  - 1. Shop Drawing Scale: 1/4 inch per foot.

### **1.6 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans and details, drawn to scale, on which fuel-oil piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Site Survey: Plans, drawn to scale, on which fuel-oil piping and tanks are shown and coordinated with other services and utilities.
- C. Qualification Data: For qualified professional engineer.
- D. Welding certificates.

- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.

## **1.7 QUALITY ASSURANCE**

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.
- D. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.
- E. Comply with federal, state, and local codes, standards, and ordinances governing the installation and operation of fuel-oil systems.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

## **PART 2 PRODUCTS**

### **2.1 PIPES, TUBES, AND FITTINGS**

- A. See Part 3 piping schedule articles for where pipes, tubes, fittings, and joining materials are applied in various services.
- B. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
    - e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

### **2.2 JOINING MATERIALS**

- A. Joint Compound and Tape: Suitable for fuel oil.

### **2.3 FUEL-OIL PIPING SPECIALTIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. EBW, Incorporated
  - 2. Environ Products, Incorporated
  - 3. Morrison Bros. Company
  - 4. OPW.
  - 5. Preferred Utilities Manufacturing Corporation.

6. Universal Valve Company.
- B. Fitting Materials: Cast iron, malleable iron, brass, or corrosion-resistant metal; suitable for fuel-oil service.
  1. Aboveground-Mounted Fittings: Weatherproof.
- C. Spill-Containment Fill Boxes: Exposed mounting, all type 316 stainless steel construction with drainage feature to drain oil into tank, threaded fill-pipe connection, and wrench operation.
- D. Weatherproof Atmospheric Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.4 FUEL MAINTENANCE SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Fuel Technologies, International, LLC.
  2. Reverso Pumps, Inc.
- B. Description: Factory fabricated and wired fuel maintenance system for fuel-oil filtration; with enclosure, filter, fuel-oil pump, and controls; FMG approved, listed, and labeled by an NRTL acceptable to authorities having jurisdiction.
  1. Enclosure: NEMA 250, Type 3R, painted steel containing pumps, filters, accessories, and controls. Hinged door on the front of enclosure.
  2. Pump: Comply with HI M109, steel-gear-with-crescent, positive-displacement, direct-coupled, rotary-type.
  3. Materials: Cast-iron housing; bronze bearings; steel shaft; mechanical seals; and built-in, pressure relief bypass valve.
  4. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC."
    - a. 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.
    - b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
  5. Piping: Steel with malleable-iron fittings and threaded joints or wrought-steel fittings and welded joints.
  6. Multistage Filter: Spin-on, replaceable types.
    - a. Stage 1: Separ Filter with vacuum gauge for separating water from fuel.
    - b. Stage 2: 2-micron particulate filter.
  7. Multiple-Tank Manifolds:
    - a. Manifold fabricated of Schedule 80, black steel pipe and threaded nipples for two tanks.
    - b. Manual Isolation valves for supply and return piping to each tank.
    - c. Strainers for each tank supply connection.
  8. Programmable Logic Controller:
    - a. Vacuum alarm with shut down.
    - b. High water level in filter alarm with shut down.
    - c. Spill alarm with shut down.
    - d. Button controlled display screen; with minimum 2-line, 10-character, backlit, LCD display.
    - e. Controller strip heater with thermostat.
  9. Automatic Water Drain:
    - a. NEMA 4 automatic water drain system control panel with Master switch/breaker for incoming power. Individual push button circuit breakers for pump and solenoid. Red indicator light for system operating status.
    - b. Signal in fuel maintenance cabinet triggers the Automatic Water Drain function from water contacts on the filter in the fuel maintenance cabinet.
    - c. 7 day programmable PLC controller in automatic water drain system control panel and sensor to trigger an off delay timer that energizes the drain pump and solenoid valve at the same time. The pump runs for a prescribed time period and then shuts off.

- d. Hydrocarbon absorption filter piped between fuel maintenance cabinet and PLC controller cabinet removes petroleum product from drain water.
  - e. When automatic drain function is turned off, an alarm shall be initiated and sent to the building BAS.
  - f. Plug in electrical cord. 120v, 1PH, 60 Hz.
10. Interface with automatic control system is specified in Division 23 Section "Instrumentation and Controls for HVAC" to control and indicate the following:
- a. Start/stop system when required by schedule.
  - b. Operating status.
  - c. Alarm off-normal status.
- C. Capacities and Characteristics:
- 1. Capacity (Each Pump): 3 gpm.
  - 2. Maximum Suction Lift: 15 feet.
  - 3. Inlet and Outlet Size: ¾ in.
  - 4. Electrical Characteristics (Pump Set):
    - a. Volts: 120.
    - b. Phase: Single.
    - c. Hertz: 60.
    - d. Full-Load Amperes: 3.
    - e. Maximum Overcurrent Protection: 10 amp.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine roughing-in for fuel-oil piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

### **3.2 OUTDOOR PIPING SCHEDULE**

- A. Aboveground fuel-oil fill and vent piping shall be the following:
  - 1. NPS 2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
  - 2. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints.

### **3.3 OUTDOOR PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install vent pipe at a minimum slope of 2 percent downward toward fuel-oil storage tank sump.
- C. Install system components with pressure rating equal to or greater than system operating pressure.

### **3.4 INDOOR PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- C. Install piping free of sags and bends.
- D. Install fittings for changes in direction and branch connections.
- E. Install escutcheons for penetrations of walls and screens.

- F. Verify final equipment locations for roughing-in.
- G. Comply with requirements for equipment specifications in Division 23 Sections for roughing-in requirements.
- H. Prohibited Locations:
  1. Do not install fuel-oil piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
  2. Do not install fuel-oil piping in solid walls or partitions.
- I. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- J. Connect branch piping from top or side of horizontal piping.
- K. Install unions in pipes NPS 2 and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
- L. Do not use fuel-oil piping as grounding electrode.

### **3.5 PIPING JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.
  1. Bevel plain ends of steel pipe.
  2. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 23 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  1. NPS 1-1/4 and Smaller: Maximum span, 84 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  4. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
  5. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
  6. NPS 4: Maximum span, 13 feet; minimum rod size, 5/8 inch.
- C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.

### **3.7 INDOOR PIPING SCHEDULE**

- A. Aboveground fuel-oil fill and vent piping shall be the following:
  1. NPS 1/2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
  2. NPS 5/8 to NPS 2: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
  3. NPS 2-1/2 and Larger: Steel pipe, steel fittings, and welded or flanged joints.
  4. Steel pipe with malleable-iron fittings and threaded joints.



### **3.8 FUEL MAINTENANCE SYSTEM INSTALLATION**

- A. Install suction line, with foot valve, at one end of storage tank, 1 inch from the bottom of tank.
- B. Install return line at the opposite end of storage tank from suction line.

### **3.9 CONNECTIONS**

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Install unions, in piping NPS 2 and smaller, at final connection to each piece of equipment having threaded pipe connection.
- C. Install flanges, in piping NPS 2-1/2 and larger, at final connection to each piece of equipment having flanged pipe connection.
- D. Connect piping to equipment with union.

### **3.10 FIELD PAINTING OF FUEL OIL VENT AND FILL PIPING**

- A. Comply with requirements in Division 9 painting Sections for painting interior and exterior fuel-oil piping.
- B. Paint exposed, metal piping, and piping specialties, except components with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel gloss.
    - d. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### **3.11 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Tests and Inspections:
  - 1. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.
- D. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION**

# SECTION 233113 METAL DUCTS

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Sheet metal materials.
  - 3. Sealants and gaskets.
  - 4. Hangers and supports.
- B. Related Sections:
  - 1. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
  - 2. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Sealants and gaskets.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Equipment installation based on equipment being used on Project.
  - 10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Duct installation in mechanical/electrical spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  - 2. Suspended ceiling components.
  - 3. Structural members to which duct will be attached.
- B. Field quality-control reports.

### 1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## **PART 2 PRODUCTS**

### **2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### **2.2 SHEET METAL MATERIALS**

- 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. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.
- D. 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.

### **2.3 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. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 4 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. 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.
- 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.

## 2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. 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."
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Duct supports from below:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## PART 3 EXECUTION

### 3.1 DUCT INSTALLATION

- 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. Duct dimensions indicated on drawings are clear airway dimensions. Overall duct dimensions to be increased to account for duct liner thickness in order to maintain clear airway dimensions.
- C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- D. Install ducts in maximum practical lengths.
- E. Install ducts with fewest possible joints.
- F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

- J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- K. Where ducts pass through HVAC wall casing, cover the opening between the HVAC casing and duct with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### **3.2 INSTALLATION OF EXPOSED DUCTWORK**

- A. Protect ducts exposed in mechanical/electrical 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. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- D. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.3 DUCT SEALING**

- A. Seal ducts at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  2. Unconditioned Space, Generator Radiator Discharge-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.

### **3.4 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. 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.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. 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.
- F. 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.

### **3.5 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 PAINTING

- A. Paint all exposed ductwork including supports and hangers. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099000 "Painting."

### 3.7 FIELD QUALITY CONTROL

- A. Perform inspections.
- B. Leakage Tests:
  - 1. Visually inspect ductwork for leaks when generators are running. Seal up any noticeable leaks.
- C. Maximum Allowable Leakage: Comply with requirements for Leakage Class 6 for ducts with duct pressure classification 2-inches or less.
- D. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- E. Duct system will be considered defective if it does not pass inspections.
- F. Prepare test and inspection reports.

### 3.8 DUCT CLEANING

- A. Clean new duct system(s) before generator testing.
- 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. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
- C. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets.
  - 2. Generator Radiator fans including fan housings, plenums, blades or vanes
  - 3. Duct mounted dampers, and accessories.
- D. 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.

### 3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  - 1. Underground Ducts: Refer to specification Section 233116 "Nonmetal Ducts".
- B. Generator Radiator Discharge-Air Ducts:
  - 1. Ducts Connected to generator radiator and HVAC wall casing.
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- C. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
- D. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

- b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- E. Branch Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.

**END OF SECTION**

# SECTION 233119 HVAC CASINGS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Factory or Shop-fabricated, field-assembled, double -wall casings for HVAC equipment.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Static-Pressure Classes:
  - 1. 4-inch wg.
- B. Structural Performance:
  - 1. Casings shall be fabricated to withstand 133 percent of the indicated static pressure without structural failure. Wall deflection at the indicated static pressure shall not exceed 1/8 inch per foot of width.
    - a. Fabricate outdoor casings to withstand wind load of 15 lbf/sq. ft.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Factory-fabricated casings.
  - 2. Sealants and gaskets.
- B. Shop Drawings: For HVAC casings. Include plans, elevations, sections, components, and attachments to other work.
  - 1. Detail HVAC casing assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Sheet metal thickness(es).
  - 3. Reinforcement and spacing.
  - 4. Seam and joint construction.
  - 5. Access doors including frames, hinges, and latches.
  - 6. Hangers and supports including methods for building attachment and casing attachment.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for casing joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for casing joint and seam welding.



## **PART 2 - PRODUCTS**

### **2.1 GENERAL CASING FABRICATION REQUIREMENTS**

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 9, "Equipment and Casings," for acceptable materials, material thicknesses, and casing construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
  - 1. Fabricate casings according to SMACNA's "Rectangular Industrial Duct Construction Standards."
- B. All materials used to be stainless steel complying with ASTM A 480/A 480M Type 316 and having a No. 2D finish.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, stainless steel plates, shapes, and bars.
- D. Sealing Requirement: SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class A. Seal all seams, joints, connections, and abutments to building.
- E. Penetrations: Cover with stainless steel escutcheons. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
- F. Access Doors: Fabricate access doors according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 9-15, "Casing Access Doors - 2-inch wg," and Figure 9-16, "Casing Access Doors - 3-10-inch wg"; and according to pressure class of the plenum or casing section in which access doors are to be installed.
  - 1. Size: 30 by 72 inches.
  - 2. Vision Panel: Double-glazed, safety glass with an airspace between panes and sealed with interior and exterior rubber seals.
  - 3. Hinges: Piano or butt hinges and latches, number and size according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 4. Latches: Minimum of two wedge-lever-type latches, operable from inside and outside.
  - 5. Neoprene gaskets around entire perimeters of door frames.
  - 6. Doors shall open out into area wells.

### **2.2 SHOP-FABRICATED CASINGS**

- A. Double-Wall Casings: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for sheet metal thickness based on indicated static-pressure class unless otherwise indicated.
- B. Double-Wall Casing Inner and outer Panel: Perforated sheet stainless steel. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for sheet metal thickness based on indicated static-pressure class unless otherwise indicated.
- C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Maximum Thermal Conductivity: 0.27 Btu x in. /h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Cover and seal insulation within polyester film complying with UL 181, Class 1 on perforated panels. Insulation shall be totally encased in polyester film.
- D. Fabricate casings with standing seams and angle-iron reinforcements unless otherwise indicated.
- E. Reinforce casings with stainless steel angles.

### **2.3 SEALANT MATERIALS**

- 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 or negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with stainless steel.
- C. 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.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine casing insulation materials and liners before installation. Reject casings that are wet, moisture damaged, or mold damaged.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install casings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Equipment Mounting:
  1. Install HVAC casings in concrete wall openings.
- C. Apply sealant to joints, connections, and mountings.
- D. Field-cut openings for pipe and conduit penetrations; insulate and seal according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Support casings on floor or foundation system. Secure and seal to base.
- F. Support components rigidly with ties, braces, brackets, and anchors of types that will maintain housing shape and prevent buckling.
- G. Align casings accurately at connections, with 1/8-inch misalignment tolerance and with smooth interior surfaces.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspections:
  1. Inspect installed casing for gaps or voids and for any noticeable air leakage when generators are running.
  2. Disassemble, reassemble, and seal segments of systems as needed to eliminate gaps, voids or noticeable air leakage.
- B. HVAC casings will be considered defective if they do not pass inspections.
- C. Prepare inspection reports.

### **3.4 CLEANING**

- A. Comply with requirements for cleaning in Section 233113 "Metal Ducts."

**END OF SECTION**

# SECTION 233300 AIR DUCT ACCESSORIES

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Flange connectors.
  - 2. Turning vanes.
  - 3. Duct-mounted access doors.
  - 4. Flexible connectors.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Control-damper installations.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Source quality-control reports.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

## **PART 2 PRODUCTS**

### **2.1 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. 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.

### **2.2 FLANGE CONNECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Incorporated. ([www.ductmate.com](http://www.ductmate.com))
  - 2. Elgen Manufacturing. ([www.elgenmfg.com](http://www.elgenmfg.com))
  - 3. Nexus PDQ; Division of Shilco Holdings Incorporated. ([www.nexuspdq.com](http://www.nexuspdq.com))
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
  - 1. Material: Galvanized steel.

2. Gage and Shape: Match connecting ductwork.

### 2.3 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ductmate Industries, Incorporated. ([www.ductmate.com](http://www.ductmate.com))
  2. Elgen Manufacturing. ([www.elgenmfg.com](http://www.elgenmfg.com))
  3. Sheetmetal Connectors Incorporated. ([www.smcduct.com](http://www.smcduct.com))
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
  1. Vane Construction: Single and Double wall.
  2. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

### 2.4 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. American Warming and Ventilating; a Division of Mestek, Incorporated. ([www.arcat.com](http://www.arcat.com))
  2. Cesco Products; a Division of Mestek, Incorporated. ([www.cescoproducts.com](http://www.cescoproducts.com))
  3. Ductmate Industries, Incorporated. ([www.ductmate.com](http://www.ductmate.com))
  4. Elgen Manufacturing. ([www.elgenmfg.com](http://www.elgenmfg.com))
  5. Flexmaster U.S.A., Incorporated. ([www.flexmasterusa.com](http://www.flexmasterusa.com))
  6. Greenheck Fan Corporation. ([www.greenheck.com](http://www.greenheck.com))
  7. McGill AirFlow LLC. ([www.mcgillairflow.com](http://www.mcgillairflow.com))
  8. Nailor Industries Incorporated. ([www.nailor.com](http://www.nailor.com))
  9. Pottorff. ([www.pottorff.com](http://www.pottorff.com))
  10. Ventfabrics, Incorporated. ([www.ventfabrics.com](http://www.ventfabrics.com))
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
  1. Door:
    - a. Single wall, rectangular.
    - b. Galvanized sheet metal and thickness as indicated for duct pressure class.
    - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - d. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  3. Size of Access Doors with Number of Hinges and Locks:
    - a. Access Doors to be minimum 24in. x 23 in. with three hinges or Continuous and two compression latches with outside and inside handles.

### 2.5 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ductmate Industries, Incorporated. ([www.ductmate.com](http://www.ductmate.com))
  - b. Duro Dyne Incorporated. ([www.durodyne.com](http://www.durodyne.com))
  - c. Elgen Manufacturing. ([www.elgenmfg.com](http://www.elgenmfg.com))
  - d. Ventfabrics, Incorporated. ([www.ventfabrics.com](http://www.ventfabrics.com))
  - e. Ward Industries, Incorporated.; a Division of Hart & Cooley, Incorporated. ([www.hartandcooley.com](http://www.hartandcooley.com))
2. Materials: Flame-retardant or noncombustible fabrics.
3. Coatings and Adhesives: Comply with UL 181, Class 1.

4. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 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.
5. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
  - a. Minimum Weight: 16 oz. /sq. yd.
  - b. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
  - c. Service Temperature: Minus 67 to plus 500 deg F.

## 2.6 DUCT ACCESSORY HARDWARE

1. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.
- C. Install control dampers where indicated on plans and drawings.
  1. Duct openings shall be free of any obstruction or irregularities that interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4" larger than damper dimensions and shall be square, straight, and level.
  2. Multiple damper sections will be square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal  $\pm 1/8$ -inches.
  3. Install extended shaft or jackshaft per manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
  4. Damper blades, axles, and linkage shall operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
  5. Provide a visible and accessible indication of damper position on the drive shaft end.
  6. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.
- D. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment.
  1. Access doors shall be inward operation when installed upstream from dampers and inward operation when installed downstream from generator radiators. Install access doors in the following locations:
    - a. Upstream and downstream from turning vanes.
    - b. Upstream from control dampers.
    - c. Downstream of generator radiators.
    - d. Elsewhere as indicated.
  2. Access Door Sizes:
    - a. All access doors to be 24 inches x 24 inches.
  3. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- E. Install flexible connectors to connect ducts to generator radiator discharge duct connections.

### **3.2 FIELD QUALITY CONTROL**

#### **A. Tests and Inspections:**

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.

**END OF SECTION**

# SECTION 235116 FABRICATED BREECHINGS AND ACCESSORIES

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Listed, refractory-lined breechings.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.
- B. Shop Drawings: For breechings.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of hangers and seismic restraints. Provide structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Sample Warranty: For special warranty.

### **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in breechings.
- C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

### **1.6 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, structural failures caused by expansion and contraction.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 LISTED, REFRACTORY-LINED METAL BREECHINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Van-Packer Company, Inc. ([www.vpstack.com](http://www.vpstack.com))
  - 2. Warren Environment, Inc. ([www.warrenenvironment.com](http://www.warrenenvironment.com))



- B. Comply with ASME STS-1.
- C. Design Wind Loads: 150 mph .
- D. Design for seismic conditions at Project site.
- E. Refractory Lining: Tested according to UL 959 for temperature and acid resistance and bearing the testing laboratory label.
  - 1. Temperature Rating: 1800 deg F continuously and 2000 deg F intermittently.
  - 2. Acid Extraction: Maximum of 0.2 percent.
  - 3. Cold Crushing Strength: Minimum of 3200 psig.
  - 4. Thickness: Minimum of 2 inches.
- F. Finish: Factory-applied, high-heat-resistant paint; color as selected by Architect.

## **2.2 STEEL PIPE AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide steel pipe manufactured by one of the following:
  - 1. American Steel Pipe; Division of American Cast Iron Pipe Company.
  - 2. Central Steel and Wire Company.
  - 3. LaBarge Pipe and Steel Company.
- B. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- C. Stainless-Steel Pipe and Fittings: Schedule 10, ASTM A 312/A 312M, Grade TP304L or TP316L, unless otherwise indicated; seamless pipe and ASTM A 403/A 403M, Class S, seamless fittings matching pipe thickness and grade, for welded joints.
- D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt welding.
  - 3. Facings: Raised face.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 APPLICATION**

- A. Listed, Refractory-Lined Metal Breechings: Freestanding dual-fuel boiler vents, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.
- B. Field-Fabricated Metal Breechings: Dual-fuel boilers, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.
- C. Field-Fabricated Metal Breechings: Steel pipe for use with engine exhaust.

### **3.3 INSTALLATION OF UNLISTED, FIELD-FABRICATED BREECHINGS**

- A. Suspend breechings independent of their appliance connections.
- B. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch misalignment tolerance.

### **3.4 CLEANING**

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings that are not completed or connected to equipment.

**END OF SECTION**



# SECTION 260500 COMMON WORK RESULTS FOR ELECTRICAL

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Common electrical installation requirements.
  - 3. Demolition.
  - 4. Cutting and patching for electrical construction.
  - 5. Touchup painting.
  - 6. Disposition of existing materials and equipment.
  - 7. Electric Service Outage and Energizations.

### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Comply with State and /or City Code requirements.
- D. All materials shall meet the standards of the following institutes where applicable:
  - 1. National Fire Protection Association (NFPA)
  - 2. American Society of Testing Materials (ASTM)
  - 3. American National Standards Institute (ANSI)
  - 4. National Electrical Manufacturer's Association (NEMA)
  - 5. Institute of Electrical and Electronic Engineers (IEEE)

### 1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Section 083100 "Access Doors and Panels."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 078400 "Firestopping."
- E. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- F. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- G. Coordinate electrical service connections to components furnished by utility companies.
  1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
  2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- H. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability. Document results of said testing.

## **1.5 DRAWINGS**

- A. The drawings indicate the arrangements of electrical equipment. Review architectural drawings and details for door swings, cabinets, counters and built-in equipment; conditions indicated on architectural plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of recessed electrical equipment with concealed ductwork and piping, and wall thickness. All devices, raceway, and electrical equipment in finished and/or public spaces shall be recessed or concealed unless otherwise noted.
- B. Do not scale drawings. Obtain dimensions for layout of equipment from Architectural plans and details unless indicated on Electrical plans.
- C. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Architect.
- D. Equipment layout is based on one manufacturer's product or from composite dimensions from multiple manufacturers. Where equipment selected for use on the job differs from layout, coordinate space requirements and connection arrangements.

## **1.6 EQUIPMENT REQUIRING ELECTRICAL SERVICE**

- A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service.
- B. Drawings indicate design loads, voltages and corresponding control equipment, feeders, and overcurrent devices. If equipment actually furnished have loads other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the owner. Such adjustment shall be subject to the review of the Architect.
- C. Incidental items not indicated on Drawing or mentioned in Specifications but that can legitimately and reasonably be inferred to belong to the Work or be necessary in good practice to provide complete system, shall be furnished and installed though not itemized here in detail.

## **1.7 MECHANICAL SYSTEMS INTERFACE**

- A. All control wiring for plumbing, heating, ventilating and air conditioning systems shall be installed under Division 23. Review Division 23 specifications and shop drawings for control systems to assure compatibility between equipment furnished under Division 23 and wiring furnished under Division 26.
- B. Motor controllers (starters) shall be furnished and installed under Division 26, unless specified to be furnished as an integral component of the equipment. Provide the number and type of auxiliary contacts necessary to interlock the equipment and provide the specified control sequence.
- C. Power wiring to all motors, motor controllers and between motors and controllers shall be provided in Division 26.

- D. All electric heating equipment shall be provided and installed under Division 23 - HEATING, VENTILATING AND AIR CONDITIONING. Power wiring to all electric heating equipment shall be provided under Division 26 of these specifications.

## **1.8 SITE INVESTIGATION**

- A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions which may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems shall be restored to their original condition, with the exception of the work under this contract, before the completion of this project. Existing systems and conditions which are not detailed on the drawings must still be restored to their original condition.

## **1.9 EQUIVALENTS AND SUBSTITUTIONS**

- A. The applicable paragraphs for General Requirements, Division 01 apply herein.
- B. Basis of Design: The manufacturer's name and product listed on the drawings, or listed first of several names in these Specifications, is used as a basis for design to establish space requirements, a standard of quality and performance.
- C. Equivalents: Products of one or more other manufacturer's names listed in these Specifications following the words "or equivalent by" may be selected, subject to paragraph below titled "Contractor's Responsibility for Equivalent and Substitutions".
- D. Other Options:
1. For products specified by naming only one manufacturer, refer to paragraph below under "Substitutions".
  2. For products specified only by performance characteristics or reference standards, select any manufacturer meeting the requirements.
- E. Substitutions: Requests for acceptance of a product of manufacturer's name not listed in these Specifications will be considered if any one of the following conditions is met:
1. The named product is not available because of strikes or discontinuance of manufacture; and the proposed product is equivalent to the named product.
  2. The proposed product is superior to the named product, in the opinion of the Owner's Representative.
  3. The proposed product is equivalent to the named product and its use will be to the advantage of the Owner, by the Owner receiving an equitable credit or cost savings. The Owner's Representative reserves the right to reject any substitution.
  4. Submit proposed substitutions with bid along with alternate price, complete descriptive data and a comparison of the substitute manufacturer's product with specified product. Request for acceptance of a product of manufacturer's name not listed in these Specifications, is subject to the paragraph titled "Contractor's Responsibility Equivalents and Substitutions".
- F. Contractor's Responsibility for Equivalents and Substitutions:
1. Items submitted as a substitution to the Basis of Design or listed general equivalents shall be identified as such and shall include a written request for substitution indicating the following:
    - a. Contract Price adjustment.
    - b. Contract time adjustment.
    - c. Item by item breakdown of differences between Basis of Design and substituted item.
    - d. Operation, maintenance and energy cost difference.
  2. Products of manufacturer must match the features, construction, performance and size of those selected for design. Standard catalogued may require certain modifications to meet specified requirements.
  3. The responsibility for providing that specified requirements have been met remains with the manufacturer and Contractor. Should the substituted item fail to perform in accordance with the Specifications, replace same with the originally specified item without extra cost to the contract.
  4. When requesting review of an equivalent or substituted product, submit a comparison chart listing features, construction, performance and sizes of name product versus equivalent or substituted product.

5. Submittals for review of an equivalent or substituted product will be reviewed for acceptability when all the above requirements have been met. Contractor shall be responsible for all costs incurred by the Architect and Engineer for review of equivalency beyond initial review.
6. Coordinate the installation of the product with all trades.
7. Contractor shall be responsible for changes in electric wiring, materials and for all other additional costs of construction by all trades involved to accommodate the product to perform the same as the product used in the "Basis of Design".
8. Coordination of General Equivalents and Substitutions: Where Contract Documents permits selection from general equivalents, or where substitutions are authorized, coordinate clearance and other interface requirements with other work.
9. Provide necessary additional items so that selected or substituted item operates equivalent to the Basis of Design and properly fits in the available space allocated for the Basis of Design.
10. Contractor is responsible for assuring that piping, conduit, duct, flue and other service locations for general equivalents or substitutions do not cause access, service or operational difficulties any greater than would be encountered with the Basis of Design.
11. Failure to comply with these requirements will result in immediate rejection of the request for substitution.

### **1.10 GENERAL SUBMITTAL REQUIREMENTS**

- A. Refer to Division 01 for additional requirements.
- B. Coordination and Sequencing:
  1. Coordinate submittals 3 weeks (minimum) prior to expected order date so that work will not be delayed by submittals.
  2. Do not submit product data, or allow its use on the project until compliance with requirement of Contract Documents has been confirmed by Contractor.
  3. Submittal is for information and record, unless otherwise indicated, and is not a change order request.
  4. Submitting contractor is responsible for routing reviewed submittals to all parties affected including but not limited to electrical, building automation and temperature control, and test and balance subcontractors.
  5. Make submittals for group of similar products or materials or by area of work complete and at one time, not in piecemeal fashion.
  6. Identify submittals with Architect's project name and number, with item designation as indicated on drawings, and referenced to applicable paragraphs of the specifications. Submit in brochure form.
  7. Submittals of products needed to start of Project for its installation, or those requiring a long lead time for assembly or manufacturing, should be submitted before the others.
- C. Preparations of Submittals:
  1. Refer to Division 01 requirements.
  2. Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, Supplier, submittal name and similar information to distinguish it from other submittals.
  3. Indicate any portions of work, which deviate from the Contract Documents.
    - a. Explain the reasons for the deviations.
    - b. Show how such deviations coordinate with interfacing portions of other work.
  4. Show Contractor's executed review and approval marking.
  5. Provide space for the Owner's Representative "Action" marking.
  6. Submittals, which are received from sources other than through Contractor's office, will be returned "Without Action".
  7. Submittals shall be presented in a neat and legible fashion and shall be returned "Without Action" if presented in any other fashion.
- D. Response to Submittals: Where standard product data has been submitted, it is recognized:
  1. That the Submitter has determined that the products fulfill the specified requirements.
  2. That the submittal is for the Owner's Representative information only, but will be returned with appropriate action where observed to be not in compliance with the requirements.

- E. If more than two submittals (either for shop drawings, or test reports) are made by the Contractor due to the incompleteness, non-compliance, errors, omissions, etc., the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

### **1.11 RECORD DRAWINGS**

- A. Record drawings shall meet all "As-built" and "Record Drawings" requirements for Dane County. Coordinate all requirements with Dane County staff prior to completion.
- B. Drawings:
  - 1. Record of Project Progress: Maintain drawings available at the job site for inspection. Keep an accurate, legible and continuously updated record of installed locations and all project revisions other than revised drawings issued by the Architect, including source and date of authorization. Utilize only contract drawing symbols for recording the work. Drawing notations to be sufficiently clear in the representation of the work, for utilization by a CADD operator (drafts person) who is not necessarily familiar with the installed work.
  - 2. Record of Installation: At the conclusion of the work, deliver one (1) set of updated drawings to the Owner's Representative for review. Following the review, Contractor shall have incorporated by a competent CADD operator all of the installed data represented on the project progress drawings.
  - 3. Include in Record Drawings the Following:
    - a. Revisions, including sketches, bulletins, change orders, written addenda and directives, clarifications and responses generated by requests for information (RFIs), regardless of source of the revision.
    - b. Location and configuration of equipment with related housekeeping pads.
    - c. Physical routing of ductbank work, raceways, exposed and above ceilings with locations of fire dampers, combination fire/smoke dampers, smoke detectors, power supplies, etc., plainly marked and identified.
    - d. Location of room controllers, switches, devices, and sensors.
    - e. Physical routing of raceways, underground, exposed and above ceiling with locations of accessories, pull points, access points plainly marked and identified.
    - f. Location of raceways below building and on exterior, accessories, manholes, appurtenances and stub outs dimensioned from buildings and permanent structures, both horizontally and vertically.
    - g. Location of wall and ceiling access panels.

## **PART 1 PRODUCTS**

Not used

## **PART 3 EXECUTION**

### **3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.



### **3.2 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Section 078400 "Firestopping."

### **3.3 DEMOLITION**

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Reroute circuits as required to serve equipment not in the demolition area.
- C. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- D. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- E. Remove demolished material from Project site.
- F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- G. Remove devices on wall or ceilings being removed. Coordinate with other divisions.
- H. Assume that all existing equipment and fixtures indicated to be reused are in good working condition and can be installed without repairs. Notify the Architect of items found to be in need of repair or in unusable condition for direction or decision. Repair any damage to equipment caused in removal or handling
- I. Fixtures and other equipment removed and to be-used shall be cleaned before reinstallation. Provide new lamps for reused light fixtures.
- J. Added Circuits: All loads and circuits added to existing panelboards shall be balanced between phases. On existing panelboards where circuits are changed, replace panel directories with new typed directories.
- K. All material and equipment which is noted or required by the owner to be salvaged and which is not scheduled to be reused or relocated shall be carefully removed and shall be delivered to the owner and stored where directed on the site.
- L. Remove all abandoned low voltage wiring. All wiring disconnected on one or both ends is considered abandoned unless tagged and labeled "future" or "spare". Verify with Owner any cabling connected on both ends is still in use prior to removal.

### **3.4 CUTTING AND PATCHING**

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### **3.5 FIELD QUALITY CONTROL**

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Firestopping.
  - 2. Electrical demolition.
  - 3. Cutting and patching for electrical construction.
  - 4. Touchup painting.

### **3.6 REFINISHING AND TOUCHUP PAINTING**

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Section 099000 "Painting."
  - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### **3.7 CLEANING AND PROTECTION**

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

### **3.8 DISPOSITION OF EXISTING BALLASTS CONTAINING PCBS**

- A. Environmental Protection Agency (EPA) require controlled disposal of fluorescent light ballasts containing polychlorinated biphenyls (PCBs) when removed from service. The ballasts involved were generally manufactured between 1950 and 1979.
- B. Provide suitable ballast collection containers at the project site. Check the ballasts in all fluorescent fixtures removed from service under this contract. Some ballasts may be labeled to indicate whether they do or do not contain PCBs. Remove from the fixtures all ballasts known or assumed to contain PCBs and place them in the designated ballast collection container and arrange for the disposal of the ballasts off the site in manner approved by the EPA.
- C. Bear all cost for ballast recycling.

### **3.9 DISPOSITION OF EXISTING FLUORESCENT LAMPS**

- A. EPA Regulations require the controlled disposal of fluorescent lamps.
- B. Remove all existing fluorescent lamps and package to prevent breakage according to EPA Regulations. Ship the lamps to a licensed lamp recycling facility with an approved material handler.
- C. Furnish the Owner with a Certificate of Disposal for these lamps, indicating the number of lamps, time and location of disposal.
- D. Bear all cost for lamp recycling.

### **3.10 ELECTRIC SERVICE OUTAGE AND ENERGIZATIONS**

- A. Owner Approval: Electric service outages or energizations required shall be approved by the Owner before outages or energization. Outages shall be scheduled at the convenience of the Owner.
- B. Written Request: Requests for outages and energizations shall be submitted in writing to the Owner for approval at the earliest possible date and in no case later than 14 days prior to the outage and/or energization.
- C. Cancellation: The Owner reserves the right to cancel or change the scheduling of any outage up to 24 hours before its approved starting time. There shall be no additional cost to Owner for scheduled outages, or for outages re-scheduled at the Owner's request where at least 24 hours' notice has been given by the Owner.
- D. Schedules: A minimum of two (2) weeks before the first outage, submit a schedule of proposed sequence of all the electric feeder and switchboard outages and energizations. This schedule shall show construction energizations and shall include any weekend work. The schedule shall list the work to be completed during and between each outage.

- E. Minimize all outages on the Owner's electrical system and employ sufficient workmen so that work will be carried on concurrently at more than one location, when necessary.
- F. Before submitting any energization and/or outage requests, provide the owner with evidence that the following requirements have been met:
  - 1. All required equipment and material is on the job site. All related installations that can be worked on without an energization and/or outage are complete, tested, available for inspection, and ready for service.
  - 2. All shop drawings, test reports, installation data, and operational data have been submitted and approved.
  - 3. The energizing and outage schedule has been submitted and approved.
- G. Similar outage procedures shall be followed for telecommunications and other services to the facility.

### **3.11 PRIMARY SERVICE PROCEDURES**

- A. During the energization and/or outage follow established switching procedures. Coordinate with the Owners operating personnel.
- B. Service disconnecting means and primary switches shall be left open and tagged in the name of a person to be designated by the Owner. In no case shall these cards be removed or switches closed without that person's approval.
- C. Operation of each primary switch installed under the contract shall be under Division 26. All switching of Owner system to perform the outage shall be performed by Division 26.
- D. At the time of energizing each primary feeder and/or equipment, the Contractor will be prepared to handle any situation that may arise from a cable or equipment failure or other faults on the system. If a failure or a fault occur, check out and place the system in proper operation with the required personnel and equipment.
- E. All primary and secondary temporary connections will be performed under Division 26.

**END OF SECTION**

**SECTION 260519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Aluminum building wire rated 600 V or less.
  - 3. Metal-clad cable, Type MC, rated 600 V or less.
  - 4. Connectors, splices, and terminations rated 600 V and less.

**1.3 DEFINITIONS**

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable frequency controller.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

**1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Member company of NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

**PART 2 PRODUCTS**

**2.1 COPPER BUILDING WIRE**

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Alanwire
  - 2. Alpha Wire.
  - 3. American Bare Conductor
  - 4. Belden Inc.
  - 5. Cerro Wire
  - 6. Encore Wire Corporation.
  - 7. General Cable Technologies Corporation.
  - 8. Okonite Company (The)
  - 9. Service Wire Co.
  - 10. Southwire Incorporated.
  - 11. United Copper Industries.

- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.
  - 2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 3. Type XHHW-2: Comply with UL 44.

## 2.2 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Encore Wire Corporation
  - 2. General Cable Technologies Corporation.
  - 3. Houston Wire & Cable Co.
  - 4. Kaiser
  - 5. Okonite Company (The)
  - 6. Southwire Incorporated.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.
- E. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.
  - 2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 3. Type XHHW-2: Comply with UL 44.

## 2.3 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. AFC Cable Systems.
  - 2. Allied.
  - 3. Anixter
  - 4. Kaf-Tech
  - 5. Service Wire Co.
  - 6. Southwire Incorporated.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. RoHS compliant.
  - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

- D. Circuits:
  - 1. Single circuit and multicircuit with color-coded conductors.
- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
- H. Armor: Steel, interlocked.

## **2.4 CONNECTORS AND SPLICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. 3M Electrical Products
  - 2. AFC Cable Systems, Inc.
  - 3. Gardner Bender.
  - 4. Hubbell Power Systems, Inc.
  - 5. Ideal Industries, Inc.
  - 6. ILSCO
  - 7. NSi Industries LLC.
  - 8. O-Z/Gedney; a brand of the EGS Electrical Group.
  - 9. Service Wire Co.
  - 10. TE Connectivity Ltd.
  - 11. Thomas & Betts Corporation
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  - 1. Material: Copper.
  - 2. Type: One hole with standard barrels.
  - 3. Termination: Compression.

## **PART 3 EXECUTION**

### **3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall stranded.
- B. Branch Circuits: Copper. Stranded for No. 12 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

### **3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.

- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.
- H. Group conductors with phases A, B, C, and neutral together in all conduits or raceways regardless of number of sets of conductors, conduits or raceway type.
- I. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three branch circuits are to be installed in any one conduit, on 3 phase 4 wire system, unless specifically indicated otherwise on the drawings. No two branch circuits of the same phase are to be installed in the same conduit, unless specifically indicated on the drawings. Where the quantity of wires is not indicated on the drawings for branch circuits (2) #12 copper conductors shall be provided.
- J. Splicing feeder conductors in a new installation is not allowed.

### **3.4 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

### **3.5 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.7 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078400 "Firestopping."

### **3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  - 3. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

**END OF SECTION**





# SECTION 260523 CONTROL-VOLTAGE ELECTRICAL POWER CABLES

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Category 5e twisted pair cable.
  - 2. Category 6 twisted pair cable.
  - 3. Category 6a twisted pair cable.
  - 4. Twisted pair cabling hardware.
  - 5. RS-485 cabling.
  - 6. Low-voltage control cabling.
  - 7. Control-circuit conductors.
  - 8. Identification products.
- B. Related Requirements:
  - 1. Section 078400 "Firestopping": For penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

### **1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.

### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

### **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

## **PART 2 PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
  - 1. Flame Travel Distance: 60 inches (1520 mm) or less.
  - 2. Peak Optical Smoke Density: 0.5 or less.
  - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- E. RoHS compliant.

### **2.2 CATEGORY 5E BALANCED TWISTED PAIR CABLE**

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. ADC.
  - 2. Alpha Wire Company; a division of Belden Inc.
  - 3. Belden Inc.
  - 4. Berk-Tek
  - 5. CommScope, Inc.
  - 6. Draka Cableteq USA.
  - 7. General Cable.
  - 8. Genesis Cable Products; Honeywell International, Inc.
  - 9. Mohawk; a division of Belden Inc.
  - 10. Nexans; Berk-Tek Products.
  - 11. Siemon Company (The).
  - 12. Superior Essex Inc.
  - 13. SYSTIMAX Solutions; a CommScope, Inc. brand.
  - 14. 3M.
  - 15. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- D. Conductors: 100-ohm, 24 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Riser.
- G. Jacket: White thermoplastic.

### **2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE**

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. ADC.
  - 2. Alpha Wire Company; a division of Belden Inc.
  - 3. Belden Inc.
  - 4. Berk-Tek
  - 5. CommScope, Inc.

6. Draka Cableteq USA.
  7. General Cable.
  8. Genesis Cable Products; Honeywell International, Inc.
  9. Mohawk; a division of Belden Inc.
  10. Nexans; Berk-Tek Products.
  11. Siemon Company (The).
  12. Superior Essex Inc.
  13. SYSTIMAX Solutions; a CommScope, Inc. brand.
  14. 3M.
  15. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Riser.
- G. Jacket: White thermoplastic.

## **2.4 CATEGORY 6A BALANCED TWISTED PAIR CABLE**

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. ADC.
  2. Alpha Wire Company; a division of Belden Inc.
  3. Belden Inc.
  4. Berk-Tek
  5. CommScope, Inc.
  6. Draka Cableteq USA.
  7. General Cable.
  8. Genesis Cable Products; Honeywell International, Inc.
  9. Mohawk; a division of Belden Inc.
  10. Nexans; Berk-Tek Products.
  11. Siemon Company (The).
  12. Superior Essex Inc.
  13. SYSTIMAX Solutions; a CommScope, Inc. brand.
  14. 3M.
  15. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- C. Standard: Comply with TIA-568-C.2 for Category 6a cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Riser.
- G. Jacket: White thermoplastic.

## **2.5 BALANCED TWISTED PAIR CABLE HARDWARE**

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. ADC.
  2. Alpha Wire Company; a division of Belden Inc.
  3. Belden Inc.
  4. Berk-Tek
  5. CommScope, Inc.
  6. Draka Cableteq USA.

7. General Cable.
  8. Genesis Cable Products; Honeywell International, Inc.
  9. Mohawk; a division of Belden Inc.
  10. Nexans; Berk-Tek Products.
  11. Siemon Company (The).
  12. Superior Essex Inc.
  13. SYSTIMAX Solutions; a CommScope, Inc. brand.
  14. 3M.
  15. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- C. General Requirements for Balanced Twisted Pair Cable Hardware:
1. Comply with the performance requirements of Category 5e.
  2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- E. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- G. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 24 or 48 ports.
  2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
  3. Number of Jacks per Field: One for each four-pair cable indicated.
- H. Patch Cords: Factory-made, four-pair cables in 36-inch (900-mm) lengths; terminated with an eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
  2. Patch cords shall have color-coded boots for circuit identification.
- I. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
  2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
  3. Marked to indicate transmission performance.
- J. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
  2. Designed to snap-in to a patch panel or faceplate.
  3. Standards:
    - a. Category 5e, unshielded twisted pair cable shall comply with IEC 60603-7-2.
    - b. Category 5e, shielded twisted pair cable shall comply with IEC 60603-7-3.
    - c. Category 6, unshielded twisted pair cable shall comply with IEC 60603-7-4.
    - d. Category 6, shielded twisted pair cable shall comply with IEC 60603-7.5.
    - e. Category 6a, unshielded twisted pair cable shall comply with IEC 60603-7-41.
    - f. Category 6a, shielded twisted pair cable shall comply with IEC 60603-7.51.
  4. Marked to indicate transmission performance.

- K. Faceplate:
1. Two port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
  2. Eight port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
  3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
  4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- L. Legend:
1. Machine printed, in the field, using adhesive-tape label.
  2. Snap-in, clear-label covers and machine-printed paper inserts.

## 2.6 RS-232 CABLE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Allied Wire & Cable Inc.
  2. Belden Inc.
  3. General Cable.
  4. Genesis Cable.
  5. Southwire Company.
  6. PVC-Jacketed, TIA 232-F:
    - a. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
    - b. Polypropylene insulation.
    - c. Aluminum foil-polyester tape shield with 100 percent shield coverage.
    - d. PVC jacket.
    - e. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
    - f. NFPA 70 Type: Type CM.
    - g. Flame Resistance: Comply with UL 1581.
  7. Plenum-Type, TIA 232-F:
    - a. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
    - b. PE insulation.
    - c. Aluminum foil-polyester tape shield with 100 percent shield coverage.
    - d. Fluorinated ethylene propylene jacket.
    - e. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
    - f. Flame Resistance: Comply with NFPA 262.

## 2.7 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CMG.
1. Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
  2. Fluorinated ethylene propylene insulation.
  3. Unshielded.
  4. Fluorinated ethylene propylene jacket.
  5. Flame Resistance: NFPA 262.

## 2.8 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with NFPA 262.

## 2.9 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Encore Wire Corporation.
  2. General Cable Technologies Corporation.
  3. Southwire Company.
- A. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- B. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.
1. Smoke control signaling and control circuits.
- E. Class 2 0-10V Control Circuits Installed with Class 1 Conductors: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

## 2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Test cables on receipt at Project site.
  1. Test each pair of twisted pair cable for open and short circuits.

### 3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
  1. Outlet boxes for cables shall be no smaller than 4 inches (102 mm) square by 1-1/2 inches (38 mm) deep with extension ring sized to bring edge of ring to within 1/8 inch (3.1 mm) of the finished wall surface.
  2. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
  1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
  2. Install cable trays to route cables if conduits cannot be located in these positions.
  3. Secure conduits to backboard if entering the room from overhead.
  4. Extend conduits 3 inches (75 mm) above finished floor.
  5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. General Requirements for Cabling:
  1. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
  2. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  3. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
  4. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
  5. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
  7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
  9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
  10. Support: Do not allow cables to lay on removable ceiling tiles.
  11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
  12. Provide strain relief.
  13. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
  14. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
- C. Balanced Twisted Pair Cable Installation:
  1. Comply with TIA-568-C.2.
  2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
  3. Do not untwist balanced twisted pair cables more than 1/2 inch (12 mm) at the point of termination to maintain cable geometry.
- D. Installation of Control-Circuit Conductors:
  1. Install wiring in raceways.
  2. Use insulated spade lugs for wire and cable connection to screw terminals.



3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 30 inches (760 mm) apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches (305 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
  - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

### 3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No. 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No. 12 AWG.

### 3.6 FIRESTOPPING

- A. Comply with requirements in Section 078400 "Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."

- C. Comply with BICSI TDMM, "Firestopping" Chapter.

### **3.7 GROUNDING**

- A. For data communication wiring, comply with ANSI-J-STD-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

### **3.8 IDENTIFICATION**

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

### **3.9 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections:
- E. Tests and Inspections:
  - 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- F. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

**END OF SECTION**



# SECTION 260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section includes grounding and bonding systems and equipment.
  - 1. Ground bonding common with lightning protection system.
  - 2. Foundation steel electrodes.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
    - a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
      - 1) Test wells.
      - 2) Ground rods.
      - 3) Ground rings.
      - 4) Grounding arrangements and connections for separately derived systems.

### **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Certified by NETA.

## **PART 2 PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### **2.2 MANUFACTURERS**

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

1. 3M
2. Alanwire
3. Burndy
4. Cerrowire
5. Erico
6. Galvan Electrical
7. General Cable Technologies Corporation.
8. Harger
9. Hilti
10. Hubbell
11. IIsco
12. Lyncole
13. Panduit
14. Southwire Incorporated.
15. Thomas & Betts
16. United Copper Industries.

## 2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2, Type THHN-2, THWN-2, and Type XHHW-2.
- D. Bare Copper Conductors:
  1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.
  4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- E. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- E. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- F. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- G. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.

- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- J. Straps: Solid copper. Rated for 600 A.
- K. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with zinc-plated bolts.
    - a. Material: Tin-plated aluminum.
    - b. Listed for direct burial.
  - 2. U-bolt type with malleable-iron clamp and copper ground connector.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m).
  - 1. Ground rods to have knurled pattern at clamp or compression connection.
- B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

## PART 3 EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Irreversible compression or welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.
- B. Transformer: Ground the secondary side of transformers to establish separately derived system. Size ground conductor as indicated or per NFPA 70.

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
  - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. Use exothermic welds for all below-grade connections.
  3. Rod to have knurled area for clamp or compression connection. Knurl may be field installed with tool made for purpose.
  4. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use irreversible compression or exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- H. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  2. Make connections with clean, bare metal at points of contact.
  3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### **3.6 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Tests and Inspections:
  1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.



3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
  - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method according to IEEE 81.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
  1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
  5. Substations and Pad-Mounted Equipment: 5 ohms.
  6. Manhole Grounds: 10 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

# SECTION 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Steel slotted support systems.
  - 2. Conduit and cable support devices.
  - 3. Support for conductors in vertical conduit.
  - 4. Structural steel for fabricated supports and restraints.
  - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  - 6. Fabricated metal equipment support assemblies.
  - 7. Construction requirements for concrete bases.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Slotted support systems, hardware, and accessories.
    - b. Clamps.
    - c. Hangers.
    - d. Sockets.
    - e. Eye nuts.
    - f. Fasteners.
    - g. Anchors.
    - h. Saddles.
    - i. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  - 1. Hangers. Include product data for components.
  - 2. Slotted support systems.
  - 3. Equipment supports.
  - 4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Ductwork, piping, fittings, and supports.
  - 3. Structural members to which hangers and supports will be attached.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Items penetrating finished ceiling, including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.

- c. Sprinklers.
  - d. Access panels.
- B. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.
  2. AWS D1.2/D1.2M.

## 1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, re-inforcement, and formwork requirements are specified together with concrete Specifications.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
  2. Self-extinguishing according to ASTM D 635.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Power-Strut
    - f. Thomas & Betts Corporation.
    - g. Unistrut; Tyco International, Ltd.
    - h. Wesanco, Inc.
  2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
  3. Material for Channel, Fittings, and Accessories: Galvanized steel.
  4. Channel Width: Selected for applicable load criteria.
  5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) Hilti Inc.
  - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
  - 3) MKT Fastening, LLC.
  - 4) Simpson Strong-Tie Co.
- 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
    - 2) Empire Tool and Manufacturing Co., Inc.
    - 3) Hilti Inc.
    - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
    - 5) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

### **2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## **PART 3 EXECUTION**

### **3.1 APPLICATION**

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA 101
- B. Comply with requirements in Section 078400 "Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Concrete bases shall be 6 inches high for all Emergency and Essential power systems to comply with NFPA 110.
- C. Concrete bases shall be 4 inches for Normal power systems.
- D. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- E. Anchor equipment to concrete base.
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**



**SECTION 260533  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Nonmetal conduits, tubing, and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Boxes, enclosures, and cabinets.
- B. Related Requirements:
  - 1. Section 078400 "Firestopping" for firestopping at conduit and box entrances.

**1.3 DEFINITIONS**

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Source quality-control reports.

**PART 2 PRODUCTS**

**2.1 METAL CONDUITS AND FITTINGS**

- A. Metal Conduit:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. AFC Cable Systems, Inc.
    - b. Allied Tube & Conduit; a Tyco International Ltd. Co.
    - c. Anamet Electrical, Inc.
    - d. Calconduit
    - e. Electri-Flex Company.
    - f. FSR Inc.
    - g. Gibson Stainless



- h. Korkap
  - i. Opti-Com Manufacturing Network, Inc.
  - j. O-Z/Gedney; a brand of EGS Electrical Group.
  - k. Perma-Cote
  - l. Picoma Industries, Inc.
  - m. Plasti-Bond
  - n. Republic Conduit.
  - o. Robroy Industries.
  - p. Southwire Company.
  - q. Thomas & Betts Corporation.
  - r. Western Tube and Conduit Corporation.
  - s. Wheatland Tube Company; a division of John Maneely Company.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. GRC: Comply with ANSI C80.1 and UL 6.
  4. IMC: Comply with ANSI C80.6 and UL 1242.
  5. EMT: Comply with ANSI C80.3 and UL 797.
  6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

**B. Metal Fittings:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following
  - a. AFC Cable Systems, Inc.
  - b. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - c. Anamet Electrical, Inc.
  - d. Bridgeport Fittings, Inc.
  - e. Calconduit
  - f. Electri-Flex Company.
  - g. FSR Inc.
  - h. Gibson Stainless
  - i. Konkore
  - j. Opti-Com Manufacturing Network, Inc.
  - k. O-Z/Gedney; a brand of EGS Electrical Group.
  - l. Perma-Cote
  - m. Picoma Industries, Inc.
  - n. Plasti-Bond
  - o. Republic Conduit.
  - p. Robroy Industries.
  - q. Southwire Company.
  - r. Thomas & Betts Corporation.
  - s. Topaz Electric; a division of Topaz Lighting Corp.
  - t. Western Tube and Conduit Corporation.
  - u. Wheatland Tube Company; a division of John Maneely Company.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: Setscrew.
7. EMT Fittings Materials:
  - a. All Zinc materials shall be ASTM B86 certified
  - b. All Zinc Product shall be ZAMAK #3 and/or #7 formula.
  - c. All Steel shall be SAE 1050.
8. EMT Fittings Design:
  - a. Zinc die cast components shall be ball burnished.
  - b. Steel parts shall be zinc plated for corrosion protection.
  - c. All Locknuts shall have a dual, precision machined-cut thread, reversible and possess a serrated face on each side.

- d. All set screw products shall be manufactured with a tri-drive head and staked or modified to prevent disassembly.
  - e. All fitting throat diameters shall be smooth with no sharp edges or slag.
  - f. Rain tight products shall have internal sealing rings to create and maintain a rain tight seal.
  - g. All fittings shall be tested per UL 514B and be listed by Underwriters Laboratories.
9. Transition Fittings:
- a. All transitions fittings (go-to or from-to fittings) or fittings used to transition from one raceway type to another must be UL listed for that application.
10. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

### A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. AFC Cable Systems, Inc.
  - b. Anamet Electrical, Inc.
  - c. Arnco Corporation.
  - d. CANTEX Inc.
  - e. CertainTeed Corp.
  - f. Condux International, Inc.
  - g. Electri-Flex Company.
  - h. FRE Composites
  - i. Kraloy.
  - j. Lamson & Sessions
  - k. Niedax
  - l. RACO; a Hubbell company.
  - m. Thomas & Betts Corporation.
  - n. Topaz Electric; a division of Topaz Lighting Corp.
2. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
4. LFNC: Comply with UL 1660.

### B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. AFC Cable Systems, Inc.
  - b. Anamet Electrical, Inc.
  - c. Arnco Corporation.
  - d. CANTEX Inc.
  - e. CertainTeed Corp.
  - f. Condux International, Inc.
  - g. Electri-Flex Company.
  - h. FRE Composites
  - i. Kraloy.
  - j. Lamson & Sessions
  - k. Niedax
  - l. RACO; a Hubbell company.
  - m. Thomas & Betts Corporation.
  - n. Topaz Electric; a division of Topaz Lighting Corp.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  - a. Fittings for LFNC: Comply with UL 514B.
4. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. B-Line, an Eaton business
  - 2. Hoffman; a Pentair company.
  - 3. Milbank
  - 4. Mono-Systems, Inc.
  - 5. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Adalet.
  - 2. Crouse-Hinds, an Eaton business
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman; a Pentair company.
  - 7. Hubbell Incorporated; Killark Division.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney; a brand of EGS Electrical Group.
  - 12. Plasti-Bond
  - 13. RACO; a Hubbell Company.
  - 14. Spring City Electrical Manufacturing Company.
  - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  - 16. Thomas & Betts Corporation.
  - 17. Topaz Electric; a division of Topaz Lighting
  - 18. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

- J. Gangable boxes are prohibited.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
  - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

## **PART 3 EXECUTION**

### **3.1 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC direct buried.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: GRC.
  - 7. Boxes and Enclosures: NEMA 250, Type 1.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10 and UL514B.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

### **3.2 INSTALLATION**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Do not install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. RNC Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
  - a. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. EMT, RSC/IMC Expansion Joint Fittings:

1. Install in each run of metallic conduit, indoors or outdoors, that is over 100' long in a straight run, or crosses a building (or structure) expansion joint.
2. Weatherproof and approved for use without external bonding jumper.
3. Sizes ½" through 4" EMTconduit, 1/2" to 6" RSC/IMC.
4. 4" maximum movement.
5. Electrogalvanized steel body.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a rain-tight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Do not install boxes back-to-back.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

FF. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

GG. Boxes installed in metal stud and sheetrock walls shall have far-side box support.

HH. Boxes shall be secured to metal studs with spring steel clamp which wraps around the entire face of the stud and digs into both sides of the stud. Clamp shall be screwed into the stud.

II. Set outlet boxes for flush mounted devices to within 1/8" of finished wall.

JJ. Minimum box size to be two gang. For installation of single gang device use properly sized mud ring with thickness to install device within 1/8" of finished wall.

KK. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

### **3.3 INSTALLATION OF UNDERGROUND CONDUIT**

#### **A. Direct-Buried Conduit:**

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312333 "Trenching and Backfilling" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312333 "Trenching and Backfilling."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312333 "Trenching and Backfilling."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### **3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- #### **A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."**

### **3.5 FIRESTOPPING**

- #### **A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 "Firestopping."**

### **3.6 PROTECTION**

- #### **A. Protect coatings, finishes, and cabinets from damage and deterioration.**
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

**SECTION 260544**  
**SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Round sleeves.
  - 2. Rectangular sleeves.
  - 3. Sleeve seal systems.
  - 4. Grout.
  - 5. Pourable sealants.
  - 6. Foam sealants.
- B. Related Requirements:
  - 1. Section 078400 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**PART 2 PRODUCTS**

**2.1 ROUND SLEEVES**

- A. Wall Sleeves, Steel:
  - 1. Description: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Wall Sleeves, Cast Iron:
  - 1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.
- C. Pipe Sleeves, PVC:
  - 1. Description: ASTM D 1785, Schedule 40.
- D. Molded Sleeves, PVC:
  - 1. Description: With nailing flange for attaching to wooden forms.
- E. Molded Sleeves, PE or PP:
  - 1. Description: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sheet Metal Sleeves, Galvanized Steel, Round:
  - 1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch (0.6-mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

**2.2 RECTANGULAR SLEEVES**

- A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:
  - 1. Description:
    - a. Material: Galvanized sheet steel.
    - b. Minimum Metal Thickness:



- 1) For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - 2) For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- B. STI EZ-Path enclosed fire-rated device, containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to adjust, remove, or reinstall firestop materials. The pathway shall be UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL1479).
1. Series 22: 1.5 inches (38 mm) high x 1.5 inches (38 mm) wide x 10.5 inches (267 mm) long, volume expansion of fire seal 40 times, inserts into 2 inch (51 mm) cored hole, maintains rating up to 4 hours installed in wall, capacity of approximately 25 CAT5 cables.
  2. Series 33: 3.0 inches (76 mm) high x 3.0 inches (76 mm) wide x 10.5 inches (267 mm) long, volume expansion of fire seal 16 times, inserts into 4 inch (102 mm) cored hole, maintains rating up to 4 hours installed in wall, capacity of approximately 120 CAT5 cables, up to seven can be ganged together, can be lengthened in 6 inch (152 mm) increments, attaches to a 4 inch (102 mm) conduit, rated for up to 4 hours installed in floor.
  3. Series 44: 4 inches (102 mm) high x 4 5/8 inches (118 mm) wide x 14 inches (356 mm) long, volume expansion of fire seal 16 times, inserts into 6 inch (153 mm) cored hole, maintains rating up to 4 hours installed in wall, capacity of approximately 244 CAT5 cables, up to five can be ganged together in walls, up to 16 can be ganged together in floors, rated for up to 4 hours installed in floor.
  4. Approved Equals: Hilti, Metacaulk

## 2.3 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon steel.
  4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
1. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.5 POURABLE SEALANTS

- A. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

## 2.6 FOAM SEALANTS

- A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
    - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations:
  - 1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
  - 2. Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.
- G. All cable bundles shall utilize an enclosed fire rated pathway device whenever said cables penetrate rated walls.

### 3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

### **3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

**END OF SECTION**

# SECTION 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Labels.
  - 2. Bands and tubes.
  - 3. Tapes and stencils.
  - 4. Tags.
  - 5. Signs.
  - 6. Cable ties.
  - 7. Miscellaneous identification products.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 260574 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

### 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
  1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  3. Colors for 240-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  4. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  5. Color for Neutral: White.
  6. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
  1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
  1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
- E. Equipment Identification Labels:
  1. Black letters on a white field.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
  1. Manufacturers:
    - a. Brady Corporation.
    - b. Champion American.
    - c. Emedco.
    - d. Grafoplast Wire Markers.
    - e. Hellermann Tyton.
    - f. LEM Products, Inc.
    - g. Marking Services, Inc.
    - h. Panduit Corp.
    - i. Seton Identification Products.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
  1. Manufacturers:
    - a. Brady Corporation.
    - b. Hellermann Tyton.
    - c. Marking Services, Inc.
    - d. Panduit Corp.
    - e. Seton Identification Products.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester flexible label with acrylic pressure-sensitive adhesive.
  1. Manufacturers:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.

- d. Emedco.
  - e. Grafoplast Wire Markers.
  - f. Ideal Industries, Inc.
  - g. LEM Products, Inc.
  - h. Marking Services, Inc.
  - i. Panduit Corp.
  - j. Seton Identification Products.
2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  3. Marker for Labels:
    - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
    - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. Emedco.
    - e. Grafoplast Wire Markers.
    - f. Hellermann Tyton.
    - g. Ideal Industries, Inc.
    - h. LEM Products, Inc.
    - i. Marking Services, Inc.
    - j. Panduit Corp.
    - k. Seton Identification Products.
  2. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
    - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
    - c. As required by authorities having jurisdiction.

## 2.4 BANDS AND TUBES

- A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.
  1. Brady Corporation.
  2. Hellermann Tyton.
  3. Marking Services, Inc.
  4. Panduit Corp.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.
  1. Brady Corporation.
  2. Panduit Corp.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  1. Carlton Industries, LP.
  2. Champion America.
  3. Hellermann Tyton.
  4. Ideal Industries, Inc.
  5. Marking Services, Inc.
  6. Panduit Corp.

- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
  - 1. Brady Corporation.
  - 2. Carlton Industries, LP.
  - 3. Emedco.
  - 4. Marking Services, Inc.
- C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.
  - 1. Hellermann Tyton
  - 2. LEM Products, Inc.
  - 3. Marking Services, Inc.
  - 4. Seton Identification Products
- D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
  - 1. Carlton Industries, LP.
  - 2. Seton Identification Products.

## 2.6 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
  - 1. Brady Corporation.
  - 2. Carlton Industries, LP.
  - 3. Emedco.
  - 4. Grafoplast Wire Markers.
  - 5. LEM Products, Inc.
  - 6. Marking Services, Inc.
  - 7. Panduit Corp.
  - 8. Seton Identification Products.
- B. Write-On Tags:
  - 1. Carlton Industries, LP.
  - 2. LEM Products, Inc.
  - 3. Seton Identification Products.
  - 4. Polyester Tags: 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
  - 5. Marker for Tags:
    - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
    - b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.7 SIGNS

- A. Baked-Enamel Signs:
  - 1. Manufacturers:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. Emedco.
    - d. Marking Services, Inc.
  - 2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 3. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 4. Nominal Size: 7 by 10 inches (180 by 250 mm).
- B. Metal-Backed Butyrate Signs:
  - 1. Manufacturers:
    - a. Brady Corporation.

- b. Champion America.
    - c. Emedco.
    - d. Marking Services, Inc.
  - 2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing and with colors, legend, and size required for application.
  - 3. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 4. Nominal Size: 10 by 14 inches (250 by 360 mm).
- C. Laminated Acrylic or Melamine Plastic Signs:
- 1. Manufacturers:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. Emedco.
    - d. Marking Services, Inc.
  - 2. Engraved legend.
  - 3. Thickness:
    - a. For signs up to 20 sq. inches (129 sq. cm), minimum 1/16-inch- (1.6-mm-).
    - b. For signs larger than 20 sq. inches (129 sq. cm), 1/8 inch (3.2 mm) thick.
    - c. Engraved legend with black letters on white face.
    - d. Self-adhesive.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 CABLE TIES

- A. Manufacturers:
  - 1. Hellermann Tyton.
  - 2. Ideal Industries, Inc.
  - 3. Marking Services, Inc.
  - 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  - 5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.



## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### **3.2 INSTALLATION**

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
  - 3. "UPS."
- M. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- W. Nonmetallic Preprinted Tags:
1. Place in a location with high visibility and accessibility.
  2. Secure using general-purpose cable ties.
- X. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- Y. Metal-Backed Butyrate Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- Z. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- AA. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
  2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Provide conduit color as specified and identify raceways and covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. Provide labels where required by owner. System legends shall be as follows:

<b>System Type</b>	<b>Conduit Color</b>	<b>Conduit Label</b>	<b>Box Covers</b>
Emergency Power (Article 700)	Orange	Orange letters/white label	No color
Legally Required Power (Article 701)	Yellow	Yellow letter/black label	No color
Optional Stand-by Power (Article 702)	Blue	Blue letter/white label	No color
Normal Power	No color	Black letter/white label	No color

- D. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive raceway labels.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- E. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- F. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.
  2. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- H. Arc Flash Warning Labeling: Self-adhesive labels.
1. Comply with NFPA 70E and ANSI Z535.4.
  2. Comply with Section 260574 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- I. Operating Instruction Signs: Self-adhesive labels.
- J. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- K. Equipment Identification Labels:
1. Indoor Equipment: Self-adhesive label.
  2. Outdoor Equipment: Laminated acrylic or melamine sign.
  3. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchgear.
- e. Switchboards.
- f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- g. Substations.
- h. Emergency system boxes and enclosures.
- i. Motor-control centers.
- j. Enclosed switches.
- k. Enclosed circuit breakers.
- l. Enclosed controllers.
- m. Variable-speed controllers.
- n. Push-button stations.
- o. Power transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.
- w. Disconnects for any equipment provided by Owner or other trade.
- x. All electrical equipment or devices which are not located within sight of their source of power shall have nameplates listing their source of power (panelboard or switchboard name and number) along with voltage, circuit number, and load served.

**END OF SECTION**



# SECTION 260572 SHORT-CIRCUIT STUDIES

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

### 1.4 ACTION SUBMITTALS

- A. Product Data:
  - 1. For computer software program to be used for studies.
  - 2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
    - a. Short-circuit study input data, including completed computer program input data sheets.
    - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
      - 1) Submit study report for action prior to submitting for final approval the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
      - 2) Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:

1. For Short-Circuit Study Software Developer.
2. For Short-Circuit Study Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:
  - a. Final one-line diagram.
  - b. Final Short-Circuit Study Report.
  - c. Short-circuit study data files.
  - d. Power system data.

## 1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
  1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
  2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- F. Field Adjusting Agency Qualifications:
  1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
  2. A member company of NETA.
  3. Acceptable to authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:
  1. CGI CYME
  2. EDSA Micro Corporation
  3. ESA Inc.
  4. Operation Technology, Inc.
  5. Power Analytics, Corporation.
  6. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
  1. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

## 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Extent of Study: Only new added equipment and existing modified equipment needs to be included in study and report.
- B. Executive summary of study findings.
- C. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- D. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Conduit material.
  - 4. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 5. Motor and generator designations and kVA ratings.
  - 6. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
  - 7. Derating factors and environmental conditions.
  - 8. Any revisions to electrical equipment required by the study.
- E. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- F. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- G. Short-Circuit Study Input Data:
  - 1. One-line diagram of system being studied.
  - 2. Power sources available.
  - 3. Manufacturer, model, and interrupting rating of protective devices.
  - 4. Conductors and conduit material.
  - 5. Transformer data.
- H. Short-Circuit Study Output:
  - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Equivalent impedance.
  - 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Calculated asymmetrical fault currents:
      - 1) Based on fault-point X/R ratio.
      - 2) Based on calculated symmetrical value multiplied by 1.6.
      - 3) Based on calculated symmetrical value multiplied by 2.7.



3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

## **PART 3 EXECUTION**

### **3.1 POWER SYSTEM DATA**

- A. Obtain all data necessary for the conduct of the study.
  1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
  2. For equipment included as Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
  1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Obtain electrical power utility impedance at the service.
  3. Power sources and ties.
  4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  9. Motor horsepower and NEMA MG 1 code letter designation.
  10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or non-magnetic).
  11. Derating factors.

### **3.2 SHORT-CIRCUIT STUDY**

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on the device characteristics supplied by device manufacturer.
- D. Extent of the electrical power system to be studied is indicated on Drawings.

- E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
  - 1. To normal and emergency systems low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- I. Include in the report identification of any protective device applied outside its capacity.

**END OF SECTION**



# SECTION 260573 COORDINATION STUDIES

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
  - 1. Emergency system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.
  - 2. Elevator overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.
  - 3. Study results shall be used to determine coordination of series-rated devices.

### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

### 1.4 ACTION SUBMITTALS

- A. Product Data:
  - 1. For computer software program to be used for studies.
  - 2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
    - a. Coordination-study input data, including completed computer program input data sheets.
    - b. Study and equipment evaluation reports.
  - 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
    - a. Submit study report for action prior to submitting for final approval the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For Power System Analysis Software Developer.
  - 2. For Power Systems Analysis Specialist.
  - 3. For Field Adjusting Agency.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
  - 1. The following are from the Coordination Study Report:
    - a. Final one-line diagram.
    - b. Final protective device coordination study.
    - c. Coordination study data files.
    - d. List of all protective device settings.
    - e. Time-current coordination curves.
    - f. Power system data.

## 1.7 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
  - 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
  - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Field Adjusting Agency Qualifications:
  - 1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
  - 2. A member company of NETA.
  - 3. Acceptable to authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:
  - 1. CGI CYME
  - 2. EDSA Micro Corporation
  - 3. ESA Inc.
  - 4. Operation Technology, Inc.
  - 5. Power Analytics, Corporation.
  - 6. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242 and IEEE 399.

- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  - 1. Optional Features:
    - a. Arcing faults.
    - b. Simultaneous faults.
    - c. Explicit negative sequence.
    - d. Mutual coupling in zero sequence.

## 2.2 COORDINATION STUDY REPORT CONTENTS

- A. Extent of Study: Only new added equipment and existing modified equipment needs to be included in study and report.
- B. Executive summary of study findings.
- C. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of results.
- D. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
  - 6. Any revisions to electrical equipment required by the study.
  - 7. Study Input Data: As described in "Power System Data" Article.
    - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Short-Circuit Studies."
- E. Protective Device Coordination Study:
  - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
    - a. Phase and Ground Relays:
      - 1) Device tag.
      - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
      - 3) Recommendations on improved relaying systems, if applicable.
    - b. Circuit Breakers:
      - 1) Adjustable pickups and time delays (long time, short time, ground).
      - 2) Adjustable time-current characteristic.
      - 3) Adjustable instantaneous pickup.
      - 4) Recommendations on improved trip systems, if applicable.
    - c. Fuses: Show current rating, voltage, and class.
- F. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
  - 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
  - 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
  - 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
  - 4. Plot the following listed characteristic curves, as applicable:
    - a. Power utility's overcurrent protective device.

- b. Medium-voltage equipment overcurrent relays.
  - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
  - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
  - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
  - f. Cables and conductors damage curves.
  - g. Ground-fault protective devices.
  - h. Motor-starting characteristics and motor damage points.
  - i. Generator short-circuit decrement curve and generator damage point.
  - j. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels.
  6. Maintain selectivity for tripping currents caused by overloads.
  7. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
  8. Provide adequate time margins between device characteristics such that selective operation is achieved.
  9. Comments and recommendations for system improvements.
- G. Submit separate summary to show emergency system(s) overcurrent devices selectively coordinated with all supply side overcurrent protective devices.
- H. Submit separate summary to show elevators overcurrent devices selectively coordinated with all supply side overcurrent protective devices.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

### **3.2 POWER SYSTEM DATA**

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
  1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
  2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
  3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
  - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
  - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Generator thermal-damage curve.
  - e. Ratings, types, and settings of utility company's overcurrent protective devices.
  - f. Special overcurrent protective device settings or types stipulated by utility company.
  - g. Time-current-characteristic curves of devices indicated to be coordinated.
  - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
  - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

### 3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of the electrical power system to be studied is indicated on Drawings.



- E. Begin analysis at the service(s) and generator(s), extending down to the system overcurrent protective devices as follows:
  - 1. To normal, emergency, and legally required systems low-voltage load buses to the point where fault current is 10 kA or less. With the exception of generator(s) and its associated distribution equipment between where the generator power and normal building power transfer, generators and their associated equipment shall be analyzed to the point where fault currents are 10 kA or less.
  - 2. Selectively coordinate to 0.1 second. Bring any coordination challenges to the attention of the Engineer.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
  - 1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- H. Motor Protection:
  - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
  - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.
- K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- M. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
  - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
  - 4. Include in the report identification of any protective device applied outside its capacity.

### 3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
  - 1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
  - 2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.

3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

### **3.5 MOTOR-STARTING STUDY**

- A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

### **3.6 FIELD ADJUSTING**

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

### **3.7 DEMONSTRATION**

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:
  1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
  2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
  3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

**END OF SECTION**



# SECTION 260574 ARC-FLASH HAZARD ANALYSIS

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

### **1.3 DEFINITIONS**

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

### **1.4 ACTION SUBMITTALS**

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
  - 1. Arc-flash study input data, including completed computer program input data sheets.
  - 2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
  - 3. Submit study report for action prior to submitting for final approval the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data:
  - 1. For Power Systems Analysis Software Developer.
  - 2. For Power System Analysis Specialist.
  - 3. For Field Adjusting Agency.

- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
  - 2. Operation and Maintenance Procedures: In addition to items specified in Section 017800 "Closeout Submittals," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

## 1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
  - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
  - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
  - 2. A member company of NETA.
  - 3. Acceptable to authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:
  - 1. CGI CYME
  - 2. EDSA Micro Corporation
  - 3. ESA Inc.
  - 4. Operation Technology, Inc.
  - 5. Power Analytics, Corporation.
  - 6. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

## 2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Extent of Study: Only new added equipment and existing modified equipment needs to be included in study and report.
- B. Executive summary of study findings.
- C. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- D. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- E. Study Input Data: As described in "Power System Data" Article.
- F. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Short-Circuit Studies."
- G. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Coordination Studies."
- H. Arc-Flash Study Output Reports:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- I. Incident Energy and Flash Protection Boundary Calculations:
  - 1. Arcing fault magnitude.
  - 2. Protective device clearing time.
  - 3. Duration of arc.
  - 4. Arc-flash boundary.
  - 5. Restricted approach boundary.
  - 6. Limited approach boundary.
  - 7. Working distance.
  - 8. Incident energy.
  - 9. Hazard risk category.
  - 10. Recommendations for arc-flash energy reduction.
- J. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

## 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
  - 1. Location designation.
  - 2. Nominal voltage.
  - 3. Protection boundaries.
    - a. Arc-flash boundary.

- b. Restricted approach boundary.
  - c. Limited approach boundary.
  - 4. Arc flash PPE category.
  - 5. Required minimum arc rating of PPE in Cal/cm squared.
  - 6. Available incident energy.
  - 7. Working distance.
  - 8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

### **3.2 ARC-FLASH HAZARD ANALYSIS**

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Coordination studies prior to starting the Arc-Flash Hazard Analysis.
1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Short-Circuit Studies."
  2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
1. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
  2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
  3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
  4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
  2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
  2. When the line terminals of the circuit breaker are separate from the work location.

- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.
- J. Arc Energy Reduction: Study effects of implementing energy reduction switches or relay settings. Provide a report showing the incident energy when the energy reductions switches or protective relay settings are turned on.

### 3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
  1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
  2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Obtain electrical power utility impedance at the service.
  3. Power sources and ties.
  4. Short-circuit current at each system bus, three phase and line-to-ground.
  5. Full-load current of all loads.
  6. Voltage level at each bus.
  7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
  8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
  9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  13. Motor horsepower and NEMA MG 1 code letter designation.
  14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

### 3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
  1. Motor-control center.
  2. Low-voltage switchboard.
  3. Switchgear.



4. Low voltage transformers.
  5. Panelboard and safety switch over 250 V.
  6. Applicable panelboard and safety switch under 250 V.
  7. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
1. Indicate arc-flash energy.
  2. Indicate protection level required.

### **3.5 APPLICATION OF WARNING LABELS**

- A. Install the arc-fault warning labels under the direct supervision and control of the Power System Analysis Specialist.

### **3.6 DEMONSTRATION**

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

**END OF SECTION**

# **SECTION 260800 COMMISSIONING OF ELECTRICAL**

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Owner's Project Requirements (OPR), Basis of Design (BoD), and BoD-Electrical Systems Narrative documentation prepared by Owner and Architect contains requirements that apply to this Section.
- C. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Appendix 25 Section "General Commissioning Requirements". The commissioning process, which the Contractor is responsible to execute, is defined in Appendix 25 Section "General Commissioning Requirements". A Commissioning Authority (CxA) appointed by the Owner will direct the commissioning process.

### **1.2 SUMMARY**

- A. This Section includes requirements for commissioning the electrical systems, subsystems and equipment. This Section supplements the general requirements specified in Appendix 25 Section "General Commissioning Requirements."

### **1.3 DEFINITIONS**

- A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor.
- B. Design Team: Includes the architect plus consultant/design professionals responsible for design of fire suppression, plumbing, HVAC, controls for HVAC systems, electrical, communications, electronic safety and security, as well as other related systems.
- C. BoD: Basis of Design.
- D. BoD-Electrical: Electrical systems basis of design.
- E. CxA: Commissioning Authority.
- F. OPR: Owner's Project Requirements.
- G. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

#### 1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the CxA. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Division 01 Sections on Project Closeout and General Commissioning for substantial completion details and detailed commissioning requirements.
- B. List of electrical systems to be commissioned:

Normal Power Electrical Distribution Equipment
Emergency Power Electrical Distribution Equipment

#### 1.5 SUBMITTALS

- A. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 019113 "General Commissioning Requirements."

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 SYSTEMS READINESS CHECKLISTS

- A. System Readiness Checklists are part of the commissioning process. Systems Readiness Checklists provide documentation that systems, subsystems, and equipment are ready for functional testing. The Contractor shall complete the Systems Readiness Checklists for submission to the CxA and Owner. Refer to Section 019113 "General Commissioning Requirements" for further details.

#### 3.2 CONTRACTORS TESTS

- A. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements. Refer to Section 019113 "General Commissioning Requirements" for further details.

#### 3.3 FUNCTIONAL PERFORMANCE TESTING

- A. System functional performance testing is part of the Commissioning Process. Functional performance testing shall be performed by the contractor under the direction of the CxA. The CxA will witness and document the functional performance testing. Refer to Section 09113 "General Commissioning Requirements", for system functional performance testing and commissioning requirements.

### **3.4 OPERATIONS AND MAINTENANCE MANUALS**

- A. General: The specific content and format requirements for the standard O&M manuals are detailed in Section 019113 “General Commissioning Requirements”.
- B. CxA Review and Approval: Prior to substantial completion, the CxA shall review the O&M manual data, documentation and redlined as-builds for equipment and systems that were commissioned to verify compliance with the O&M documentation requirements of the specifications. The CxA shall communicate deficiencies in the manuals to the Owner. Upon a successful review of the corrections, the CxA shall recommend approval and acceptance of these sections of the O&M manuals to the Owner. The CxA shall also review each equipment warranty and verify that all requirements to keep the warranty valid are clearly stated. This work does not supersede the normal review requirement of the O&M manual data as indicated elsewhere in the specifications.

### **3.5 TRAINING OF OWNERS PERSONNEL**

- A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner’s Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner’s Representative after submission and approval of formal training plans. Refer to Section 019113 “General Commissioning Requirements” and Division 26 Sections for additional contractor training requirements.

**END OF SECTION**



# SECTION 262213 LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
  - 7. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 8. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  - 9. Include diagrams for power, signal, and control wiring.
- C. Refer to Section 018113 "Sustainable Design Requirements" for requirements of sealants, primers, paints, adhesives, caulk, aerosols, and coatings.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Source quality-control reports.
- C. Field quality-control reports.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

### **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
  - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

## 1.8 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by Square D Co/Groupe Schneider NA; Schneider Electric or owner approved equal.
- C. Source Limitations: Obtain each transformer type from single source from single manufacturer.

### 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
  - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
  - 1. One leg per phase.
  - 2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
  - 3. Grounded to enclosure.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Coil Material: Aluminum.

2. Internal Coil Connections: Brazed or pressure type.
  3. Terminal Connections: Welded.
- D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- E. Enclosure: Ventilated.
1. NEMA 250: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.
  2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  3. Wiring Compartment: Sized for conduit entry and wiring installation.
  4. Finish: Comply with NEMA 250.
    - a. Finish Color: Gray weather-resistant enamel.
- F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- G. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- H. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
1. Complying with DOE 2016 Amended Energy Conservation Standard for Low-Voltage Dry-Type Distribution Transformers, efficiency levels.
    - a. 15 kVA: 97.89% efficiency
    - b. 30 kVA: 98.27% efficiency
    - c. 45 kVA: 98.40% efficiency
    - d. 75 kVA: 98.60% efficiency
    - e. 112.5 kVA: 98.74% efficiency
    - f. 150 kVA: 98.83% efficiency
    - g. 225 kVA: 98.94% efficiency
    - h. 300 kVA: 99.02% efficiency
    - i. 500 kVA: 99.14% efficiency
    - j. 750 kVA: 99.23% efficiency
    - k. 1000 kVA: 99.28% efficiency
- J. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- K. Wall Brackets: Manufacturer's standard brackets.
- L. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
1. 9.00 kVA and Less: 40 dBA.
  2. 9.01 to 30.00 kVA: 45 dBA.
  3. 30.01 to 50.00 kVA: 45 dBA for K-factors of 1, 4, and 9.
  4. 50.01 to 150.00 kVA: 50 dBA for K-factors of 1, 4, and 9.
  5. 150.01 to 300.00 kVA: 55 dBA for K-factors of 1, 4, and 9.
  6. 300.01 to 500.00 kVA: 60 dBA for K-factors of 1, 4, and 9.

## 2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
1. Resistance measurements of all windings at rated voltage connections and at all tap connections.



2. Ratio tests at rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:
  - a. High-voltage to ground.
  - b. Low-voltage to ground.
  - c. High-voltage to low-voltage.
9. Temperature tests.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Secure transformer to concrete base according to manufacturer's written instructions.
- D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- E. Remove shipping bolts, blocking, and wedges.
- F. Provide a local enclosed circuit breaker overcurrent device/disconnect for all transformers not located within sight of primary feeder breaker unless upstream circuit breaker overcurrent device/disconnect is capable of being lock in the OPEN position. Size to be same as upstream overcurrent device. Field mark location of circuit breaker overcurrent device/disconnect not within sight of the transformer.

### **3.3 CONNECTIONS**

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
    - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
    - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Large (Larger Than 167-kVA Single Phase or 500-kVA Three Phase) Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
    - c. Perform power-factor or dissipation-factor tests on all windings.
    - d. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
    - e. Perform an excitation-current test on each phase.
    - f. Perform an applied voltage test on all high- and low-voltage windings to ground. See IEEE C57.12.91, Sections 10.2 and 10.9.
    - g. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- D. Remove and replace units that do not pass tests or inspections and retest as specified above.

- E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - 2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
  - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### **3.5 ADJUSTING**

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### **3.6 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION**

# SECTION 262413 SWITCHBOARDS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Service and distribution switchboards rated 600 V and less.
  - 2. Surge protection devices.
  - 3. Disconnecting and overcurrent protective devices.
  - 4. Instrumentation.
  - 5. Control power.
  - 6. Accessory components and features.
  - 7. Identification.
- B. Related Requirements
  - 1. Section 260574 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

### 1.3 REFERENCES

- A. Latest Edition of Referenced Standards:
  - 1. National Electrical Contractors Association (NECA):
    - a. "Standard of Installation".
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. AB 1 – Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker enclosures.
    - b. PB 2 - Deadfront Distribution Switchboards.
    - c. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 3. National Fire Protection Association (NFPA):
    - a. 70 - National Electrical Code (NEC).
  - 4. Underwriters Laboratories, Inc. (UL).
    - a. UL 489 - Molded Case Circuit Breakers and Circuit Breaker Enclosures.
    - b. UL 891 - Deadfront Switchboard.
    - c. UL 1066 – Low Voltage Power Circuit Breakers

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, Surge Protective Device SPD (formerly known as transient voltage suppression device or TVSS), ground-fault protection per NEC 230.95, accessory, and component.
  - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.

7. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
  8. Detail enclosure types for types other than NEMA 250, Type 1.
  9. Detail bus configuration, current, and voltage ratings.
  10. Detail short-circuit current rating of switchboards and overcurrent protective devices.
  11. Detail utility company's metering provisions with indication of approval by utility company.
  12. Include evidence of NRTL listing for series rating of installed devices.
  13. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  14. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Include selectable ranges for each type of overcurrent protective device.
  15. Include schematic and wiring diagrams for power, signal, and control wiring.
  16. Include report of emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.
- C. Delegated Design Submittal:
1. For arc-flash hazard analysis.
  2. For arc-flash labels.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Field Quality-Control Reports:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for switchboards and all installed components.
    - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
    - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Include selectable ranges for each type of overcurrent protective device.

## **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation according to NECA 400 and NEMA PB 2.1.

## 1.10 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
  - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's written permission.
  - 4. Comply with NFPA 70E.

## 1.11 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

## 1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of installation or 18 months from date of purchase.

## PART 2 PRODUCTS

### 2.1 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by Square D; a brand of Schneider Electric or owner approved equal.

- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. 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.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:
  - 1. Main Devices: Manually operated, Stationary Individual construction mounted.
  - 2. Branch Devices: Panel mounted.
  - 3. Sections front and rear aligned.
- I. Nominal System Voltage: 480Y/277 V.
- J. Main-Bus Continuous: As shown on drawings.
- K. Indoor Enclosures: Steel, NEMA 250, Type 1.
- L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- M. Barriers: Between adjacent switchboard sections.
- N. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
  - 1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
  - 2. Space-Heater Power Source: 120-V external branch circuit.
- O. Arc Energy Reduction
  - 1. Provide for circuit breakers 1200A and larger with:
    - a. An energy reducing maintenance bypass switch with visual status indicator. Switch, indicator, and associated circuitry and connections shall meet the requirements of NEC article 240.87.
- P. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.
- Q. Hinged Front Panels: Allow access to circuit breaker, accessory, and blank compartments.
- R. Pull Box on Top of Switchboard:
  - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
  - 2. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
  - 3. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
  - 4. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- S. Buses and Connections: Three phase, four wire unless otherwise indicated.
  - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
  - 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
  - 3. Tin-plated aluminum feeder circuit-breaker line connections.
  - 4. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.

5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
  6. Disconnect Links:
    - a. Isolate neutral bus from incoming neutral conductors.
    - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
  7. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
  8. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- T. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

## 2.2 SURGE PROTECTION DEVICES

- A. SPD's are not to be supplied as integral to switchboards. Refer to Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" for requirements.

## 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. In the emergency distribution system(s), provide devices to selectively coordinate with all supply side overcurrent protective devices.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
  6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  8. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
    - f. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

## 2.4 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, and the following:



- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
  - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Phase Currents, Each Phase: Plus or minus 1 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    - d. Megawatts: Plus or minus 2 percent.
    - e. Megavars: Plus or minus 2 percent.
    - f. Power Factor: Plus or minus 2 percent.
    - g. Frequency: Plus or minus 0.5 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
    - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
    - j. Contact devices to operate remote impulse-totalizing demand meter.
  - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
  - 3. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.
    - a. Communication Interface: Comply with ASHRAE 135. The communication interface shall enable the BAS operator to remotely monitor power metering from a BAS operator workstation. Control features and monitoring points displayed locally at switchboard shall be available through the BAS.

## 2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- B. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400 and NEMA PB 2.1.
  - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
  - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
  - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
  - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install switchboards and accessories according to NECA 400 and NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches (50-mm) above concrete base after switchboard is anchored in place.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to switchboards.
  6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Section 260548 "Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Comply with NECA 1.

### 3.3 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
- D. Connect customer metering to building management system for monitoring of power usage.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  1. An arc-energy reduction protection performance test must be completed after the equipment is first installed on-site and energized, and the test must be performed according to the manufacturer's instructions. Provide separate documentation of this testing, certifying that the primary current injection test, or another approved testing method, was conducted by a qualified person(s) in accordance with the equipment instructions. Provide copies of this certification to the engineer, owner, and the AHJ.
  2. Acceptance Testing:

- a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
- b. Test continuity of each circuit.
- 3. Test ground-fault protection of equipment for service equipment per NFPA 70.
- 4. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- 5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 6. Perform the following infrared scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
  - c. Instruments and Equipment:
    - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.6 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Coordination Studies."

### **3.7 PROTECTION**

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

### **3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

**END OF SECTION**

# SECTION 262416 PANELBOARDS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
  - 7. Include dimensioned plans, elevations, sections, and details.
  - 8. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
  - 9. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 10. Detail bus configuration, current, and voltage ratings.
  - 11. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 12. Include evidence of NRTL listing for series rating of installed devices.
  - 13. Include evidence of NRTL listing for SPD as installed in panelboard.
  - 14. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 15. Include wiring diagrams for power, signal, and control wiring.
  - 16. Key interlock scheme drawing and sequence of operations.

1. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.
2. Include report of emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

### **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.

### **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

### **1.10 FIELD CONDITIONS**

- A. Environmental Limitations:
  1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify Owner no fewer than ten days in advance of proposed interruption of electric service.
  2. Do not proceed with interruption of electric service without Owner's written permission.
  3. Comply with NFPA 70E.

### **1.11 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fail in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: Five years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 PANELBOARDS COMMON REQUIREMENTS**

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Surface-mounted, dead front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Height: 86 inches (218.44 cm) maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 7. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
- F. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated aluminum.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 4. Isolated Ground Bus (where noted on drawings): Adequate for branch-circuit isolated ground conductors; insulated from box.
  - 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum.
  - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
  - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.

4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- I. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
    1. Percentage of Future Space Capacity: 10 percent.
  - J. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
    1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
    2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
  - K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
    1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
    2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

## 2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by Square D; a brand of Schneider Electric or owner approved equal.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: As indicated on drawings and schedules.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices: Fused switches.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by Square D; a brand of Schneider Electric or owner approved equal.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As indicated on drawings and schedules.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by Square D; a brand of Schneider Electric or owner approved equal.
- B. In the emergency distribution system(s), provide devices to selectively coordinate with all supply side overcurrent protective devices.
- C. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  - 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  - 8. Subfeed Circuit Breakers: Vertically mounted.
  - 9. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - e. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.



- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## **2.7 ACCESSORY COMPONENTS AND FEATURES**

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.
- C. Handle Padlock Attachment: Handle attachment for 1, 2, or 3 pole breakers to lock breaker in ON or OFF position.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- D. Equipment Mounting:
  - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548 "Seismic Controls for Electrical Systems."
- G. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated. Operating handle of top-most circuit breaker, in on position, shall not be higher than 79 inches (2000 mm) above finished floor or grade.

- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.
- F. Panelboards using series ratings must meet field labeling requirements per NEC Sections 110.22 and 240.86(B). The equipment marking shall be readily visible and state the following: CAUTION-SERIES COMBINATION SYSTEM RATED \_\_\_\_\_ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. An arc-energy reduction protection performance test must be completed after the equipment is first installed on-site and energized, and the test must be performed according to the manufacturer's instructions. Provide separate documentation of this testing, certifying that the primary current injection test, or another approved testing method, was conducted by a qualified person(s) in accordance with the equipment instructions. Provide copies of this certification to the engineer, owner, and the AHJ.

2. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
  - c. Instruments and Equipment:
    - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- F. Submit report to show emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.

### **3.5 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Coordination Studies."

### **3.6 PROTECTION**

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

### **3.7 CLEANING**

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

**END OF SECTION**

# SECTION 262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Molded-case circuit breakers (MCCBs).
  - 2. Enclosures.

### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of NRTL listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 1. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.
  - 3. Provide coversheet indicating project title, project location, and vendor contact information.
  - 4. Organize submittal into logical sections and provide table of contents.
  - 5. Provide itemized bill of materials indicating model number and quantity for each product.
  - 6. On datasheets with multiple products, indicate which product is provided under this project.
  - 7. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 8. Manufacturers' catalog sheets with complete technical data for each item being furnished.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
  - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - a. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in electronic format.

## **1.7 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
  1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

## **1.8 FIELD CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
  2. Altitude: Not exceeding 6600 feet (2010 m).

## **1.9 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: One year(s) from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

### **2.2 MOLDED-CASE CIRCUIT BREAKERS**

- A. In the emergency distribution system(s), provide devices to selectively coordinate with all supply side overcurrent protective devices.
- B. Manufacturers: Subject to compliance with requirements, provide products by Square D; a brand of Schneider Electric or owner approved equal.
- C. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- D. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 140 deg F (60 deg C) rated wire on 125-A circuit breakers and below.

- G. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I<sup>2</sup>t response.
- K. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

## 2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

## 2.4 IDENTIFICATION

- A. Controller Nameplates: Baked-enamel signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
  - 1. Comply with requirements in Section 260574 "Arc-Flash Hazard Analysis." Produce a 3-1/2-by-5-inch (89-by-127-mm) self-adhesive label for each work location included in the analysis.
  - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3-1/2-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
    - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
      - 1) Location designation.
      - 2) Nominal voltage.
      - 3) Flash protection boundary.
      - 4) Hazard risk category.
      - 5) Incident energy.
      - 6) Working distance.
      - 7) Engineering report number, revision number, and issue date.
    - b. Labels shall be machine printed, with no field-applied markings.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### **3.2 PREPARATION**

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than ten days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's written permission.
  - 4. Comply with NFPA 70E.

### **3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS**

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

### **3.4 INSTALLATION**

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

### **3.5 IDENTIFICATION**

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### **3.6 FIELD QUALITY CONTROL**

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections for Switches:
  - 1. An arc-energy reduction protection performance test must be completed after the equipment is first installed on-site and energized, and the test must be performed according to the manufacturer's instructions. Provide separate documentation of this testing, certifying that the primary current injection test, or another approved testing method, was conducted by a qualified person(s) in accordance with the equipment instructions. Provide copies of this certification to the engineer, owner, and the AHJ.
  - 2. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.

- b. Inspect anchorage, alignment, grounding, and clearances.
  - c. Verify that the unit is clean.
  - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
  - e. Verify that fuse sizes and types match the Specifications and Drawings.
  - f. Verify that each fuse has adequate mechanical support and contact integrity.
  - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.
      - (a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      - (a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
  - i. Verify correct phase barrier installation.
  - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
3. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

- 1. Visual and Mechanical Inspection:
  - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
  - b. Inspect physical and mechanical condition.
  - c. Inspect anchorage, alignment, grounding, and clearances.
  - d. Verify that the unit is clean.
  - e. Operate the circuit breaker to ensure smooth operation.
  - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.
      - (a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      - (a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
  - h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:



- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  4. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
1. Test procedures used.

2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

### **3.7 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Coordination Studies."

**END OF SECTION**



# SECTION 263213.13 DIESEL-ENGINE-DRIVEN GENERATOR SETS

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Diesel engine.
  - 2. Diesel fuel-oil system.
  - 3. Control and monitoring.
  - 4. Generator overcurrent and fault protection.
  - 5. Generator, exciter, and voltage regulator.
  - 6. Load bank.
  - 7. Vibration isolation devices.
- B. Related Requirements:
  - 1. Section 263600 "Transfer Switches" for transfer switches, including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

### 1.3 DEFINITIONS

- A. EPS: Emergency power supply.
- B. EPSS: Emergency power supply system.
- C. Operational Bandwidth: The total variation, from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Include thermal damage curve for generator.
  - 3. Include time-current characteristic curves for generator protective device.
  - 4. Include fuel consumption in gallons per hour (liters per hour) at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
  - 5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
  - 6. Include airflow requirements for cooling and combustion air in cubic feet per minute (cubic meters per minute) at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F (35, 27, 21, and 10 deg C). Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
  - 7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.
- B. Shop Drawings:
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.

7. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
8. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
9. Identify fluid drain ports and clearance requirements for proper fluid drain.
10. Provide installation drawing indicating suitability of vibration isolation selection and/or seismic restrains. May be in the form of seismic certification.
11. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
12. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.
13. Include report of emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.
14. Fuel Filtering System Details: Control panel location, features, power and control wiring.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer, manufacturer and testing agency.
- B. Source Quality-Control Reports: Including, but not limited to, the following:
  1. Certified summary of prototype-unit test report.
  2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
  3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
  4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements. Provide line-by-line listing of Compliance, Deviations, and Exceptions.
  5. Report of sound generation.
  6. Report of exhaust emissions showing compliance with applicable regulations.
  7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- C. Field quality-control reports.
- D. Warranty: For special warranty.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
    - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.

### **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
  2. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
  3. Tools: Each tool listed by part number in operations and maintenance manual.

### **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Accredited by NETA.
  1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

- C. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business or residence to Project site.
- D. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- E. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

## 1.9 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Section 077200 "Roof Accessories."

## 1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: 3 years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Caterpillar; Engine Div.
  2. Generac Power Systems, Inc.
  3. Kohler Co.; Generator Division.
  4. MTU On Site Energy.
  5. Onan/Cummins Power Generation; Industrial Business Group.
- B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. B11 Compliance: Comply with B11.19.
- B. NFPA Compliance:
  1. Comply with NFPA 37.
  2. Comply with NFPA 70.
    - a. 2020 Edition, Article 445.6
  3. Comply with NFPA 110 requirements for Level 1 EPSS.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.
- E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  1. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).
  2. Relative Humidity: Zero to 95 percent.

3. Altitude: Sea level to 1000 feet (300 m).

## 2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Power Rating: Emergency Standby Power.
- D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.
- E. EPSS Class: Engine generator shall be classified as a Class 72 according to NFPA 110.
- F. Service Load: 625 kVA.
- G. Power Factor: 0.8 , lagging.
- H. Frequency: 60 Hz
- I. Voltage: 480 V ac.
- J. Phase: Three-phase, four-wire wye.
- K. Induction Method: Turbocharged.
- L. Governor: Adjustable isochronous, with speed sensing.
- M. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
- N. Capacities and Characteristics:
  - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
  - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- O. Engine Generator Performance:
  - 1. Steady-State Voltage Operational Bandwidth: 2 percent of rated output voltage, from no load to full load.
  - 2. Transient Voltage Performance: Not more than 20 percent variation for 100 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
  - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency, from no load to full load.
  - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
  - 5. Transient Frequency Performance: Less than 5 percent variation for 100 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
  - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics.
  - 7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
  - 8. Start Time: Comply with NFPA 110, Type 10 system requirements, and NFPA 70 Article 700.12.
- P. Engine Generator Performance for Sensitive Loads:
  - 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

- a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage, from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 100 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency, from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 100 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content, measured line to neutral, shall not exceed 5 percent THD, 3 percent single harmonic.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
  - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements, and NFPA 70 Article 700.12.

Q. Parallel Engine Generators:

1. Automatic reactive output power control and load sharing between engine generators operated in parallel.
2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.
7. Paralleling: Generators shall be compatible for paralleling system. Unit must be capable of being paralleled with any manufacturer's generator set without costly upgrades to the existing switchgear line up or existing generator sets.

## 2.4 DIESEL ENGINE

- A. Fuel: ASTM D 975 diesel fuel oil, Grade 2-D S15.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid mounted.
  1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Jacket Coolant Heater: Electric, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and with UL 499. Heater shall be sized to maintain 40F inside outdoor enclosure while genset is not operating.
- E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.



1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  2. Size of Radiator: Adequate to contain expansion of total system coolant, from cold start to 110 percent load condition for Prime Power units.
  3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant-system pressure for engine used. Equip with gage glass and petcock.
  4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
    - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 215 deg F (101 deg C), and noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- F. Muffler/Silencer:
1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    - a. Minimum sound attenuation of 25 dB at 500 Hz.
    - b. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 78 dBA or less.
- G. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- H. Starting System: 12 V electric, with negative ground.
1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article.
  2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  3. Cranking Cycle: As required by NFPA 110 for system level specified.
  4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
  5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories. Provide NEC 445.18 lockout/tagout EPO for disconnection of generator operation for maintenance.
  6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F (10 deg C) regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
  7. Battery Stand: Factory-fabricated, metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
  8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  9. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1 wall-mounted cabinet.

## 2.5 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 37.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Fuel-Oil Storage Tank: Comply with requirements in Section 231113 "Facility Fuel-Oil Piping".
  - 1. Fuel Tank Capacity: Minimum 133 percent of total fuel required for periodic maintenance operations between fuel refills plus fuel for the hours of continuous operation required for the indicated EPSS Class.
  - 2. Duplex Fuel-Oil Transfer Pump: Comply with requirements in Section 231113 "Facility Fuel-Oil Piping."
- G. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
  - 1. Emergency Vent.
  - 2. Tank level indicator.
  - 3. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for periodic maintenance operations between fuel refills, plus fuel for the hours of continuous operation for indicated EPSS class.
  - 4. Overfill alarm.
  - 5. Leak detection in interstitial space. Provide audible and visual alarm in the event of a leak.
  - 6. Vandal-resistant fill cap, with spill bucket installed around fill port.
  - 7. Containment Provisions: Comply with requirements of authorities having jurisdiction.
- H. Automated Fuel Filtration System: Provide an automated programmable fuel filtration and maintenance system to optimize and maintain the condition of the fuel stored in the tank. The system shall be capable of eliminating microbial contamination and removing water, sediment, and particulate to comply with ASTM D975.
  - 1. Enclosure: System shall be located within the generator enclosure or adjacent to the generator in a weatherproof, outdoor UL 50 listed enclosure with appropriate ventilation.
  - 2. Plumbing: Provide with a stainless-steel shutoff ball valve on the inlet and outlet for maintenance. Provide flow indicator. These components shall be locate within the enclosure.
  - 3. Installation: Locate system as close as possible to the designated fuel tank. The supply and return fuel lines shall be independent and separate from other fuel lines, with the supply line originating at the bottom of the tank in the deepest spot and the return line as far away as possible from the supply line within the tank.
  - 4. Filtration and Water Separation: Four stage separation process.
    - a. Stage 1: Centrifugal water and particulate separation
    - b. State 2: Water collection (removing 99.9% of water) and 30 micron hydrophobic particulate.
    - c. Stage 3: LG-X Fuel Conditioner removing ferrous metals and breaking down sediments and solids naturally forming in diesel fuel at submicron levels.
    - d. Stage 4: Secondary 3 Micron particulate and water adsorbing spin-on filter.

5. Water Sensor: Watect Model 550 microcontroller-based water sensor alarm module.
6. Controls and Display: Provide a warning light at either the exterior of the generator enclosure or the top of the control panel for visual notification of alarm conditions. All alarm system status information shall be displayed on the controller screen. Provide the following minimum control and display functions via the PLC controller:
  - a. Programmable digital timer with memory back for power outages.
  - b. Pump operating hour counter.
  - c. Pump control switch (Auto/Off/Manual) – Key operated at the front of the operating controller.
  - d. Power available indicator light.
  - e. Pump running indicator light.
  - f. Alarm indicator light. Alarms include
    - 1) High vacuum
    - 2) High pressure
    - 3) High water level
    - 4) Filter bowl
    - 5) Leak detection
  - g. Alarm reset push button
  - h. Electrical Controller Enclosure: Shall be contained within a separate UL 508A listed industrial control panel located within the generator enclosure or adjacent to the generator in a weatherproof, outdoor enclosure.
  - i. Communications: Provide communications via Modbus TCP via a 100 Base-T Ethernet or RS-485 Modbus RTU. Provide Form C dry contacts for summary alarm and leak detection to interface with the building automation system.
7. Pump: Positive displacement, gear, direct coupled, rotary pump.
8. Motor: UL listed, ODP, thermal overload protection, continuous duty.
9. Performance and Design Criteria: Minimum of 5 years of experience in the industry. System must be capable of filtering the complete tank volume once a month with the required run time of not more than 48 hours for the total tank volume. Provide sufficient contaminant and water holding capacity for the climate, tank layout, fuel delivery, and refueling intervals.

## 2.6 SEQUENCE OF OPERATION – PARALLELING GENERATORS

- A. Upon failure of utility power, the automatic transfer switch(es) provides a two-wire start signal to the system controller. The system controller sends a start command to the generators via RS485 communication. The first generator that reaches rated voltage and frequency requests permission to close into the “dead” generator bus. This is to provide dead bus arbitration. After this process, the generator closes its paralleling switch connecting to the generator bus.
- B. If the system has an emergency system transfer switch, it will typically transfer to the first generator on-line. If the emergency system load is larger than a single unit, two generators may be configured to come on-line prior to transferring the emergency system load.
- C. The system controller compares the on-line generator capacity to additional load segmentation. When adequate generator capacity becomes available, the system controller enables the priority one loads to be switched to the generator bus. This is typically accomplished by providing a permissive contact to the ATS. The system controller shall support 3 load steps.
- D. The second generator upon sensing generator bus voltage, shall synchronize and parallel to the generator bus.
- E. The system controller shall provide load-shed capability via programmed outputs based on a comparison of the number of generators on-line and connected load requirements. Three load-shed outputs shall be provided for this purpose. The system controller shall be capable of reconfiguration to match expected load conditions. Load shedding is possible through shunt trip breakers on non-critical loads in the event the demand exceeds 90% of the available generator capacity.

- F. Once utility power has returned, the two-wire start signal will be removed. The generator parallel- ing contactors will open, generators will run in a cool down mode. The generators shall stop upon expiration of the cool down period.

## 2.7 CONTROL AND MONITORING

- A. Automatic-Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate auto- matic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initi- ates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Provide minimum run time control set for 15 minutes, with override only by operation of a remote emergency-stop switch.
- C. Comply with UL 6200.
- D. Configuration:
  - 1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
    - a. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.
- E. Control and Monitoring Panel:
  - 1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
  - 2. Instruments: Located on the control and monitoring panel and viewable during operation.
    - a. Engine lubricating-oil pressure gage.
    - b. Engine-coolant temperature gage.
    - c. DC voltmeter (alternator battery charging).
    - d. Running-time meter.
    - e. AC voltmeter, for each phase.
    - f. AC ammeter, for each phase.
    - g. AC frequency meter.
    - h. Generator voltage raise/lower switches for digital controls.
  - 3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indica- tion as required by NFPA 110 for Level 1 system, including the following:
    - a. Cranking control equipment.
    - b. Run-Off-Auto switch.
    - c. Control switch not in automatic position alarm.
    - d. Overcrank alarm.
    - e. Overcrank shutdown device.
    - f. Low water temperature alarm.
    - g. High engine temperature pre-alarm.
    - h. High engine temperature.
    - i. High engine temperature shutdown device.
    - j. Overspeed alarm.
    - k. Overspeed shutdown device.
    - l. Low-fuel main tank.
      - 1) Low-fuel-level alarm shall be initiated when the level falls below that required for opera- tion for the duration required for the indicated EPSS class.
    - m. Coolant low-level alarm.
    - n. Coolant low-level shutdown device.
    - o. Coolant high-temperature prealarm.
    - p. Coolant high-temperature alarm.
    - q. Coolant low-temperature alarm.
    - r. Coolant high-temperature shutdown device.
    - s. EPS load indicator.

- t. Overvoltage and Overload.
  - u. Over KW.
  - v. Over KVA.
  - w. Undervoltage.
  - x. Battery high-voltage alarm.
  - y. Low-cranking voltage alarm.
  - z. Battery-charger malfunction alarm.
  - aa. Battery low-voltage alarm.
  - bb. Lamp test.
  - cc. Contacts for local and remote common alarm.
  - dd. Low-starting air pressure alarm.
  - ee. Low-starting hydraulic pressure alarm.
  - ff. Remote manual-stop shutdown device.
  - gg. Air shutdown damper alarm when used.
  - hh. Air shutdown damper shutdown device when used.
  - ii. Generator overcurrent-protective-device not-closed alarm.
- F. Engine Generator Metering: Comply with Section 260913 "Electrical Power Monitoring and Control
- G. Connection to Datalink:
1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
  2. Provide connections for datalink transmission of indications to remote data terminals via Mod-Bus. Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control." Also provide BACnet, Ethernet TCP/IP connect to the building automation system (BAS). Refer to specification 230993 for points to be monitored at the BAS.
- H. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.
- I. Remote Alarm Annunciator: Comply with NFPA 99. An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
1. Overcrank alarm.
  2. Coolant low-temperature alarm.
  3. High engine temperature prealarm.
  4. High engine temperature alarm.
  5. Low lube oil pressure alarm.
  6. Overspeed alarm.
  7. Low-fuel main tank alarm.
  8. Low coolant level alarm.
  9. Low-cranking voltage alarm.
  10. Contacts for local and remote common alarm.
  11. Audible-alarm silencing switch.
  12. Air shutdown damper when used.
  13. Run-Off-Auto switch.
  14. Control switch not in automatic position alarm.
  15. Fuel tank derangement alarm.
  16. Fuel tank high-level shutdown of fuel-supply alarm.
  17. Lamp test.
  18. Low-cranking voltage alarm.
  19. Generator overcurrent protective device not closed.
  20. Three spares for owner use.
- J. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

- K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- L. Each generator shall include a single generator controller that performs all genset control and paralleling functions.
- M. Each generator shall include a cycle rated paralleling switch using proven contactor technology. The generator paralleling switch shall be mounted in the generator connection box. Solutions utilizing motor operated or stored energy breakers for generator paralleling shall provide documentation of cycle rated suitability.

## 2.8 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs.
  - 1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
  - 2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. In the emergency distribution system(s), provide devices to selectively coordinate with all supply side overcurrent protective devices.
- C. Generator Overcurrent Protective Device:
  - 1. Molded-case circuit breaker, electronic-trip type; 100 percent rated; complying with UL 489.
    - a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
    - b. Trip Settings: Selected to coordinate with generator thermal damage curve.
    - c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices. Provide auxiliary contact to annunciate the breaker is open.
    - d. Mounting: Adjacent to or integrated with control and monitoring panel.
- D. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
  - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
  - 2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
  - 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
  - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- E. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
  - 1. Indicate ground fault with other engine generator alarm indications.
  - 2. Trip generator protective device on ground fault.

## 2.9 GENERATOR PARALLELING

- A. A paralleling contactor shall be integrated into each NEMA 1 panel to allow for automatic electrical closure onto a dead bus or in parallel with other generators once required conditions are satisfied. The contactor shall be as electrically operated (line power closed, DC power trip) mechanically held device with main contacts composed of silver alloy to resist welding and minimize voltage dip on closure.
- B. The contactor shall be capable of 65,000 amp maximum RMS symmetrical fault current.
- C. The contactor shall have four (4) mechanical lugs per phase for connecting cable (4/0 AWG to 350 kcmil) installed.

## **2.10 GENERATOR, EXCITER, AND VOLTAGE REGULATOR**

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft via semi-flexible drive discs. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six-lead alternator.
- E. Range: Provide limited range of output voltage by adjusting the excitation level.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Enclosure: Dripproof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
  - 1. Raise/lower switch on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
  - 2. Maintain voltage within 15 percent on one step, full load.
  - 3. Provide anti-hunt provision to stabilize voltage.
  - 4. Maintain frequency within 15 percent and stabilize at rated frequency within two seconds with 100% load pick-up.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: 12 percent, maximum.

## **2.11 VIBRATION ISOLATION DEVICES**

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
  - 1. Material: Per genset manufacturers recommendations separated by steel shims.
  - 2. Shore A Scale Durometer Rating: 30.
  - 3. Number of Layers: One.
  - 4. Minimum Deflection: 1 inch (25 mm).
- B. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.
- C. Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.
- D. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

## **2.12 FINISHES**

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

## **2.13 SOURCE QUALITY CONTROL**

- A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
  - 1. Tests: Comply with IEEE 115 and with NFPA 110, Level 1 Energy Converters.

- B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  2. Test generator, exciter, and voltage regulator as a unit.
  3. Full-load run.
  4. Maximum power.
  5. Voltage regulation.
  6. Transient and steady-state governing.
  7. Single-step load pickup.
  8. Safety shutdown.
  9. Provide 14 days' advance notice of tests and opportunity for Witness Tests by Owner's representative.
  10. Report factory test results within 10 days of completion of test.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  1. Notify Owner no fewer than ten working days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without Owner's written permission.

### **3.3 INSTALLATION**

- A. Comply with NECA 1 and NECA 404.
- B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.
- C. Equipment Mounting:
  1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
  3. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.
- D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- E. Cooling System: Install Schedule 40 black steel piping with welded joints for cooling water piping between engine generator and heat exchanger. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."



1. Install isolating thimbles where exhaust piping penetrates combustible surfaces. Provide a minimum of 9 inches (225 mm) of clearance from combustibles.
  2. Insulate cooling-system piping and components according to requirements in Section 230719 "HVAC Piping Insulation."
- F. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
1. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."
  2. Install flexible connectors and steel piping materials according to requirements in Section 232116 "Hydronic Piping Specialties."
  3. Insulate muffler/silencer and exhaust system components according to requirements in Section 230719 "HVAC Piping Insulation."
  4. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches (225 mm) of clearance from combustibles.
- G. Drain Piping: Install condensate drain piping to muffler drain outlet with a shutoff valve, stainless-steel flexible connector, and Schedule 40 black steel pipe with welded joints.
1. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."
  2. Drain piping valves, connectors, and installation requirements are specified in Section 232116 "Hydronic Piping Specialties."
- H. Fuel Piping:
1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."
  2. Copper and galvanized steel shall not be used in the fuel-oil piping system.
- I. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.
- C. Connect cooling-system water piping to engine generator with flexible connectors.
- D. Connect engine exhaust pipe to engine with flexible connector.
- E. Connect fuel piping to engines with a gate valve and union and flexible connector.
  1. Additional requirements for diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.
- H. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.
- I. Connect transfer switches to generator.
- J. Connect all fuel pumps, heaters, and accessories to emergency power.
- K. Connect generators to paralleling equipment. Connect transfer switches to paralleling equipment.

### 3.5 IDENTIFICATION

- A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

- B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

### 3.6 FIELD QUALITY CONTROL

- A. Fuel: Provide fuel for testing. Provide a full tank of fuel after completion of testing.
- B. Testing Agency:
  - 1. Owner will engage a qualified testing agency to perform tests and inspections.
  - 2. Engage a qualified testing agency to perform tests and inspections.
  - 3. Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
  - 4. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and in "Visual and Mechanical Inspection" and "Electrical and Mechanical Tests" subparagraphs below, as specified in the NETA ATS. Certify compliance with test parameters.
    - a. Visual and Mechanical Inspection:
      - 1) Compare equipment nameplate data with Drawings and the Specifications.
      - 2) Inspect physical and mechanical condition.
      - 3) Inspect anchorage, alignment, and grounding.
      - 4) Verify that the unit is clean.
    - b. Electrical and Mechanical Tests:
      - 1) Perform insulation-resistance tests according to IEEE 43.
        - (a) Machines Larger Than 200 hp (150 kW): Test duration shall be 10 minutes. Calculate polarization index.
        - (b) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
      - 2) Test protective relay devices.
      - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
      - 4) Functionally test engine shutdown for low oil pressure, overtemperature, and other protection features as applicable.
      - 5) Conduct performance test according to NFPA 110.
      - 6) Verify correct functioning of the governor and regulator.
  - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
  - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    - c. Verify acceptance of charge for each element of the battery after discharge.
    - d. Verify that measurements are within manufacturer's specifications.
  - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
  - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
  - 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
  - 7. Exhaust Emissions Test: Comply with applicable government test criteria.
  - 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

- 9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
  - 10. Noise-Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 23 feet (7 m) from edge of the generator enclosure on the property line, and compare measured levels with required values.
- D. Coordinate tests with tests for transfer switches, and run them concurrently.
  - E. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
  - F. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
  - G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
  - H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - I. Remove and replace malfunctioning units and retest as specified above.
  - J. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
  - K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component, indicating satisfactory completion of tests.
  - L. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels, so terminations and connections are accessible to portable scanner.
    - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
    - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - 3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - M. Submit report to show emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.

### **3.7 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

### **3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

**END OF SECTION**

# SECTION 263214 GENERATOR CONNECTION CABINET

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Generator Connection Cabinet (also referred to as Tap Box and Docking Station)
  - 2. Accessory components and features.
  - 3. Identification.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of connection cabinet. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each connection cabinet and related equipment.
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
  - 7. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment.
  - 8. Detail enclosure type.
  - 9. Detail bus configuration, current, and voltage ratings.
  - 10. Detail short-circuit current rating of connection cabinet.
  - 11. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
  - 12. Include schematic and wiring diagrams for power, signal, and control wiring.
  - 13. Include report of emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer.
- B. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For generator connection cabinets and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
  - 1. Routine maintenance requirements for generator connection cabinets and all installed components.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- C. Source Limitations: Obtain generator connection cabinets, components, and accessories from single source from single manufacturer.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for generator connection cabinets including clearances between generator connection cabinets and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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. Comply with NFPA 70.
- G. Comply with UL.

## 1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving generator connection cabinets into place.
- B. Environmental Limitations:
  - 1. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
    - b. Altitude: Not exceeding 6600 feet (2000 m).
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet (2000 m).

## 1.8 COORDINATION

- A. Coordinate layout and installation of generator connection cabinets and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Midwest Power (AMP)
  - 2. APT

3. ASCO
  4. ESL Power Systems
  5. HIPOWER
  6. LEX Products
  7. Power Products Inc.
  8. Powertron
  9. Trystar
- B. All equipment shall be new.
  - C. Generator tap box manufacturer must have produced and sold generator tap boxes as a standard product for a minimum of (2) years.
  - D. Contractor shall be responsible for the equipment until it has been installed and is finally inspected, tested and accepted in accordance with the requirements of this Specification.
  - E. Nominal System Voltage: 480Y/277 V.
  - F. Bus Continuous: As shown on drawings.
  - G. Generator tap box shall consist of cam-style male connectors and grounding terminals, all housed within a padlockable enclosure.
  - H. Generator tap box enclosure shall be Type 3R, constructed of continuous seam-welded, powder coated steel. The main access shall be through a hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via cable entry openings in the bottom of the enclosure. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication; color shall be light gray RAL 7038.
  - I. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground, and shall also be provided for neutral if required. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. None of the cam-style male connectors shall be accessible unless the main access door is open.
  - J. Buses and Connections: Three phase, four wire unless otherwise indicated.
    1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated aluminum or copper feeder circuit-breaker line connections.

## 2.2 IDENTIFICATION

- A. Provide label of generator connection cabinet and instruction sign for operation of disconnect/over-current device in emergency distribution switchgear.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine generator connection cabinet before installation. Reject generator connection cabinets that are moisture damaged or physically damaged.
- B. Examine elements and surfaces to receive generator connection cabinets for compliance with installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Generator connection cabinet shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation".

- B. Equipment Mounting: Install generator connection cabinet on concrete base, 6-inch (100-mm) nominal thickness, reinforced. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to generator connection cabinet.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from generator connection cabinet and components.
- D. Comply with mounting and anchoring requirements specified in Section 260548 "Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for generator connection cabinet. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on inside of front door of generator connection cabinet.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Generator Connection Cabinet Nameplates: Label each generator connection cabinet with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Generator connection cabinet will be considered defective if it does not pass tests and inspections.

**END OF SECTION**

# **SECTION 263600 TRANSFER SWITCHES**

## **PART 1 GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Contactor-type automatic transfer switches.
  - 2. Transfer switch accessories.
- B. Related Requirements:
  - 1. Section 263213.13 "Diesel-Engine-Driven Generator Sets" for generator interface.

### **1.3 DEFINITIONS**

- A. Short-Time Rated: The maximum amount of fault current a switch can withstand at a specified voltage for a given amount of time and remain functional.

### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
  - 2. Include rated capacities, weights, operating characteristics, and accessories.
- B. Shop Drawings:
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
  - 7. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
  - 8. Include material lists for each switch specified.
  - 9. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
  - 10. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer-authorized service representative.
- B. Field quality-control reports.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
    - a. Features and operating sequences, both automatic and manual.



- b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
  - 1. Member company of NETA.
    - a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.8 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Owner's written permission.

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 12 months from date of Substantial Completion.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
  - 2. Short-time Rating capability for 30 cycles. A Withstand and Close Rating is not considered a Short-Time Rating.
- H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

- K. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- L. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- M. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
  - 1. Provide pre-transfer contacts for each elevator controller.
- N. Signal-After-Transfer Contacts or Switch Position Contacts: A set of normally open/normally closed dry contacts operates after a transfer to an emergency source. These contacts shall allow only one elevator to operate at time while on generator power.
  - 1. Provide post transfer contacts for each elevator controller.
- O. Generator Start Circuit: The integrity of the generator control wiring shall be continuously monitored. Loss of integrity of the remote start circuit(s) shall initiate visual and audible annunciation of generator malfunction at the generator local and remote annunciator(s) and start the generator(s).
- P. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- Q. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- R. Battery Charger: For generator starting batteries.
  - 1. Float type, rated 2A.
  - 2. Ammeter to display charging current.
  - 3. Fused ac inputs and dc outputs.
- S. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- T. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed tape markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
  - 4. Accessible via front access.
- U. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.2 POWER MONITORING

- A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL 1244.
- B. Provide digital metering and necessary CT's, PT's and sensors in ATS or any other location identified on the construction documents.
- C. Communications:
  - 1. Power monitor shall be permanently connected to communicate via Modbus TCP via a 100 Base-T Ethernet or RS-485 Modbus TCP/IP.
  - 2. Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.
  - 3. The ATS shall be capable of communicating the basic RMS Real-Time measurements to the Power Monitoring system.

## 2.3 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by the same manufacturer as the diesel generator.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
  - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
  - 2. Switch Action: Double throw; mechanically held in both directions.
  - 3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
  - 4. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 5. Material: Tin-plated aluminum.
  - 6. Main and Neutral Lugs: Compression type.
  - 7. Ground Lugs and Bus-Configured Terminators: Compression type.
  - 8. Ground bar.
  - 9. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
  - 1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
  - 1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
  - 2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
  - 3. Fully automatic break-before-make operation with center off position.
  - 4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.
- F. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- G. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- H. Electric Nonautomatic Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- I. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- J. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- K. Automatic Transfer-Switch Controller Features:
  - 1. Controller operates through a period of loss of control power.
  - 2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  5. Test Switch: Simulate normal-source failure.
  6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
  9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
  10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
  11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
  12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
  13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    - b. Push-button programming control with digital display of settings.
    - c. Integral battery operation of time switch when normal control power is unavailable.
- L. Large-Motor-Load Power Transfer:
1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
  2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.
  3. Programmed Neutral Switch Position: Switch operator with programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Adjustable pause from 0.5 to 30 seconds minimum, and factory set for 0.5 second unless otherwise indicated. Time delay occurs for both transfer directions. Disable pause unless both sources are live.

## 2.4 TRANSFER SWITCH ACCESSORIES

- A. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciator panel display shall include the following indicators:
  - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
  - b. Switch position.
  - c. Switch in test mode.
  - d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
  - a. Indicating Lights: Grouped for each transfer switch monitored.
  - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
  - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
  - d. Lamp Test: Push-to-test or lamp-test switch on front panel.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
  1. For each of the tests required by UL 1008, performed on representative devices, for emergency and legally required systems. Include results of test for the following conditions:
    - a. Overvoltage.
    - b. Undervoltage.
    - c. Loss of supply voltage.
    - d. Reduction of supply voltage.
    - e. Alternative supply voltage or frequency is at minimum acceptable values.
    - f. Temperature rise.
    - g. Dielectric voltage-withstand; before and after short-circuit test.
    - h. Overload.
    - i. Contact opening.
    - j. Endurance.
    - k. Short circuit.
    - l. Short-time current capability.
    - m. Receptacle withstand capability.
    - n. Insulating base and supports damage.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Comply with requirements for seismic control devices specified in Section 260548 "Seismic Controls for Electrical Systems."
  3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
  4. Provide workspace and clearances required by NFPA 70.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- C. Identify components according to Section 260553 "Identification for Electrical Systems."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Comply with NECA 1.

### **3.2 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Identification for Electrical Systems."
- B. Transfer Switch Nameplates: Label each transfer switch with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

### **3.3 CONNECTIONS**

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- G. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.
- H. Provide all necessary connections between automatic transfer switches.
- I. Provide all necessary connections between automatic transfer switches and generator(s).
- J. Provide all necessary connections between automatic transfer switches and paralleling controls.
- K. Provide all necessary connections between automatic transfer switches and normal source feeder breakers.
- L. Provide all necessary connections between automatic transfer switches and generator local and remote annunciator(s).

### **3.4 FIELD QUALITY CONTROL**

- A. Administrant for Tests and Inspections:
  - 1. Owner will engage qualified testing agency to administer and perform tests and inspections.
  - 2. Engage qualified testing agency to administer and perform tests and inspections.
  - 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
  - 4. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- B. Tests and inspections:
  - 1. After installing equipment test for compliance with requirements according to NETA ATS.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.
    - d. Verify that the unit is clean.
    - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

- f. Verify that manual transfer warnings are attached and visible.
  - g. Verify tightness of all control connections.
  - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
    - 1) Use of low-resistance ohmmeter.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
  - i. Perform manual transfer operation.
  - j. Verify positive mechanical interlocking between normal and alternate sources.
  - k. Perform visual and mechanical inspection of surge arresters.
  - l. Inspect control power transformers.
    - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
    - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
    - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
3. Electrical Tests:
- a. Perform insulation-resistance tests on all control wiring with respect to ground.
  - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
  - c. Verify settings and operation of control devices.
  - d. Calibrate and set all relays and timers.
  - e. Verify phase rotation, phasing, and synchronized operation.
  - f. Perform automatic transfer tests.
  - g. Verify correct operation and timing of the following functions:
    - 1) Normal source voltage-sensing and frequency-sensing relays.
    - 2) Engine start sequence.
    - 3) Time delay on transfer.
    - 4) Alternative source voltage-sensing and frequency-sensing relays.
    - 5) Automatic transfer operation.
    - 6) Interlocks and limit switch function.
    - 7) Time delay and retransfer on normal power restoration.
    - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
- a. Check for electrical continuity of circuits and for short circuits.
  - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
  - c. Verify that manual transfer warnings are properly placed.
  - d. Perform manual transfer operation.
5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
- a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
  - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
  - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
- a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.

- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.
- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

### **3.5 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
- C. Complete installation and startup checks according to manufacturer's written instructions.
- D. Coordinate this startup with that for generator equipment.

### **3.6 CLEANING**

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions. Vacuum only; do not use compressed air for cleaning.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

**END OF SECTION**





# SECTION 264313

## SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Type 1 surge protective devices.
  - 2. Type 2 surge protective devices.
  - 3. Enclosures.
  - 4. Conductors and cables.
- B. Related Requirements:
  - 1. Section 262413 "Switchboards" for factory-installed SPDs.
  - 2. Section 262416 "Panelboards" for factory-installed SPDs.
- C. SPDs installed internal to the distribution equipment shall be of the same manufacture as the equipment. The equipment shall be fully tested and certified to their respective UL standard.

#### 1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. NRTL: Nationally Recognized Testing Laboratory.
- F. OCPD: Overcurrent protective device.
- G. SCCR: Short-circuit current rating.
- H. SPD: Surge protective device.
- I. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.
- J. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- K. Type 3 SPDs: Point of utilization SPDs.
- L. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.
- M. Type 5 SPDs: Discrete component surge suppressors, such as MOVs that may be mounted on a printed wiring board, connected by its leads or provided within an enclosure with mounting means and wiring terminations.
- N. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.

4. On datasheets with multiple products, indicate which product is provided under this project.
5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
7. Include electrical characteristics, specialties, and accessories for SPDs.
8. NRTL certification of listing to UL 1449.
  - a. Tested values for VPRs.
  - b. Inominal ratings.
  - c. MCOV, type designations.
  - d. OCPD requirements.
  - e. Manufacturer's model number.
  - f. System voltage.
  - g. Modes of protection.
  - h. SPD Type

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For SPDs to include in maintenance manuals.

### **1.7 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within five years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 GENERAL SPD REQUIREMENTS**

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. SPD shall bear the UL Mark and shall be Listed to UL 1449 4th Edition. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
- D. The manufacturer shall evaluate the performance of any overcurrent protection devices (OCPD) installed upstream of the SPD to determine if the performance of the OCPD will open prior to the surge being able to flow to the SPD. The SPD manufacturer shall indicate any recommended OCPD adjustments.

### **2.2 TYPE 1 SURGE PROTECTIVE DEVICES (SPD'S)**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Advanced Protection Technologies (APT)
  2. ABB/Current Technology, Inc.
  3. ASCO
  4. Eaton Corporation.
  5. Intermatic, Inc.
  6. Leviton Manufacturing Co., Inc.
  7. Liebert Corporation, a division of Emerson.
  8. Tycor, Cutler Hammer, Inc.
  9. Square D by Schneider Electric
- B. Standards:

1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449 4<sup>th</sup> Edition, as a Type 1 SPD.
- C. SPDs: The Project includes a UL Master Label Lightning Protection System with UL 96A Compliance, therefore the SPD's for Service Entrances must be Listed and labeled by UL.
- D. SPD shall be externally mounted to the Service Entrance Equipment. Internally mounted SPDs will not be accepted.
- E. Product Options:
1. Include integral disconnect switch if no breaker position is available.
  2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
  3. Indicator light display for protection status. Indicator lights shall change color from green, to orange, to red, to indicate several levels of product degradation.
  4. Include audible alarm.
  5. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V ac for remote monitoring of protection status. Provide all the necessary wiring and components to monitor the status via the building power monitoring and control system.
  6. Include surge counter with a minimum trigger of 100A.
- F. Performance Criteria:
1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
  2. Comply with UL 1283 EMI/RFI filtering with a minimum attenuation of -30dB at 100kHz.
  3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per mode (L-N, L-G, and N-G) shall not be less than 80 kA. The peak surge current rating shall be tested and verified by an independent 3<sup>rd</sup> party test lab. Surge ratings based solely on the arithmetic sum of the ratings of the individual MOVs used in the construction of the SPD will not be accepted.
- G. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits must not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V.
  2. Line to Line: 2000 V for 480Y/277 V.
  3. Line to Ground: 1200 V for 480Y/277 V.
  4. Neutral to Ground: 1200 V for 480Y/277 V.
- H. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
  2. Line to Line: 1200 V.
  3. Line to Ground: 700 V.
  4. Neutral to Ground: 700 V.
- I. SCCR: Not less than 100 kAIC.
- J. Inominal Rating: 20 kA. Inominal Discharge Current Ratings of 3kA, 5kA or 10kA shall not be allowed.

### 2.3 TYPE 2 SURGE PROTECTIVE DEVICES (SPD'S)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advanced Protection Technologies (APT)
  2. ABB/Current Technology, Inc.
  3. ASCO
  4. Eaton Corporation.
  5. General Electric Company.
  6. Intermatic, Inc.
  7. Leviton Manufacturing Co., Inc.

8. Liebert Corporation, a division of Emerson.
9. Tycor, Cutler Hammer, Inc.
10. Square D by Schneider Electric

B. Standards:

1. UL Listed to and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, 4<sup>th</sup> Edition, as a Type 2 SPD.
2. Comply with UL 1283.
3. Include LED indicator lights for power and protection status. Indicator lights shall change color from green, to orange, to red, to indicate several levels of product degradation.
4. Internal thermal protection that disconnects the SPD before damaging internal suppressor components. SPD's relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
5. Include NEMA ICS 5, dry Form-C contacts rated at 2 A and 24-V ac, for remote monitoring of protection status. Provide all the necessary wiring and components to monitor the status via the building power monitoring and control system.
6. Include surge counter.

C. Performance Criteria:

1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
2. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 50 kA. Peak surge current rating shall be the arithmetic sum of the ratings of the individual L-N and L-G MOVs in a given phase.
3. The peak surge current rating shall be tested and verified by an independent 3<sup>rd</sup> party test lab. Surge ratings based solely on the arithmetic sum of the ratings of the individual MOVs used in the construction of the SPD will not be accepted.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits must not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Neutral to Ground: 1200 V for 480Y/277 V.
4. Line to Line: 2000 V for 480Y/277 V

E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

## 2.4 EPSS SUPPRESSORS

- A. Provide surge protective devices for all equipment, switchgear, switchboards, or panelboards identified to be on the EPSS. Refer to one-line drawings.
- B. SPDs shall be listed and labeled as defined in NFPA 70, by Underwriters Laboratories, and marked for intended location and application.
- C. SPDs shall meet the requirements already identified in article 2.2 for Type 1 locations and article 2.3 for Type 2 locations.
- D. Unless otherwise noted, provide SPD's on all life safety and critical branch distribution and/or panels.

## 2.5 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.

## 2.6 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260523 "Control-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260523 "Control-Voltage Electrical Power Conductors and Cables."

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's written instructions.
- C. Install leads between disconnects and SPDs short (24" or less) straight, and in accordance with manufacturer's written instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Adjust circuit-breaker positions to achieve shortest and straightest leads.
  - 1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
  - 2. Do not exceed manufacturer's recommended lead length.
  - 3. Gently twist conductors together.
  - 4. Do not bond neutral and ground.
  - 5. If installed lead length must exceed 5 feet between disconnect and SPD, installer shall use a low-impedance cable connection to reduce the lead length impact to the installed performance of the SPD.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
  - 1. Controls: Comply with wiring methods in Section 260523 "Control-Voltage Electrical Power Conductors and Cables."
- F. All SPDs shall be externally mounted from metal-enclosed switchgear, switchboards, distribution boards, and panelboards to minimize the need for equipment shutdowns when replacing SPDs.

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  - 2. Inspect anchorage, alignment, grounding, and clearances.
  - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
  - 4. Voltage measurements from L-G, L-N, L-L and N-G (as applicable).
  - 5. Impulse injection to verify the system suppression voltage tolerances for all suppression paths. (Note: This testing is separate from any switchgear or other system tests. Completely disconnect the SPD from the switchgear prior to any switchgear or other system tests, including any hi pot testing.)
  - 6. Record and compare test results to factory benchmark test parameters supplied with each individual unit.
  - 7. Submit a copy of the start-up test results and the factory benchmark testing results to the engineer and the owner for confirmation of proper system function.

- B. SPD's that do not pass tests and inspections will be considered defective.

### **3.3 STARTUP SERVICE**

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

### **3.4 DEMONSTRATION**

- A. Train Owner's maintenance personnel to operate and maintain SPDs.
- B. Demonstrate where and how the Owner's maintenance personnel can view the SPD status on the power monitoring system.

**END OF SECTION**

# SECTION 265119 LED INTERIOR LIGHTING

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior solid-state luminaires that use LED technology.
  - 2. Lighting fixture supports.

### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
  - 7. Arrange in order of luminaire designation.
  - 8. Include data on features, accessories, and finishes.
  - 9. Include physical description and dimensions of luminaires.
  - 10. Include emergency lighting units, including batteries and chargers.
  - 11. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  - 12. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    - b. Provide certification of one of the following:
      - 1) LM-79-08 report at T=0 and at T=6000 hours with a summary table showing the percent lumen output change and percent input power change.



- 2) LM-80-08 test data for the LEDs at the three temperatures per LM-80-08. Provide extrapolation data using an exponential decay function to show the output at 50,000 hours. Provide the  $T_s$  value from the LM-79-08 and where the point falls in relation to the LM-80-08 extrapolated data. Interpolate between the LM-80-08 data for the  $T_s$  temperature.
- B. Shop Drawings: For nonstandard or custom luminaires.
    1. Include plans, elevations, sections, and mounting and attachment details.
    2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    3. Include diagrams for power, signal, and control wiring.
  - C. Sustainable Design Submittals:
    1. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
    2. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  - D. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
  - E. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
    1. Include Samples of luminaires and accessories involving color and finish selection.
  - F. Samples for Verification: For each type of luminaire.
    1. Include Samples of luminaires and accessories to verify finish selection.
  - G. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Luminaires.
  2. Suspended ceiling components.
  3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
  4. Structural members to which equipment and luminaires will be attached.
  5. Initial access modules for acoustical tile, including size and locations.
  6. Items penetrating finished ceiling, including the following:
    - a. Other luminaires.
    - b. Air outlets and inlets.
    - c. Sprinklers.
  7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Product Certificates: For each type of luminaire.
- D. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Sample warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. LEDs: Provide One for every 100 factory assembled replacement LED package with electrical leads. Furnish at least one of each type. May be unitized with power supply unit/driver.
  - 2. Power Supply Units/ driver: One for every 100 of each type and rating installed. Furnish at least one of each type. May be unitized with LEDs.
  - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## 1.8 QUALITY ASSURANCE

- A. Institute for Electrical and Electronics Engineers (IEEE)
  - 1. IEEE PAR1789 - Recommending practices for modulating current in High Brightness LEDs for mitigating health risks to viewers.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
  - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.
- C. Warranty Period for Light Sources: Five year replacement material warranty on all light sources (LED package, LED array, or LED module) including, but not limited to the LED die, encapsulate, and phosphor for the LEDs lumen maintenance not achieving L<sub>70</sub> after 50,000 hours.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).
  - 1. Relative Humidity: Zero to 95 percent.
- B. Altitude: Sea level to 1000 feet (300 m).

## 2.3 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL, ETL, CSA, or other qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.
- G. CRI of minimum As Scheduled on drawings. CCT of As Scheduled on drawings.
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: As scheduled.

## 2.4 LEDS

- A. LED sources must meet the following requirements:
  - 1. Operating temperature rating must be between -40°C and +50°C
  - 2. Correlated Color Temperature (CCT):
    - a. Nominal CCT: 2700 K (2725 ± 145)
    - b. Nominal CCT: 3000 K (3045 ± 175)
    - c. Nominal CCT: 3500 K (3465 ± 245)
    - d. Nominal CCT: 4000 K (3985 ± 275)
    - e. Nominal CCT: 4500 K (4503 ± 243)
    - f. Nominal CCT: 5000 K (5028 ± 283)
    - g. Nominal CCT: 5700 K (5665 ± 355)
    - h. Nominal CCT: 6500 K (6530 ± 510)
    - i. Du'v' tolerance of 0.001 ± 0.006
  - 3. Color Rendering Index (CRI): greater than or equal to 80.
  - 4. Luminaire manufacturer must submit reliability reports indicating that the manufacturer of the LED (chip, diode, or package) has performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows:
    - a. High Temperature Operating Life (HTOL)
    - b. Room Temperature Operating Life (RTOL)
    - c. Low Temperature Operating Life (LTOL)
    - d. Powered Temperature Cycle (PTMCL)
    - e. Non-Operating Thermal Shock (TMSK)
    - f. Mechanical Shock
    - g. Variable Vibration Frequency
    - h. Solder Heat Resistance (SHR)

## 2.5 LED DRIVERS / POWER SUPPLYS

- A. LED drivers must meet the following requirements:
  - 1. Drivers must have a minimum efficiency of 85%.

2. Starting Temperature: -40° C.
3. Electrical Characteristics.
  - a. Volts: as indicated on Luminaire Schedule.
  - b. Phase: Single.
  - c. Hertz: 60.
4. Power supplies can be UL Class I or II output.
5. Drivers must have a Power Factor (PF) of greater than or equal to 0.90.
6. Drivers must have a Total Harmonic Distortion (THD) of less than or equal to 20%.
7. Drivers must comply with FCC 47 CFR Part 15 non-consumer RFI/EMI standards.
8. Drivers must be Reduction of Hazardous Substances (RoHS) compliant.
9. Inrush current <2A
10. Sound rating: Inaudible in a 24 dB ambient.
11. Class P thermally protected.
12. Drivers with 0-10V dimming capability must be isolated and not allow current to leak between the power source and the 0-10V control circuit.

## 2.6 LED LUMINAIRES

- A. Provide luminaires with integral LED thermal management system (heat sinking).
- B. Luminaires shall be equipped with an LED driver that accepts 120V through 277V, 50hz to 60hz (UNIV). Component-to-component wiring within the luminaire will carry no more than 80% of rated current and be listed by UL for use at 600 VAC at 302°F/150°C or higher. Plug disconnects shall be listed by UL for use at 600 VAC, 15A or higher.
- C. LED modules shall have a minimum L70 service life of 75,000 hours at 25°C ambient temperature and based on IESNA LM-80 methodology.
- D. Provide luminaires with individual LED arrays/ modules and drivers that are accessible and replaceable from exposed side of the luminaire. Luminaires requiring removal or replacement of entire luminaire to access LEDs and drivers will NOT be accepted.
- E. Luminaire efficiency shall be minimum of 70 lumens per watt.
- F. Warranty: 5 year warranty covering the LED arrays, and LED drivers.
- G. Continuous Flicker Free dimming range 100% to 0 measured relative light output.

## 2.7 MATERIALS

- A. Metal Parts:
  1. Free of burrs and sharp corners and edges.
  2. Sheet metal components shall be steel unless otherwise indicated.
  3. Form and support to prevent warping and sagging.
- B. Steel:
  1. ASTM A 36/A 36M for carbon structural steel.
  2. ASTM A 568/A 568M for sheet steel.
- C. Stainless Steel:
  1. 1. Manufacturer's standard grade.
  2. 2. Manufacturer's standard type, ASTM A 240/240 M.
- D. Galvanized Steel: ASTM A 653/A 653M.
- E. Aluminum: ASTM B 209.

## 2.8 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.9 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## 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 the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA/IESNA-500, "Recommended Practice for Installing Indoor Commercial Lighting Systems."
- B. Comply with NECA 1.
- C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- D. Install lamps in each luminaire.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- F. Flush-Mounted Luminaire Support:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- G. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.
- H. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
  - 2. Ceiling mount with hook mount.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

### **3.3 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
    - a. If 0-10V dimming does not perform to expectations, the contractor shall provide low pass filters at the 0-10V source to remedy performance issues.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.
- D. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- E. Advance Notice: Give dates and times for field tests.
- F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
  - 1. Corroded Fixtures: Replace during warranty period.

### **3.5 STARTUP SERVICE**

- A. Clean luminaires internally and externally after installation. Use methods and materials recommended by manufacturer.

### **3.6 ADJUSTING**

### **3.7 INTERIOR LUMINAIRE SCHEDULE**

- A. See drawings for Luminaire Schedule.

**END OF SECTION**



# SECTION 267010 ELECTRIC HEATING CABLES

## **PART 1 – GENERAL**

### **1.1 RELATED DOCUMENTS**

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

### **1.2 SUMMARY**

- A. This Section includes heating cables for the following applications:
  - 1. Heat tracing.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of heater and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 1. Provide coversheet indicating project title, project location, and vendor contact information.
  - 2. Organize submittal into logical sections and provide table of contents.
  - 3. Provide itemized bill of materials indicating model number and quantity for each product.
  - 4. On datasheets with multiple products, indicate which product is provided under this project.
  - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
  - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
- B. Samples for Initial Selection: For units with factory-applied color finishes.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items; and floor plans and sections showing heating cable layout and relationships between components and adjacent structural and mechanical elements. Show the following:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For heaters and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting heaters.



## 1.6 QUALITY ASSURANCE

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

## 1.7 COORDINATION

- A. Coordinate layout and installation of electric heating cables and system components with other construction.
  - 1. Coordinate concrete, reinforcement, and formwork requirements specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Coordinate with ceiling installation requirements.
  - 3. Coordinate with roofing installer, for installation and roof penetrations specified in Section 077200 "Roof Accessories."

## 1.8 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of electric heating cables that fail in materials or workmanship within specified warranty period.
- C. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Accutron Heat Tracing Systems.
  - 2. Ari Industries.
  - 3. BICC Pyrotenax USA Inc.
  - 4. Caloric, Inc.
  - 5. Chromalox; Wiegard Industrial Division; Emerson Electric Company.
  - 6. Copperheat Inc.
  - 7. Delta-Therm Corp.
  - 8. Easy Heat, Inc.
  - 9. INDEECO.
  - 10. Maxxon Corp.; Infloor Heating Systems Div.
  - 11. Nelson Heat Tracing Systems.
  - 12. Omega Engineering Inc.
  - 13. Raychem Corporation.
  - 14. Stelpro.
  - 15. Thermon Manufacturing Co.

### 2.2 HEATING CABLES

- A. Heat-Tracing Cables: Self-regulating, electric heating cables suitable for freeze protection of metal or plastic piping.
  - 1. Cables: Pair of parallel No. 16 AWG tinned-copper bus wires embedded in cross-linked conductive polymer core, which varies power output in response to temperature along its length.
  - 2. Cable shall be capable of crossing over itself without overheating.
  - 3. Heat Output: At least 90 percent of rating over a temperature range from 40 to 150 deg F (4.4 to 65 deg C) pipe temperature.

4. Cable Cover: Fabricated of cross-linked, modified, polyolefin dielectric jacket; tinned-copper braid; and polyolefin outer jacket with ultraviolet inhibitor.

### **2.3 CONTROLS**

- A. Pipe Thermostat: Unit with preset temperature of 130 deg F (55 deg C) snap action; open-on-rise, single-pole switch with 25-A rating; and remote bulb for directly sensing pipe-wall temperature.

### **2.4 ACCESSORIES**

- A. Cable Installation Accessories: Tapes, cable ties, warning labels, end seals and splices, and installation clips.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine surfaces and substrates to receive heating cables for compliance with requirements for installation, tolerances, and other conditions affecting performance.
  1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
  2. Ensure pipe testing is complete.
  3. Ensure surfaces and substrates are level and plumb.
- B. Test cables for electrical continuity before installing.
- C. Test cables for insulation resistance before installing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Cut cable to length required.
- B. Install heater-to-cold lead connections in accessible locations. Do not embed in concrete or plaster.
- C. Avoid crossing expansion, construction, or control joints with heating cables. Provide sufficient slack conductor in expansion loop.
- D. Do not install heating cable mats across expansion, construction, or control joints.
- E. Install cables and mats after applying bituminous binder course to lower base; ensure that second bituminous binder course is applied to cables before pouring finish topping.
- F. Do not energize cables embedded in concrete, asphalt, or plaster until those assemblies are cured, except for brief testing.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

### **3.4 CONNECTIONS**

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Connect heating cables and other components to wiring systems.
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing: Perform tests after installation but before application of coverings, such as insulation, plaster, or concrete.
  - 1. Test cables for electrical continuity before energizing.
  - 2. Test cables for insulation resistance before energizing. Remove cables if measured resistance is less than 10 megohms to ground.
  - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation.
- C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

### **3.6 ADJUSTING**

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

### **3.7 PROTECTION**

- A. Protect installed heating cables, including leads, from damage before Substantial Completion.

**END OF SECTION**

# DANE COUNTY GENERATOR REPLACEMENT PROJECT

## CITY-COUNTY BUILDING

210 MARTIN LUTHER KING JR BLVD  
MADISON, WI 53703

## COUNTY COURTHOUSE BUILDING

215 S HAMILTON ST  
MADISON, WI 53703



# HGA

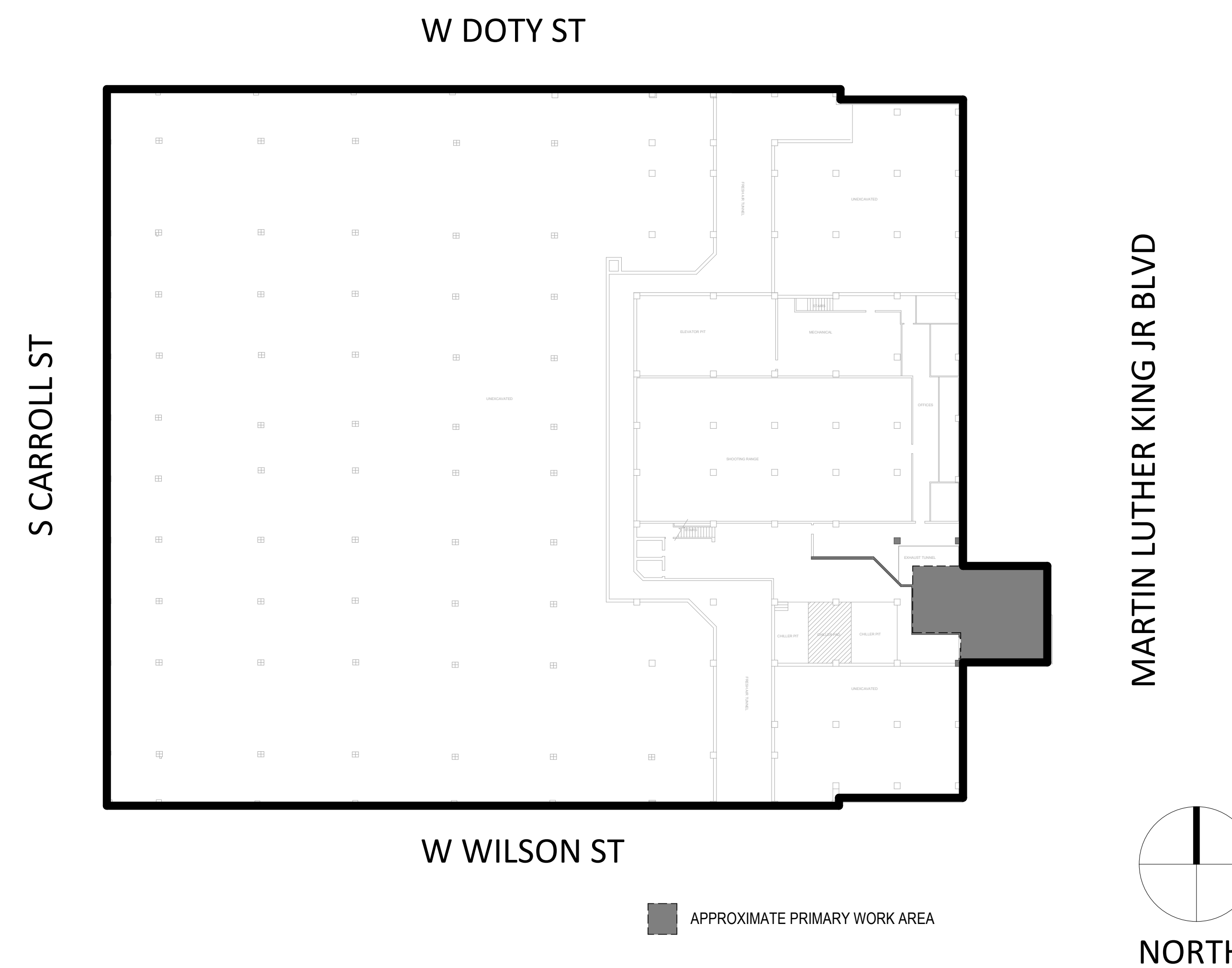
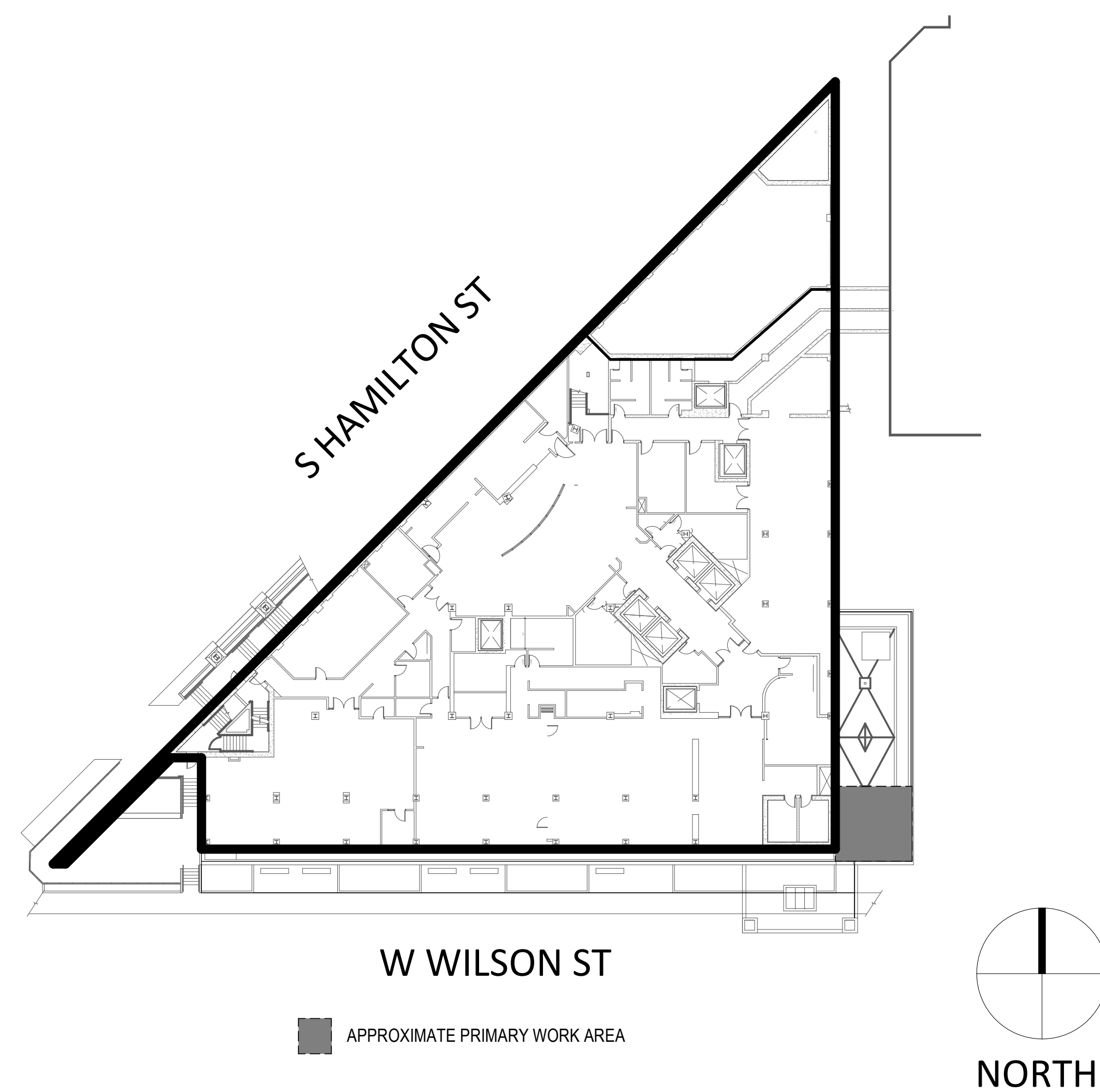
7475 HUBBARD AVENUE, SUITE 201  
MIDDLETON, WI 53562  
TELEPHONE 608.554.5333

DRAWING INDEX			
REV #	NUMBER	SHEET NAME	Discipline Order
<b>1-GENERAL</b>			
	G000	COVER SHEET, INDEX AND AREA PLANS	1-GENERAL
<b>3-STRUCTURAL</b>			
	S000	STRUCTURAL DETAILS	3-STRUCTURAL
<b>4-ARCHITECTURAL</b>			
	A200	ENLARGED PLANS	4-ARCHITECTURAL
	A600	DETAILS	4-ARCHITECTURAL
<b>5-MECHANICAL</b>			
	M001	MECHANICAL GENERAL NOTES AND SYMBOLS	5-MECHANICAL
	M100	BASEMENT - HVAC DEMO PLAN	5-MECHANICAL
	M200	BASEMENT - HVAC PLAN	5-MECHANICAL
	M201	LEVEL 01 - HVAC PLAN	5-MECHANICAL
	M700	MECHANICAL DETAILS AND SECTIONS	5-MECHANICAL
<b>8-ELECTRICAL</b>			
	E000	ELECTRICAL GENERAL NOTES AND SYMBOLS	8-ELECTRICAL
	E011	ONE-LINE DIAGRAM COURTHOUSE	8-ELECTRICAL
	E012	ONE-LINE DIAGRAM - CCB	8-ELECTRICAL
	E100	DEMOLITION PLAN	8-ELECTRICAL
	E200B	LIGHTING PLAN - SUB-BASEMENT	8-ELECTRICAL
	E208	LIGHTING PLAN - PENTHOUSE	8-ELECTRICAL
	E300B	POWER PLAN - SUB-BASEMENT	8-ELECTRICAL
	E300B.1	POWER PLAN - BASEMENT	8-ELECTRICAL
	E300G	POWER PLAN - GROUND LEVEL	8-ELECTRICAL
	E301	POWER PLAN - LEVEL 01	8-ELECTRICAL
	E305	POWER PLAN - LEVEL 05	8-ELECTRICAL
	E308	POWER PLAN - PENTHOUSE	8-ELECTRICAL
	E500	ELECTRICAL SCHEDULES	8-ELECTRICAL
Grand total: 22			

## BID DOCUMENTS

HGA COMMISSION NUMBER: 2407-004-00

JANUARY 18, 2022

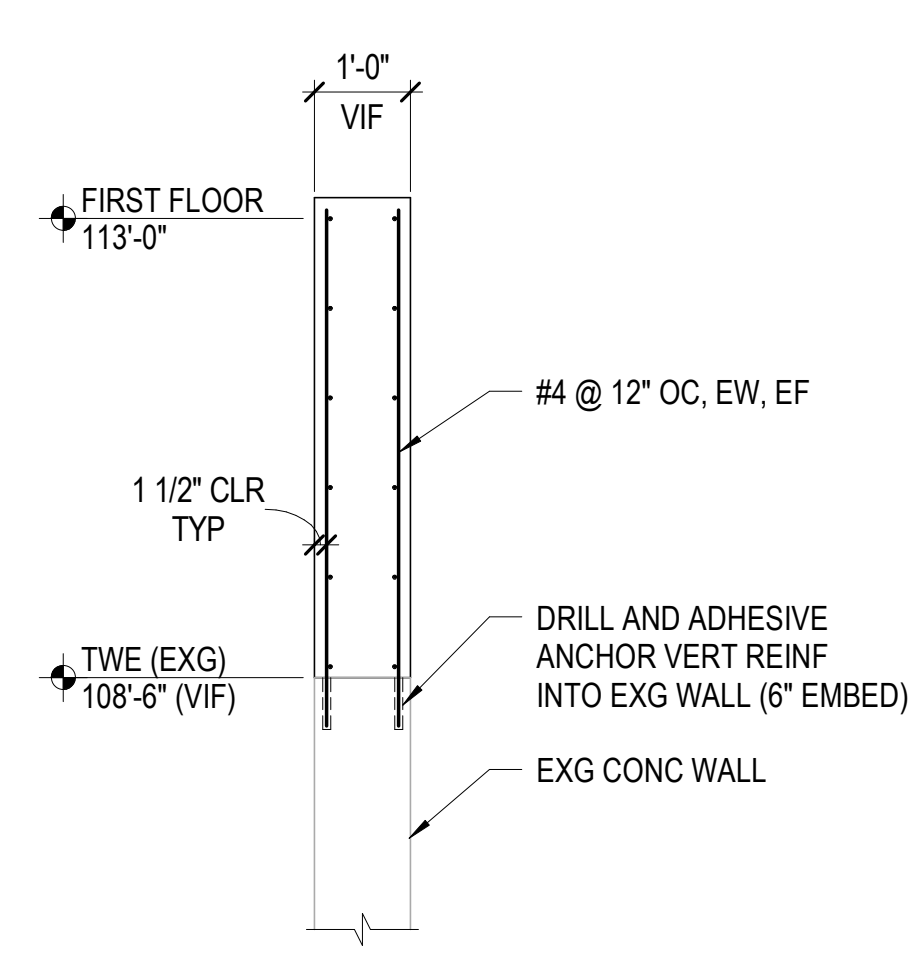


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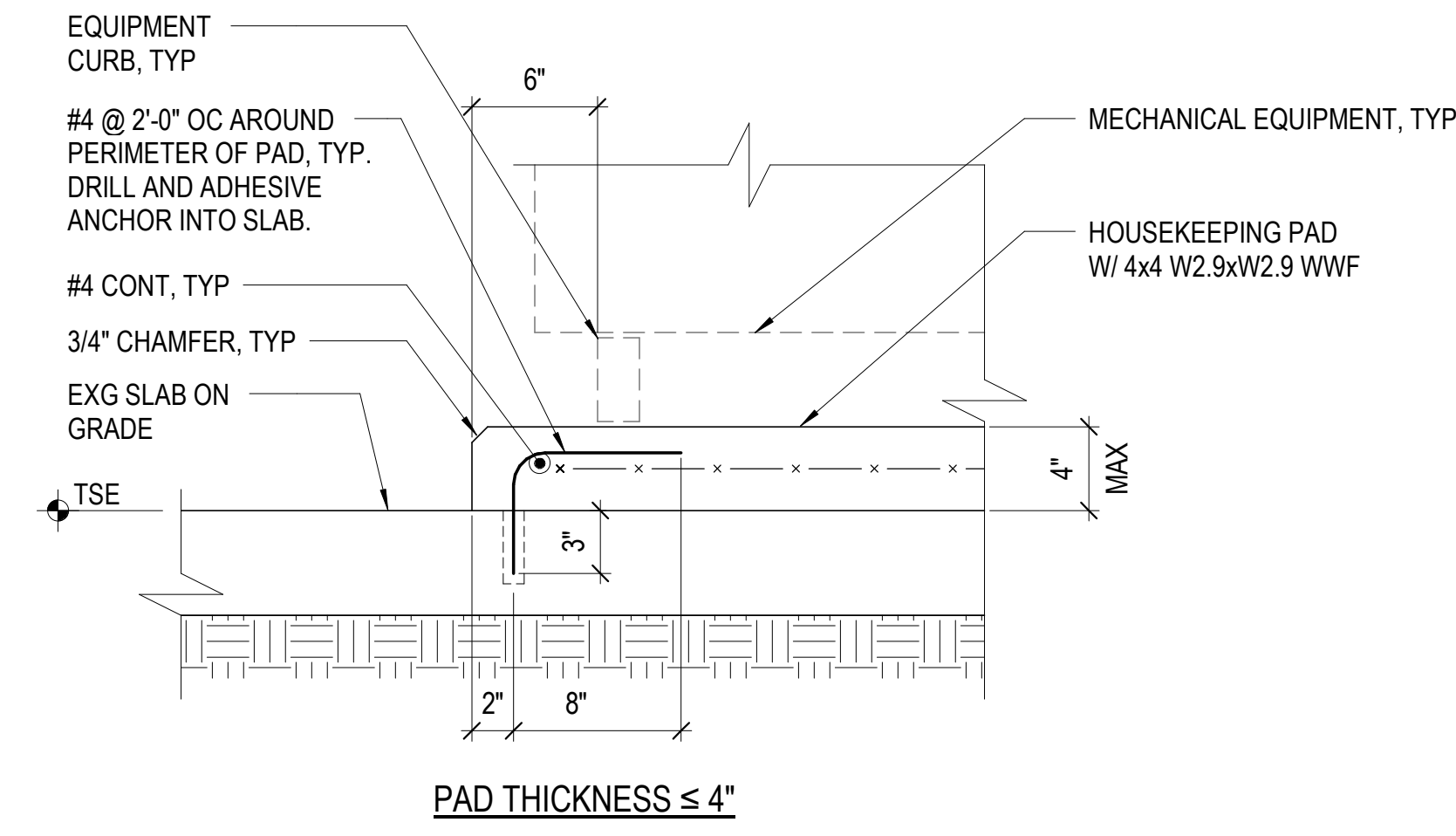
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MECHANICAL:

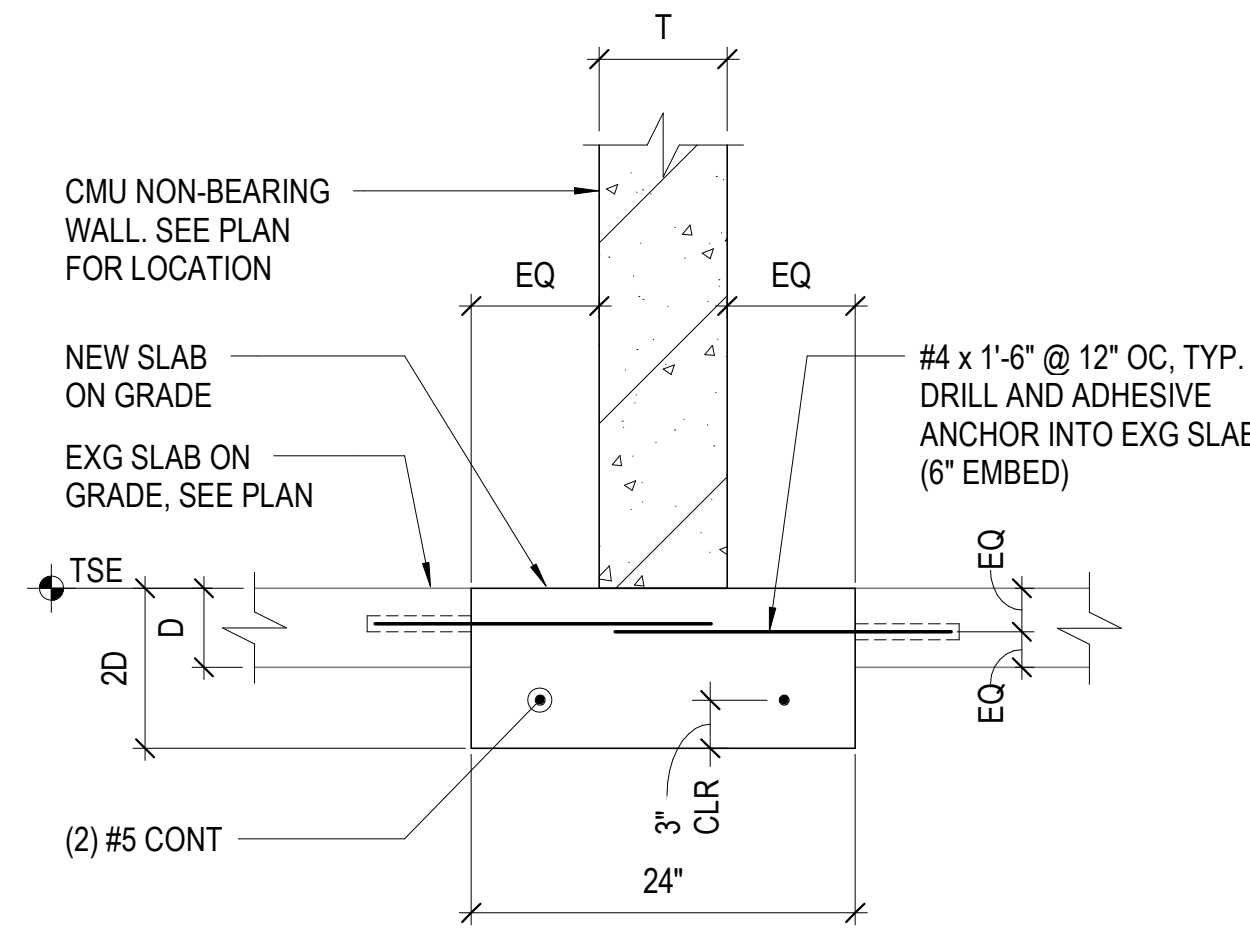
G000



1 SECTION  
1/2" = 1'-0"



2 SECTION AT EQUIPMENT HOUSEKEEPING PADS  
1 1/2" = 1'-0"



3 SECTION AT CMU FOUNDATION  
1" = 1'-0"

**STRUCTURAL GENERAL NOTES:**

**DESIGN LOADS**

PER 2015 INTERNATIONAL BUILDING CODE WITH WISCONSIN AMENDMENTS

RISK CATEGORY .....II  
NATURE OF OCCUPANCY .....OFFICE BUILDING  
ULTIMATE DESIGN WIND SPEED (3 SECOND GUST), VuIt.....115 MPH  
WIND EXPOSURE CATEGORY.....B

**MATERIALS**

CAST-IN-PLACE CONCRETE: Fc=4000 PSI AT 28 DAYS  
STEEL REINFORCING BARS: ASTM A615 (GRADE 60)

**CAST-IN-PLACE CONCRETE:**

- 1. CODE FOR REINFORCED CONCRETE DESIGN AND CONSTRUCTION - ACI 318, AS REFERENCED BY THE BUILDING CODE.
- 2. ARRANGEMENT AND BENDING OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH ACI DETAILING MANUAL, LATEST EDITION.
- 3. REINFORCING STEEL SHALL BE NEW DEFORMED BARS.
- 4. DETAIL AND PROVIDE SUITABLE WIRE SPACERS, CHAIRS, TIES, ETC., FOR SUPPORTING REINFORCING STEEL IN THE PROPER POSITION WHILE PLACING CONCRETE.
- 5. CALCIUM CHLORIDE IS NOT PERMITTED AS A CONCRETE ADDITIVE.
- 6. (CONC FIN-20) SMOOTH-FORMED FINISH: AS-CAST CONCRETE TEXTURE IMPARTED BY FORM-FACING MATERIAL, ARRANGED IN AN ORDERLY AND SYMMETRICAL MANNER WITH A MINIMUM OF SEAMS. REMOVE FINS AND OTHER PROJECTIONS EXCEEDING 1/8 INCH AMPLITUDE. REPAIR AND PATCH TIE HOLES AND DEFECTIVE AREAS.
  - a. ACI 301 SURFACE FINISH SF-3.0:
    - a. PATCH VOIDS LARGER THAN 3/4 INCH WIDE OR 1/2 INCH DEEP.
    - b. REMOVE PROJECTIONS LARGER THAN 1/8 INCH.
    - c. PATCH TIE HOLES.
    - d. SURFACE TOLERANCE: ACI 117 CLASS A.
  - 2. APPLY TO CONCRETE SURFACES EXPOSED TO PUBLIC VIEW OR TO BE COVERED WITH A COATING OR COVERING MATERIAL APPLIED DIRECTLY TO CONCRETE, SUCH AS WATERPROOFING, DAMPPROOFING, VENEER PLASTER, OR PAINTING.

△ NO DESCRIPTION DATE

Empty table grid for revision history.

ISSUANCE HISTORY - THIS SHEET

HGA NO: 2407-004-00

STRUCTURAL  
DETAILS

DATE: January 18, 2022

BID DOCUMENTS

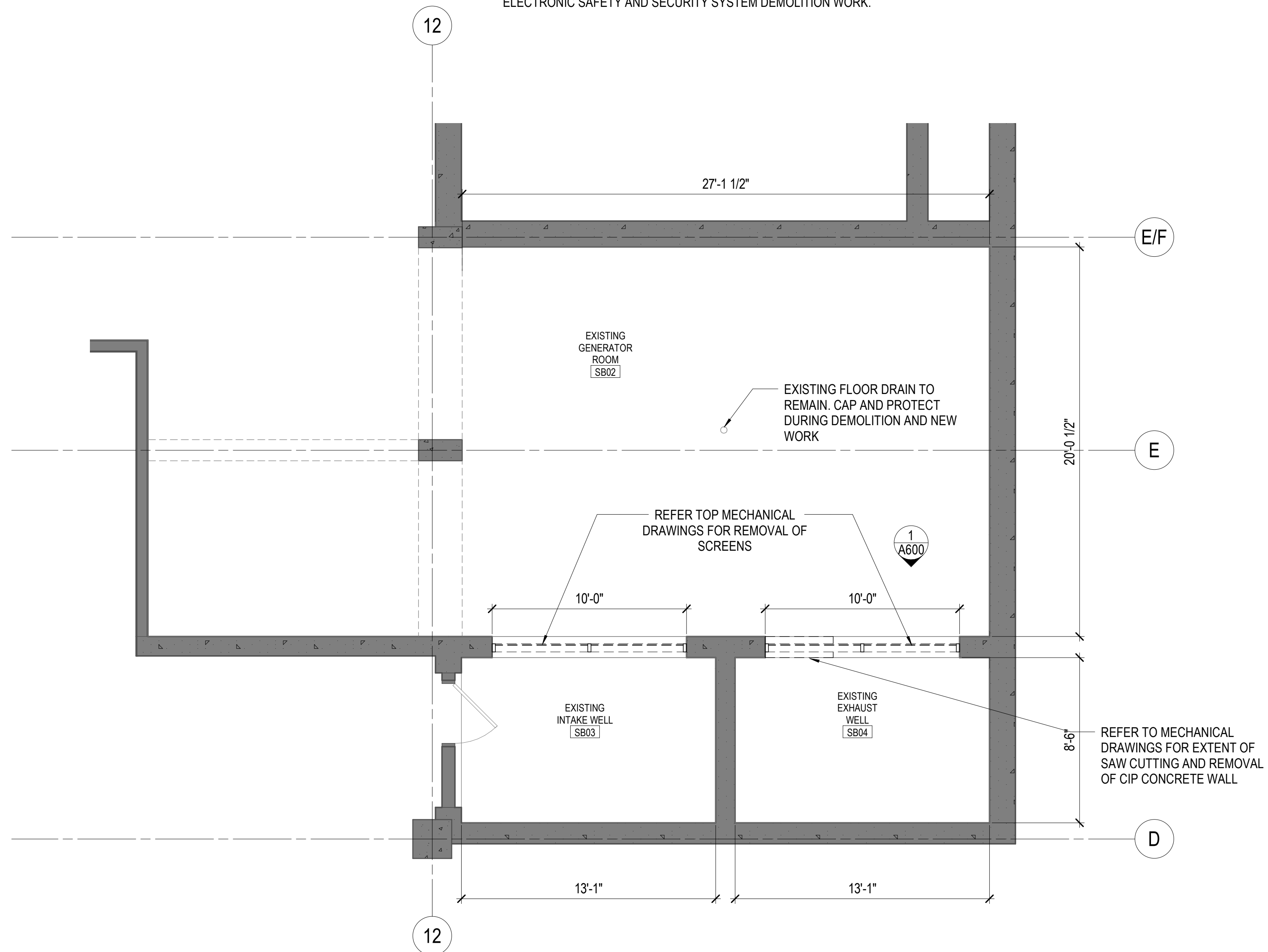
S000

**GENERAL NOTES - DEMOLITION**

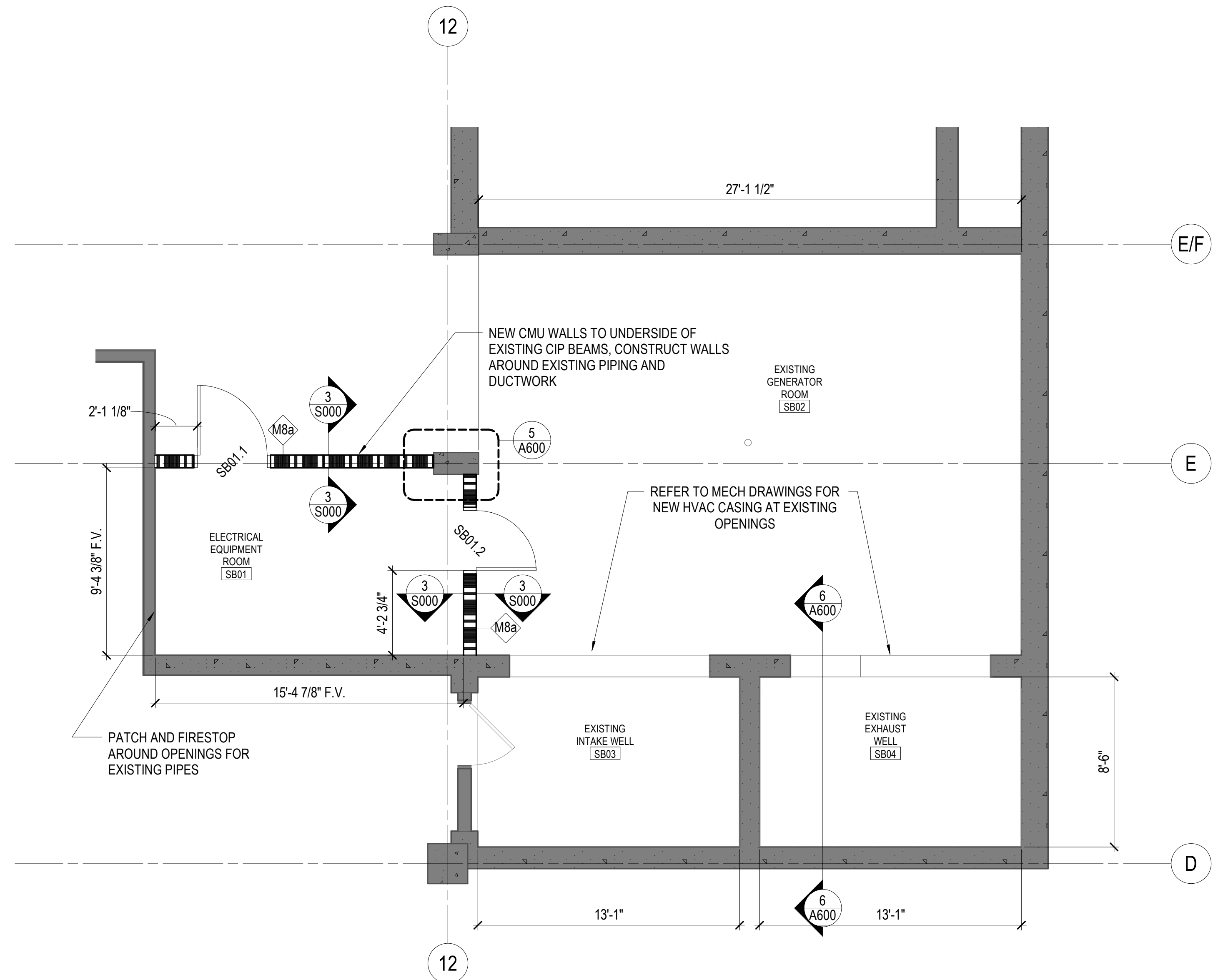
- A. COORDINATE EXTENT OF DEMOLITION WITH REQUIREMENTS FOR NEW WORK.
- B. EXISTING ITEMS TO BE SALVAGED FOR REUSE IN NEW WORK:
  - a. EXISTING UNALTERED GALVANIZED BAR GRATING
- C. MAINTAIN EGRESS FROM EXISTING OCCUPIED SPACES AND SURROUNDING BUILDING AREAS AS REQUIRED BY AUTHORITIES HAVING JURISDICTION.
- D. PROVIDE AND MAINTAIN FIRE EXTINGUISHERS IN AREA OF WORK, IN ACCORDANCE WITH REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION.
- E. PROVIDE TEMPORARY BARRIERS AND ENCLOSURES AS REQUIRED TO PROTECT MATERIALS AND PEOPLE. PREVENT DUST, FUMES, AND ODORS FROM ENTERING OCCUPIED AREAS. MAINTAIN AND RELOCATE TEMPORARY BARRIERS AND ENCLOSURES AS REQUIRED BY THE PROGRESS OF THE WORK. REMOVE TEMPORARY BARRIERS AND ENCLOSURES AT COMPLETION OF WORK.
- F. REFER TO DISCIPLINE-SPECIFIC DRAWINGS FOR RELATED FIRE SUPPRESSION, PLUMBING, HEATING VENTILATION AND AIR CONDITIONING, ELECTRICAL, COMMUNICATIONS, AND ELECTRONIC SAFETY AND SECURITY SYSTEM DEMOLITION WORK.

**GENERAL NOTES - FLOOR PLAN**

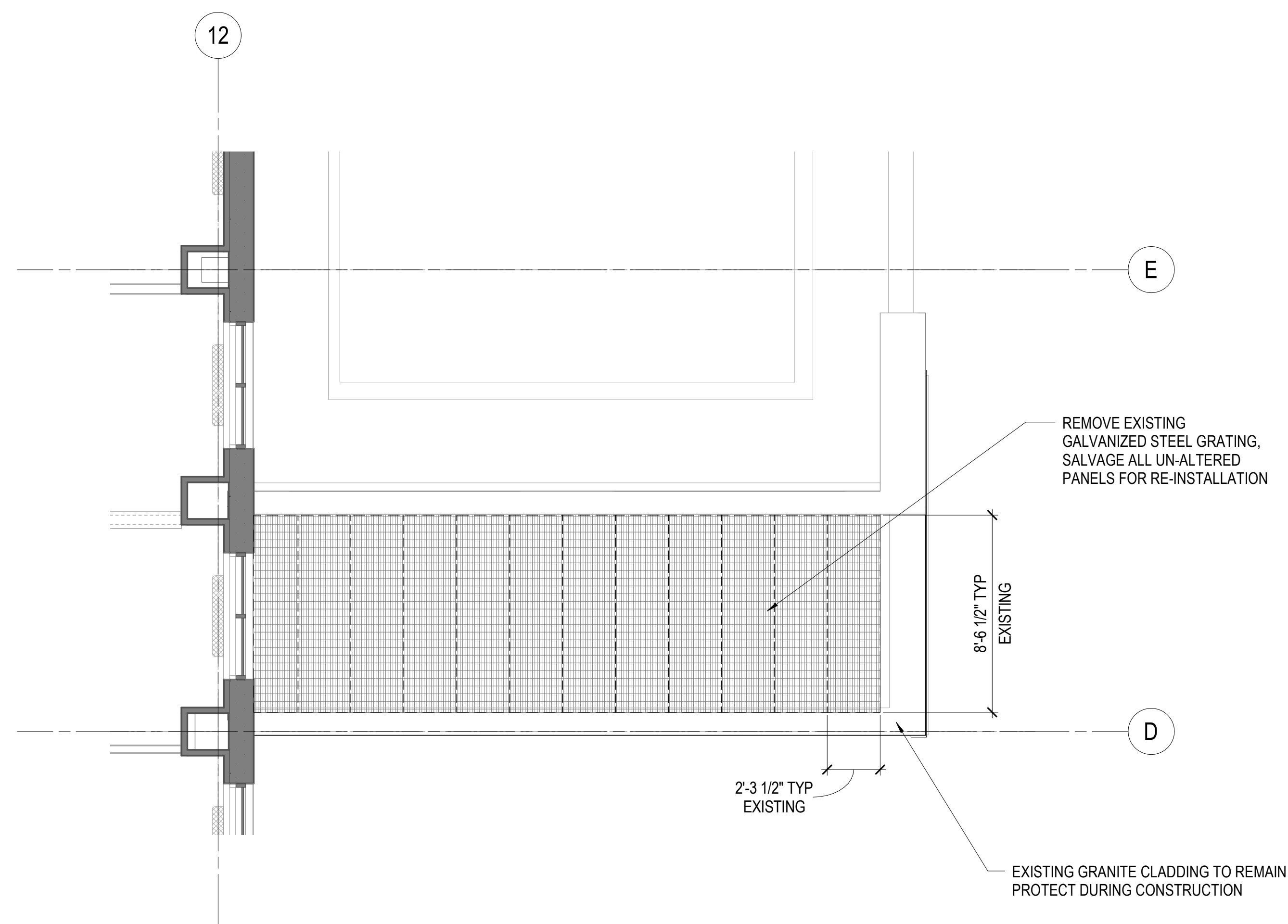
- A. LIFE SAFETY AND CODE REVIEWS ARE LIMITED TO WORK AREAS AND DO NOT INCLUDE FULL FLOORS OR ADJACENT AREAS OUTSIDE OF SCOPE.
- B. ALL EXISTING STRUCTURE TO REMAIN EXCEPT AS NOTED FOR NEW OPENINGS.
- C. INSTALL WORK STRAIGHT, PLUMB, LEVEL, SQUARE, AND TRUE, IN PROPER ALIGNMENT.
- D. CLOSE AND PATCH HOLES AND OPENINGS IN EXISTING FLOOR, WALL AND CEILING WHICH EXIST OR RESULT FROM DEMOLITION OR ALTERATION WORK TO MATCH ADJACENT UNDISTURBED SURFACES.
- E. PROVIDE FIRESTOPPING OF PENETRATIONS AND VOIDS THROUGH FIRE-RATED WALL, FLOOR AND PARTITION ASSEMBLIES (AND ROOF) INCLUDING EMPTY OPENINGS AND OPENINGS CONTAINING CABLES, PIPES, DUCTS, CONDUIT AND OTHER ELEMENTS.



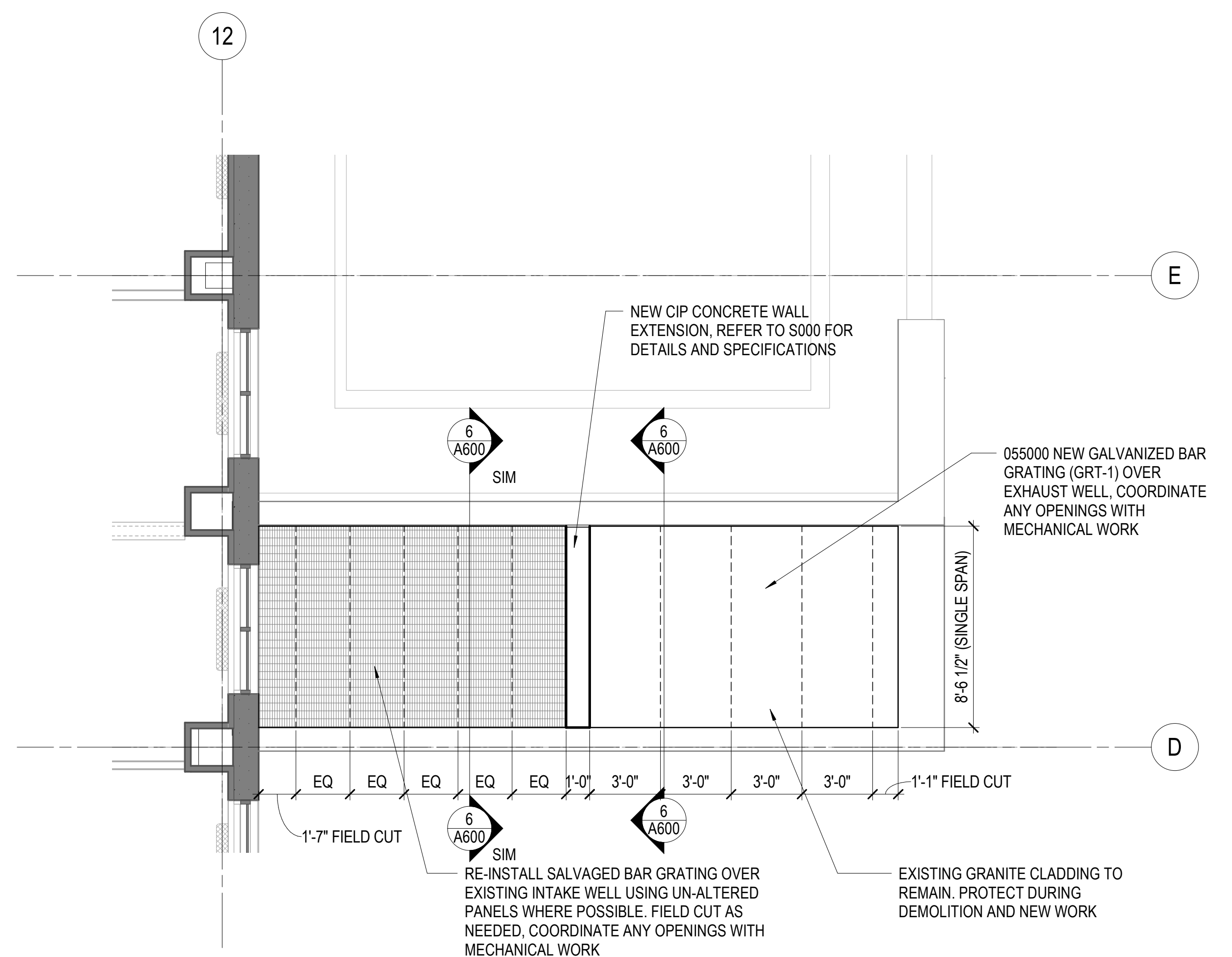
4 ENLARGED PLAN - SUB-BASEMENT - GENERATOR ROOM - DEMOLITION  
1/4\"/>



2 ENLARGED PLAN - SUB-BASEMENT - GENERATOR ROOM - NEW  
1/4\"/>



3 ENLARGED PLAN - FIRST FLOOR - EXHAUST WELLS - DEMOLITION  
1/4\"/>



1 ENLARGED PLAN - FIRST FLOOR - EXHAUST WELLS - NEW  
1/4\"/>



NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET

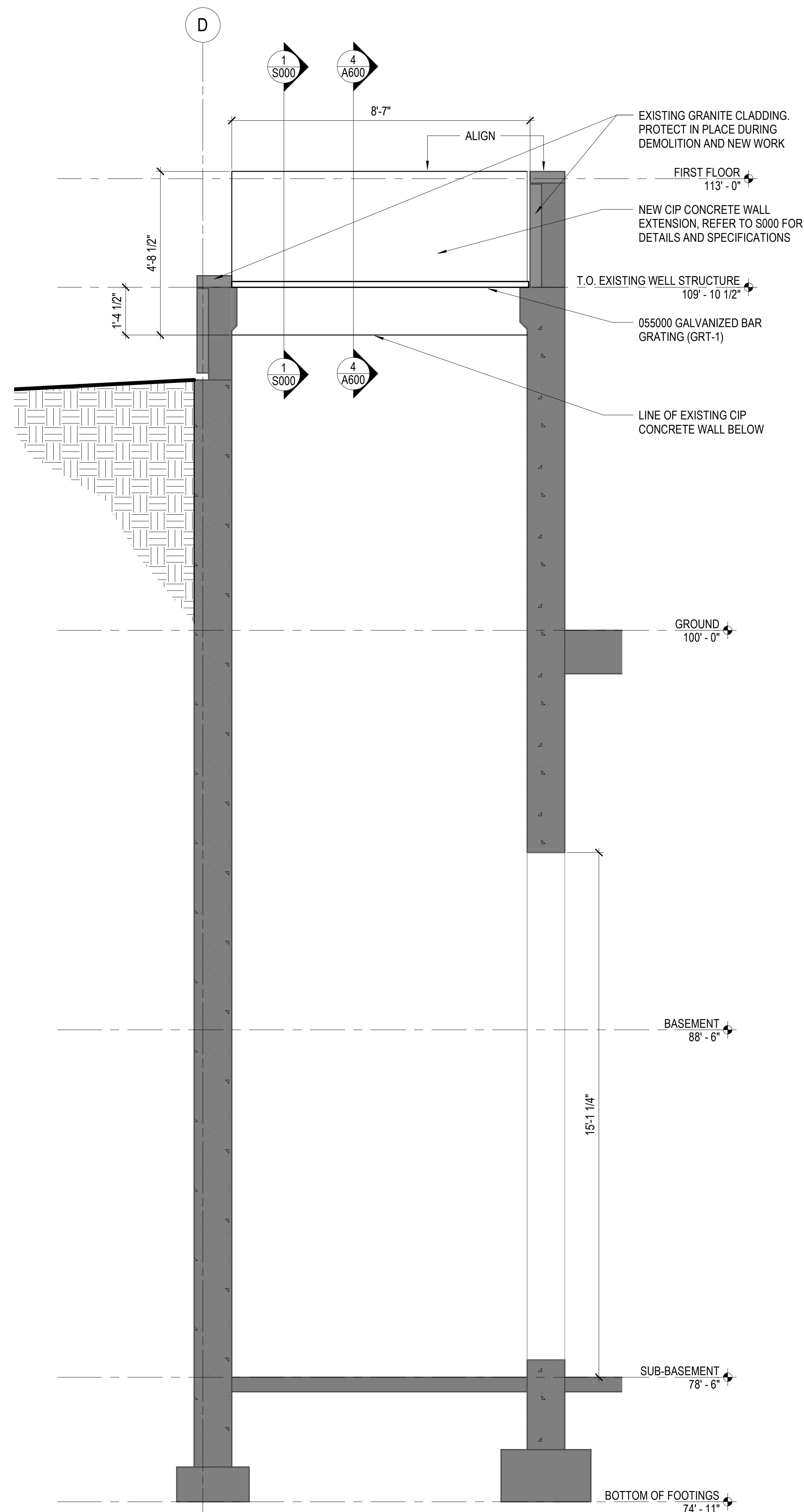
HGA NO: 2407-004-00

**ENLARGED  
PLANS**

DATE: January 18, 2022

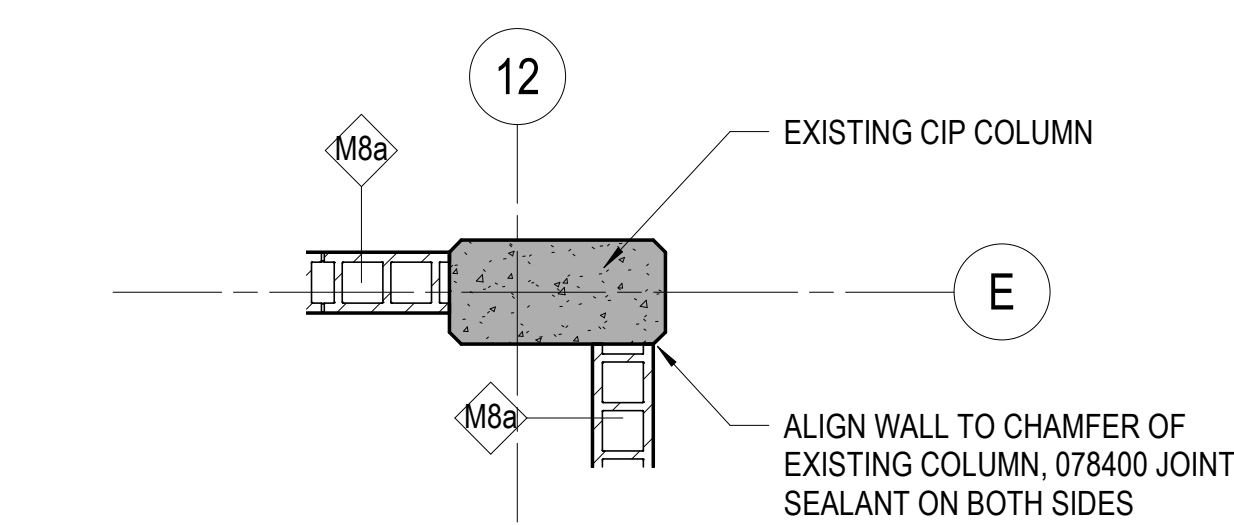
**BID DOCUMENTS**

**A200**

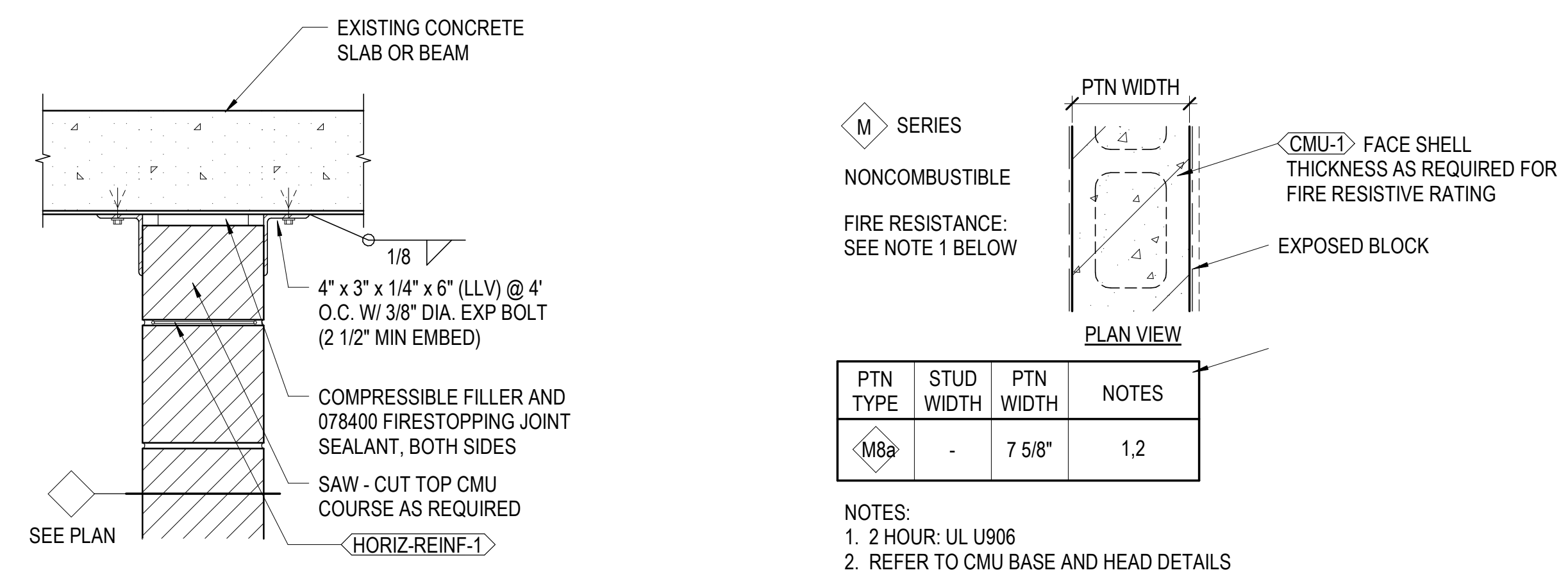


6 SECTION THROUGH EXISTING AREA WELL  
1/2" = 1'-0"

DOOR AND FRAME SCHEDULE											
REV #	DOOR NUMBER	IDENTIFICATION ROOM NAME	COUNT & WIDTH	HEIGHT	PANEL		FRAME			HDW GROUP	NOTES
					TYPE	FINISH	TYPE	FINISH	RATING		
	SB01.1	ELECTRICAL EQUIPMENT ROOM	(1) 3' - 6"	6' - 8"	HM-F	HM-1	HM-002	PT	90 MIN	1	PANIC HARDWARE AND CLOSER ON INTERIOR
	SB01.2	ELECTRICAL EQUIPMENT ROOM	(1) 3' - 0"	7' - 0"	HM-F	HM-1	HM-002	PT	90 MIN	1	PANIC HARDWARE AND CLOSER ON INTERIOR

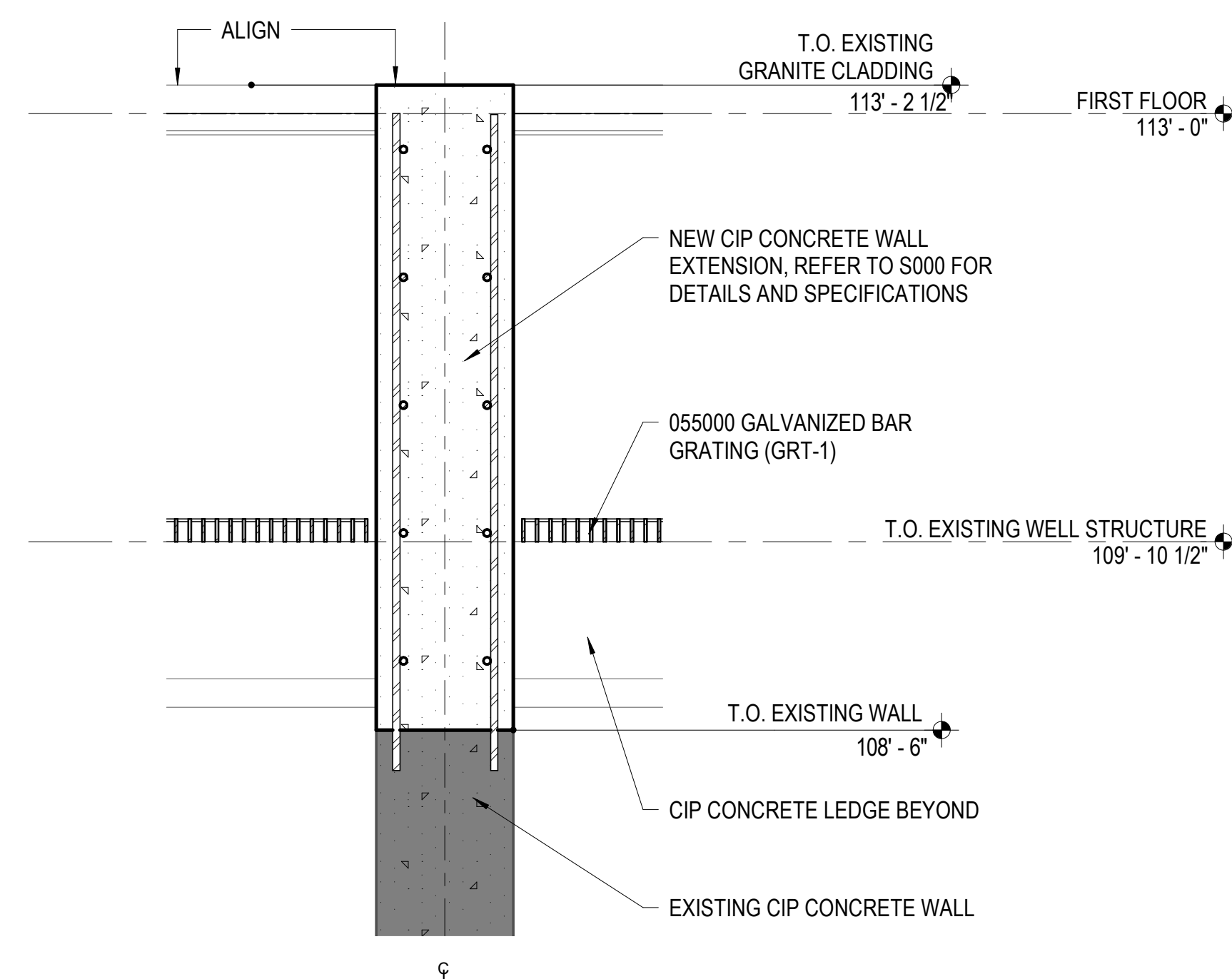


5 PLAN DETAIL - EXISTING COLUMN  
1/2" = 1'-0"

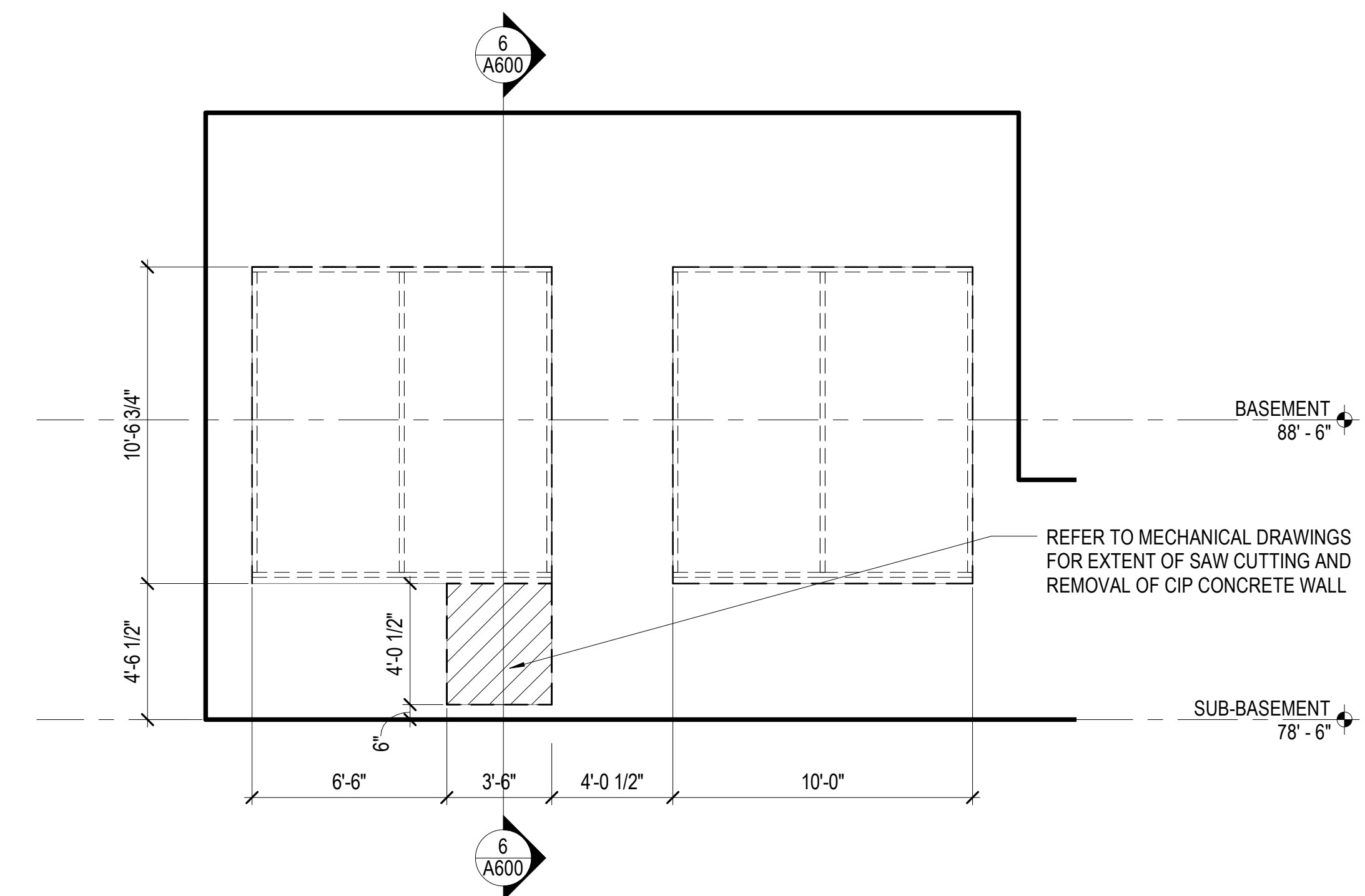


3 CMU HEAD DETAIL  
1 1/2" = 1'-0"

2 WALL TYPE LEGEND  
1 1/2" = 1'-0"



4 SECTION THROUGH SEPARATION WALL - CONCRETE  
1" = 1'-0"



1 INTERIOR ELEVATION - EXISTING GENERATOR ROOM - SOUTH - DEMOLITION  
1/4" = 1'-0"

NO	DESCRIPTION	DATE

HGA NO: 2407-004-00

DETAILS

DATE: January 18, 2022

BID DOCUMENTS

A600

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ABBREVIATIONS table with columns A, F, O, P, R, S, T, U, V, W. Includes terms like ADJ, AFF, AFMS, AHU, ALT, AP, APD, ARCH, BAS, BHP, BLDG, BTUH, BWV, CD, CFH, CFM, CIP, CLG, CO, CO2, COMB, CONC, COND, CONN, CONT, CONTR, CORR, DBC, DDC, DEG, DET, DI, DIFF, DMPR, DN, DP, DWG(S), EA, EAT, ECM, EFT, ELEC, EMER, ESP, EWT, EXG, EXH, EXT.

GENERAL SHEET ANNOTATIONS table. Includes symbols for quantity, type, neck or connection size, air volume, VAV, VAV unit number, AHU number, equipment tag, equipment type, section number, sheet location, callout number, callout symbol, 3D view number, 3D view isometric symbol, damper symbols (volume, backdraft, motorized, smoke, fire, smoke/fire), thermal design conditions (outdoor design conditions).

MECHANICAL DUCTWORK SYMBOLS table. Includes symbols for rectangular size, flat oval size, round size, concentric transition, eccentric transition, transition, elbow up/down, square elbow, 1.0 and 1.5 radius elbows, tap-in branch, spin-in conical tap, branch, duct with liner, duct with lagging, round flexible duct (double and single line).

MECHANICAL PIPING SYMBOLS table. Includes symbols for elbow down/up, tee down/up, connection, flow direction, shut-off valve, balancing valve, automatic flow control valve, valve in vertical pipe, check valve, 2-way/3-way modulating control valve, 2-way/3-way control valve, pressure reducing valve, relief or safety valve, relief or safety valve (plan view), flow measuring device, strainer, expansion joint, flexible connection, pipe anchor, pipe guide, air vent, eccentric/concentric reducer, sensor well, test plug, thermometer, pressure gauge, temperature sensor, pitch pipe down, steam trap, differential static pressure sensor, condensate sensor, thermostat or temp sensor, static pressure sensor, control sensor, pressure sensor, pressure controller and monitor, occupancy sensor.

GENERAL MECHANICAL & PLUMBING SYMBOLS table. Includes symbols for connect to existing, key note, revision triangle, datum, break symbol, round supply air diffuser, ceiling supply air diffuser, ceiling return grille/register, ceiling exhaust air grille/register, linear slot diffuser, sidewall supply air or return air grille/register, return/relief/transfer airflow direction arrow, supply/outside airflow direction arrow, return/relief/exhaust airflow direction arrow, demolish existing duct/pipes/equipment, pump, fan.

MECHANICAL GENERAL NOTES table. Includes notes A and B regarding coordination of piping, ductwork, fire protection, equipment, controls, supports, electrical, cable tray, AV devices, etc.

MECHANICAL DEMOLITION NOTES table. Includes notes 1 through 6 regarding existing conditions, demolition extent, coordination with owner, noise control, and safety.

MECHANICAL PIPING SYSTEMS table. Includes symbols and descriptions for HWS, HWR, THWS, THWR, CHWS, CHWR, CWS, CWR, LPS, LPR, HPS, HPR, RC, CD, MW, PC, SV.

MECHANICAL PIPING SYSTEMS table. Includes symbols and descriptions for HWS, HWR, THWS, THWR, CHWS, CHWR, CWS, CWR, LPS, LPR, HPS, HPR, RC, CD, MW, PC, SV.

MECHANICAL SHEET LIST table with columns SHEET NUMBER, SHEET NAME, and Sheet Order. Lists sheets M001 through M700.

Table with columns NO, DESCRIPTION, DATE. Includes ISSUANCE HISTORY - THIS SHEET.

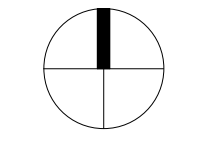
HGA NO: 2407-004-00

MECHANICAL  
GENERAL  
NOTES AND  
SYMBOLS

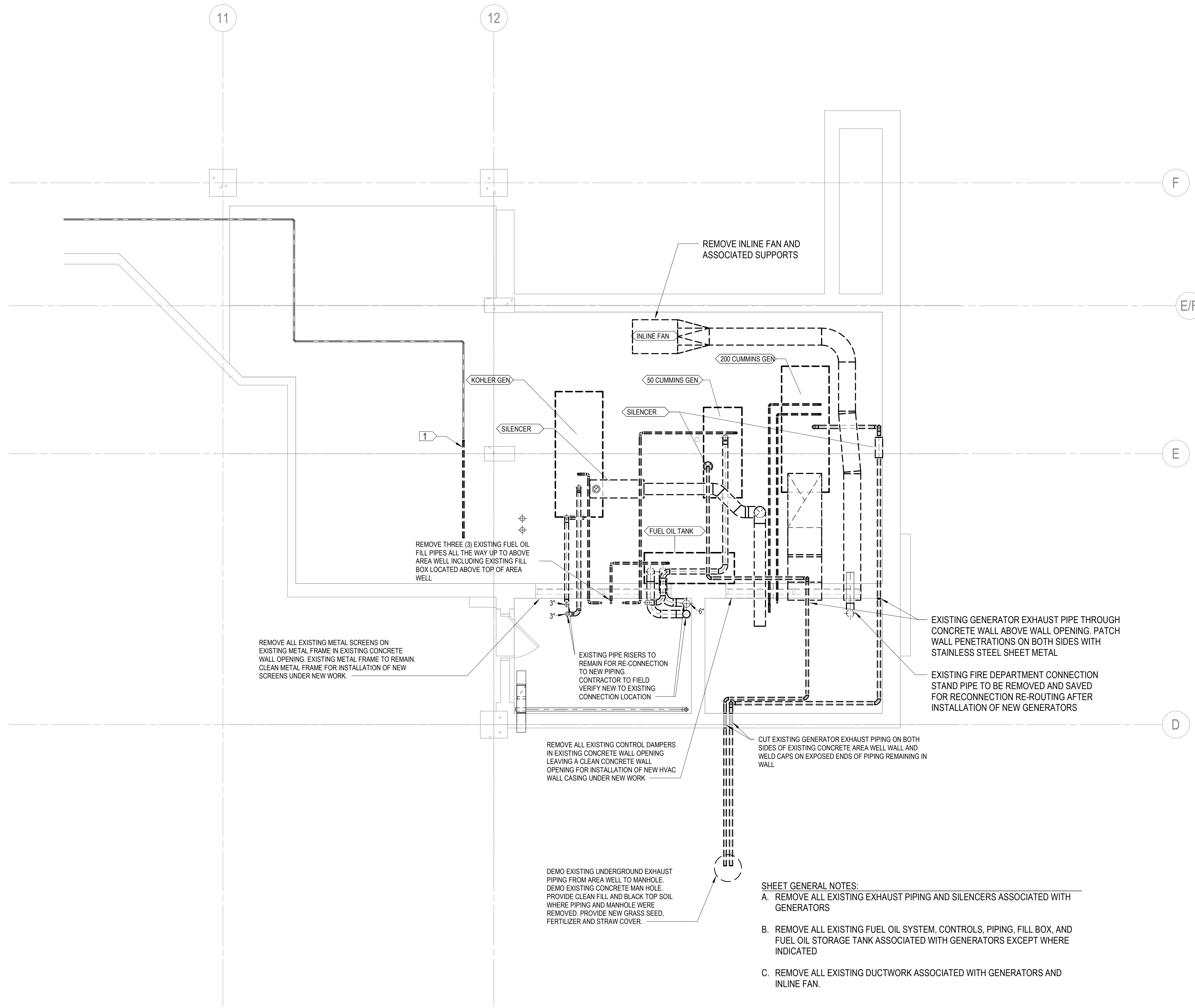
DATE: January 18, 2022

BID DOCUMENTS

M001







- SHEET GENERAL NOTES:**
- A. REMOVE ALL EXISTING EXHAUST PIPING AND SILENCERS ASSOCIATED WITH GENERATORS
  - B. REMOVE ALL EXISTING FUEL OIL SYSTEM, CONTROLS, PIPING, FILL BOX, AND FUEL OIL STORAGE TANK ASSOCIATED WITH GENERATORS EXCEPT WHERE INDICATED
  - C. REMOVE ALL EXISTING DUCTWORK ASSOCIATED WITH GENERATORS AND INLINE FAN.
- KEY NOTES:**
- 1. EXISTING SPRINKLER SYSTEM TO BE CUT BACK OUTSIDE OF NEW ELECTRICAL ROOM AND RE-ROUTED INTO GENERATOR ROOM WITH NEW SPRINKLER HEADS AND HEAT TRACE ON NEW PIPING.

1 SUB-BASEMENT DEMO PLAN  
1/4" = 1'-0"

NO	DESCRIPTION	DATE

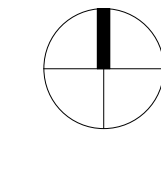
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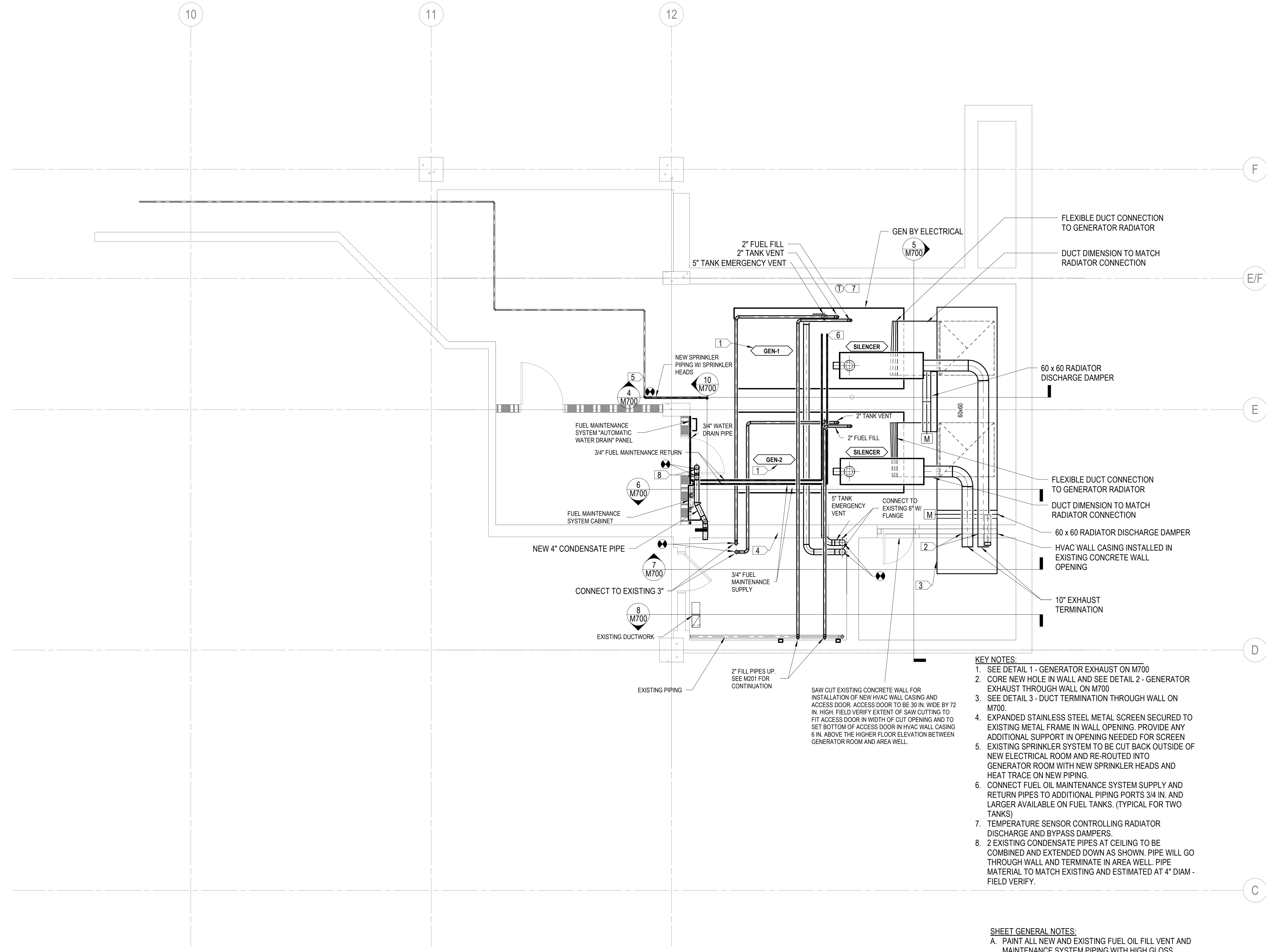
SUB-BASEMENT  
- HVAC DEMO  
PLAN

DATE: January 18, 2022

BID DOCUMENTS

M100





- KEY NOTES:**
- SEE DETAIL 1 - GENERATOR EXHAUST ON M700
  - CORE NEW HOLE IN WALL AND SEE DETAIL 2 - GENERATOR EXHAUST THROUGH WALL ON M700
  - SEE DETAIL 3 - DUCT TERMINATION THROUGH WALL ON M700
  - EXPANDED STAINLESS STEEL METAL SCREEN SECURED TO EXISTING METAL FRAME IN WALL OPENING. PROVIDE ANY ADDITIONAL SUPPORT IN OPENING NEEDED FOR SCREEN
  - EXISTING SPRINKLER SYSTEM TO BE CUT BACK OUTSIDE OF NEW ELECTRICAL ROOM AND RE-ROUTED INTO GENERATOR ROOM WITH NEW SPRINKLER HEADS AND HEAT TRACE ON NEW PIPING.
  - CONNECT FUEL OIL MAINTENANCE SYSTEM SUPPLY AND RETURN PIPES TO ADDITIONAL PIPING PORTS 3/4 IN. AND LARGER AVAILABLE ON FUEL TANKS. (TYPICAL FOR TWO TANKS)
  - TEMPERATURE SENSOR CONTROLLING RADIATOR DISCHARGE AND BYPASS DAMPERS.
  - 2 EXISTING CONDENSATE PIPES AT CEILING TO BE COMBINED AND EXTENDED DOWN AS SHOWN. PIPE WILL GO THROUGH WALL AND TERMINATE IN AREA WELL. PIPE MATERIAL TO MATCH EXISTING AND ESTIMATED AT 4" DIAM - FIELD VERIFY.

**SHEET GENERAL NOTES:**  
 A. PAINT ALL NEW AND EXISTING FUEL OIL FILL VENT AND MAINTENANCE SYSTEM PIPING WITH HIGH GLOSS BLACK PAINT SUITABLE FOR EXTERIOR EXPOSURE

**1 SUB-BASEMENT HVAC PLAN**  
 1/4" = 1'-0"

NO	DESCRIPTION	DATE

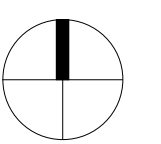
ISSUANCE HISTORY - THIS SHEET  
 HGA NO: 2407-004-00

**SUB-BASEMENT  
 - HVAC PLAN**

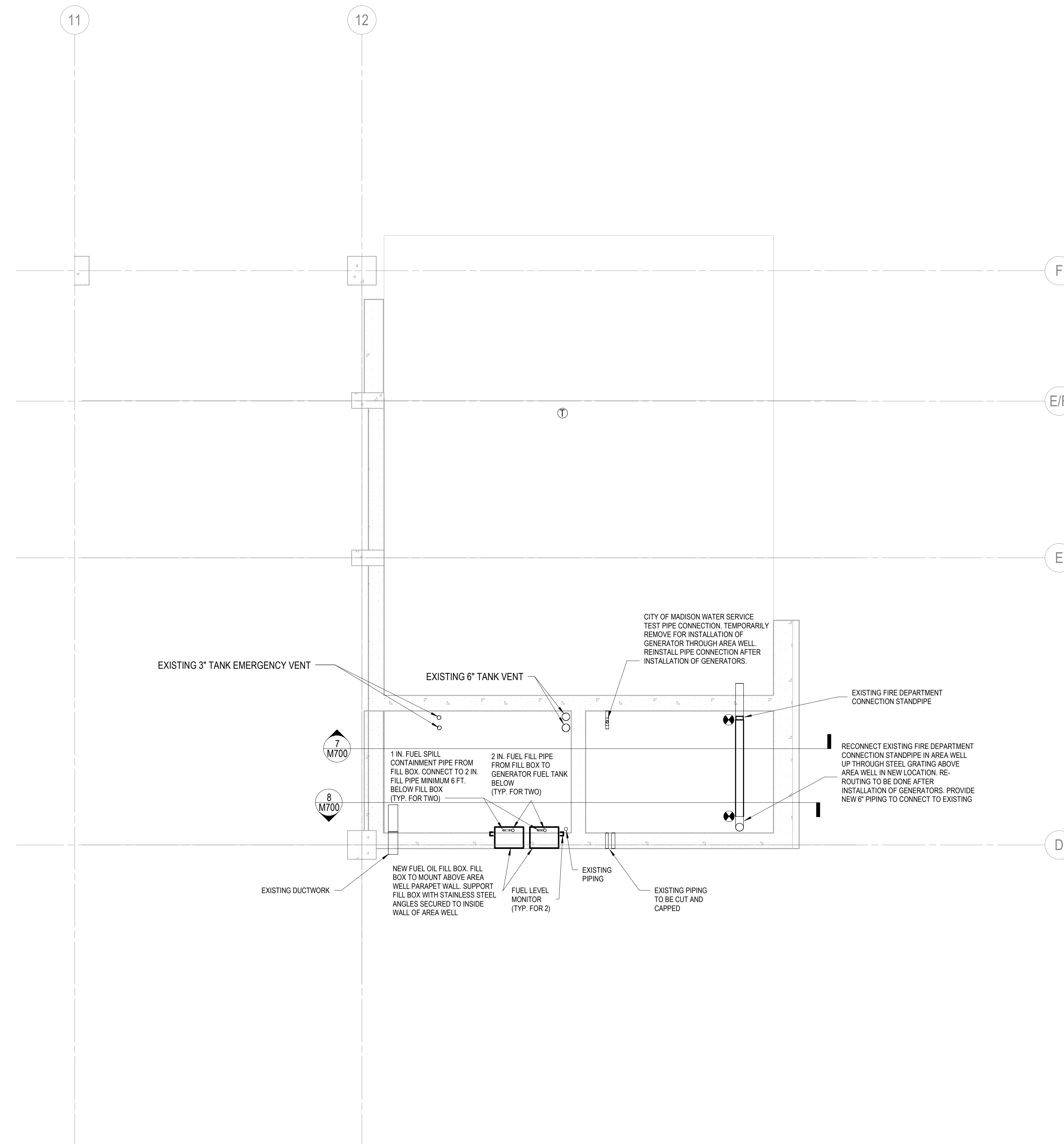
DATE: January 18, 2022

BID DOCUMENTS

**M200**



Author: 1/14/2022 1:22:22 PM  
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1 GRADE - HVAC PLAN  
1/4" = 1'-0"

NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET

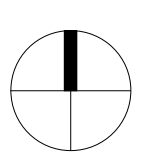
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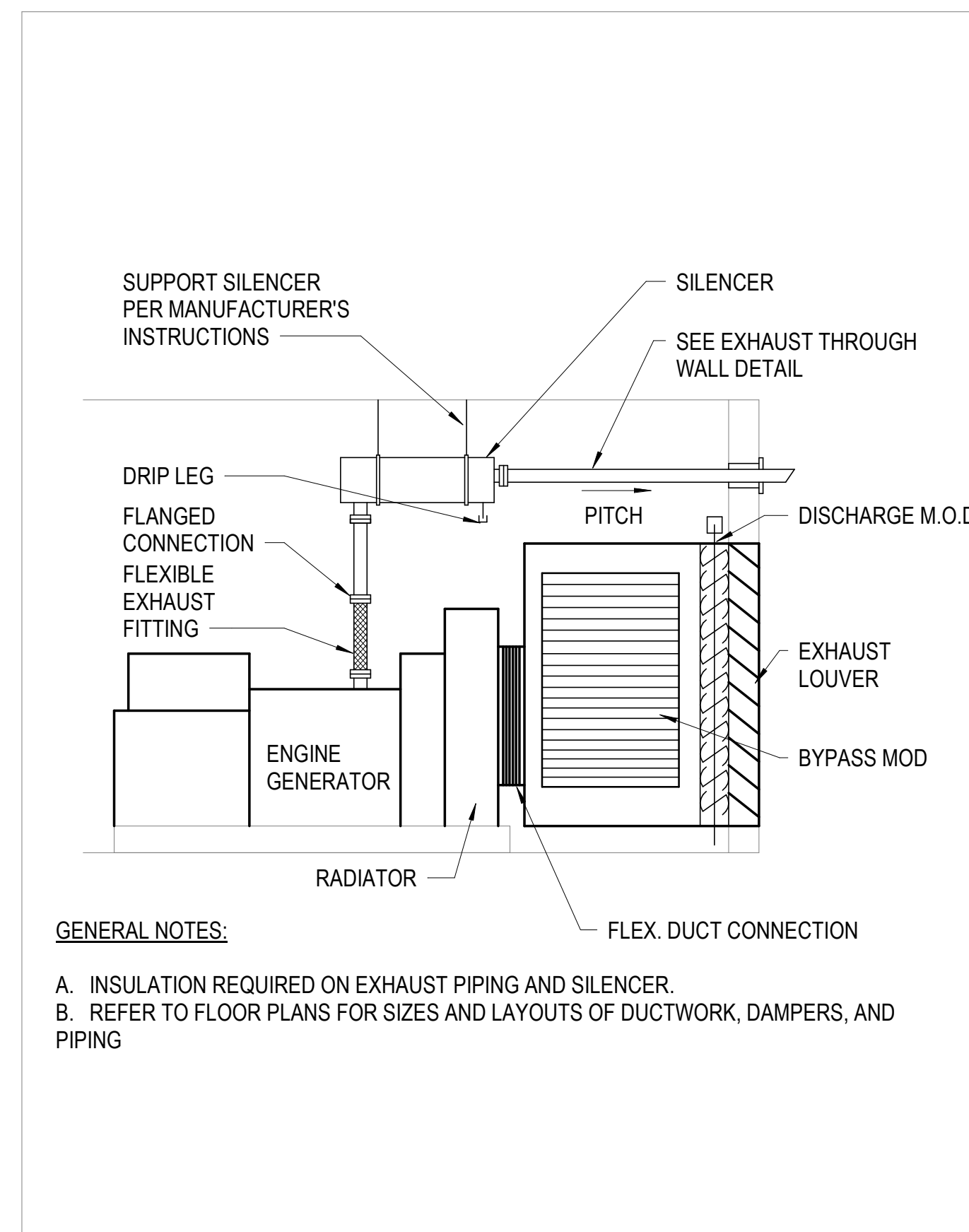
**LEVEL 01 - HVAC PLAN**

DATE: January 18, 2022

BID DOCUMENTS

**M201**

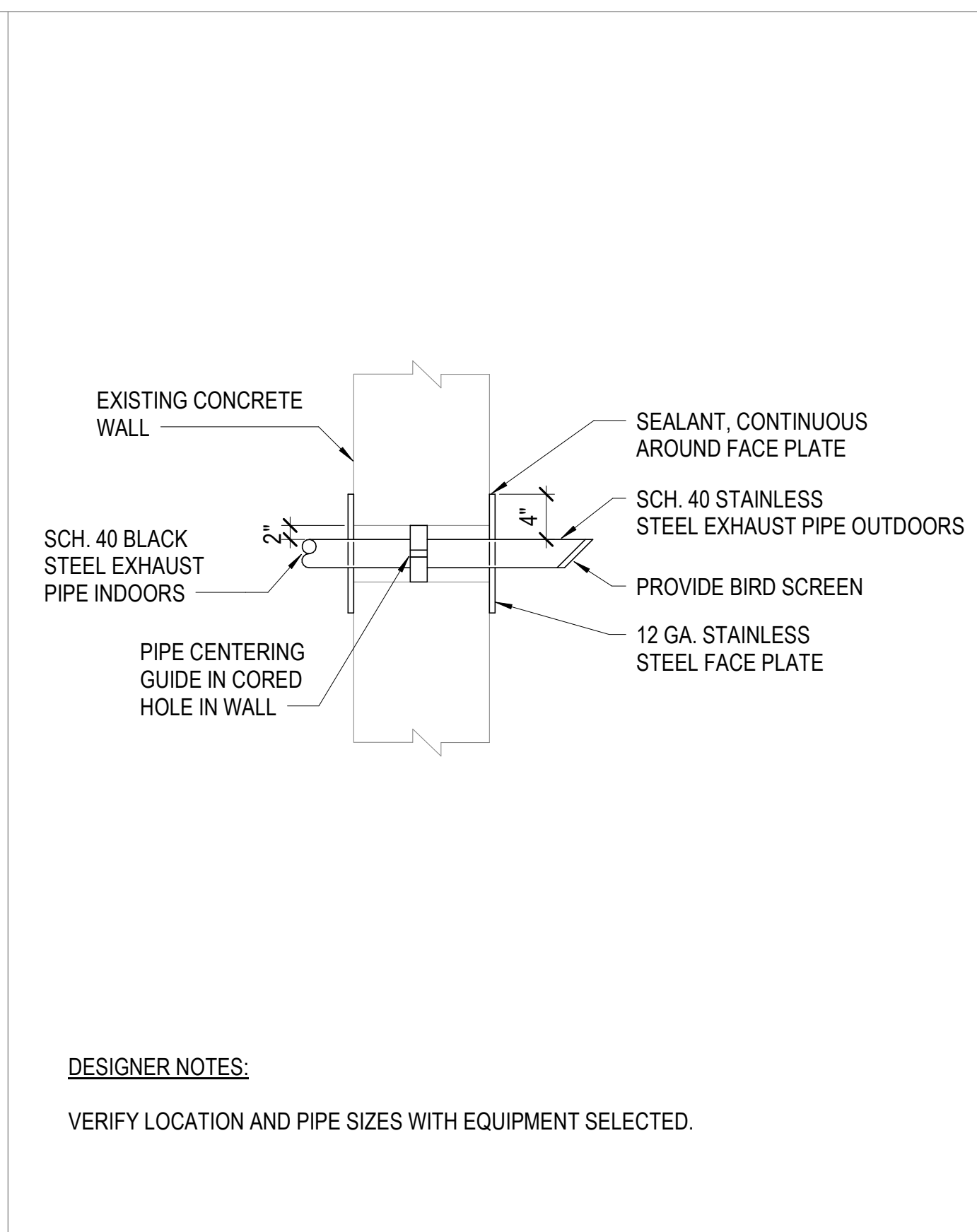




GENERAL NOTES:

- A. INSULATION REQUIRED ON EXHAUST PIPING AND SILENCER.
- B. REFER TO FLOOR PLANS FOR SIZES AND LAYOUTS OF DUCTWORK, DAMPERS, AND PIPING

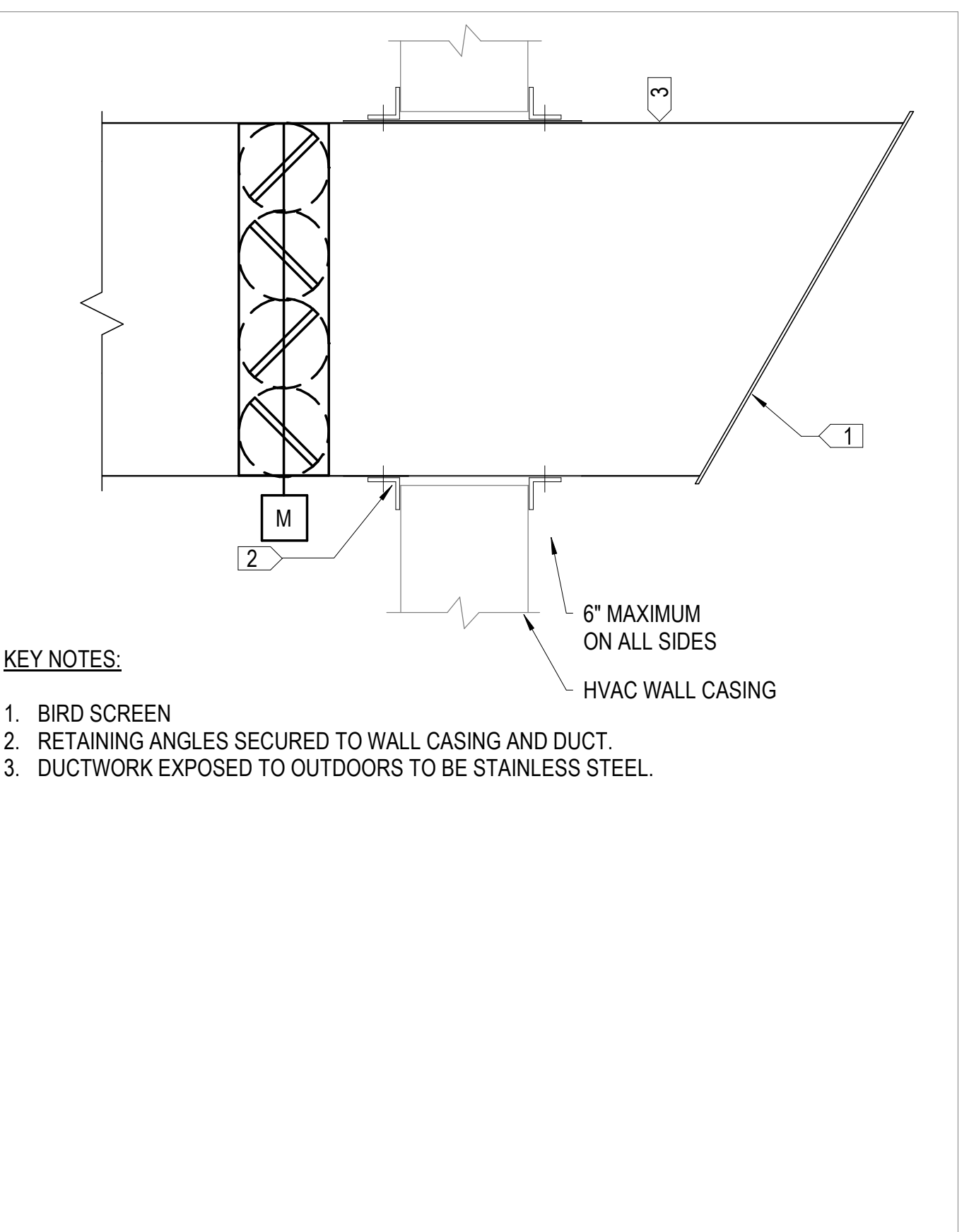
1 GENERATOR EXHAUST  
NOT TO SCALE



DESIGNER NOTES:

VERIFY LOCATION AND PIPE SIZES WITH EQUIPMENT SELECTED.

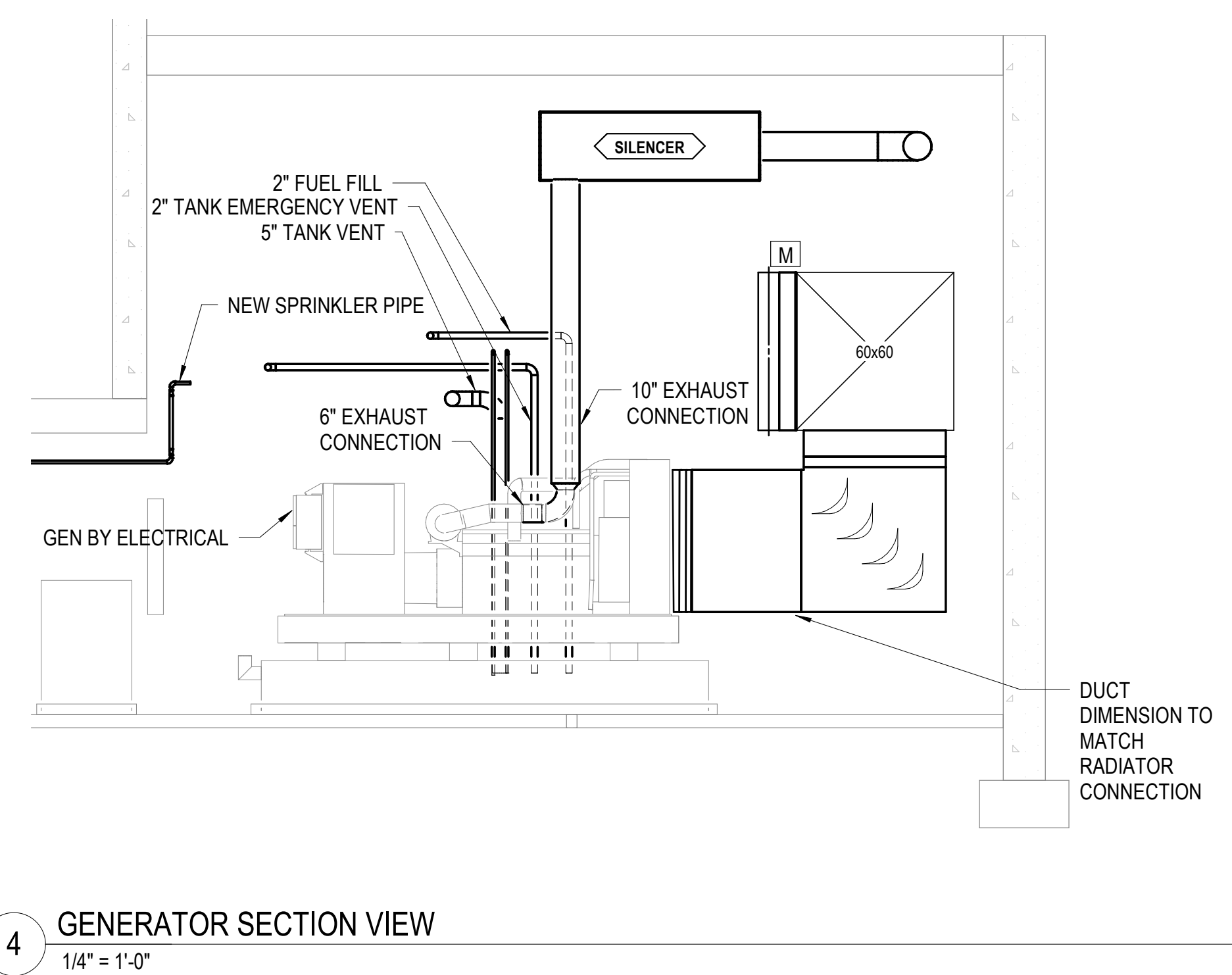
2 GENERATOR EXHAUST THROUGH WALL  
NOT TO SCALE



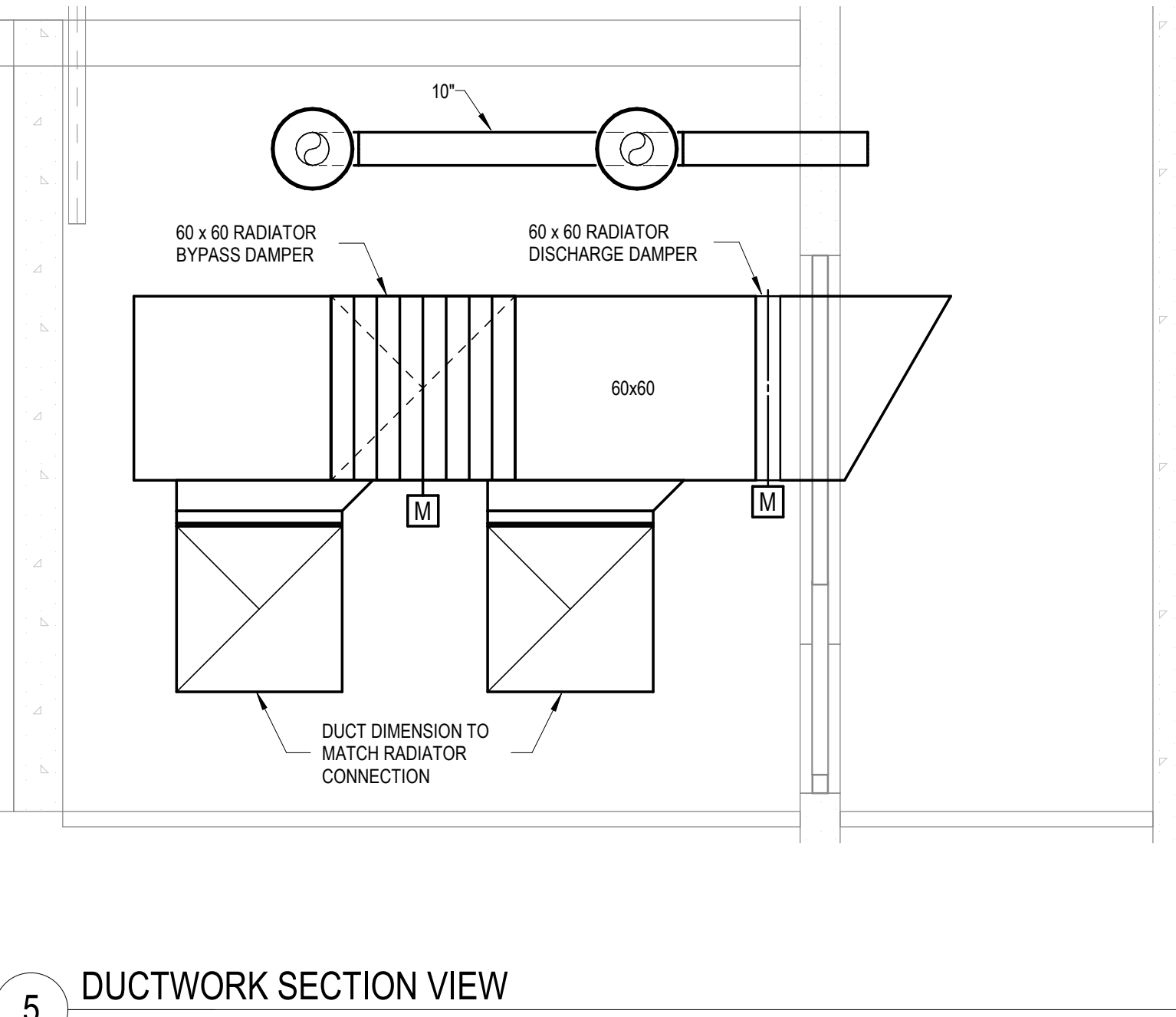
KEY NOTES:

- 1. BIRD SCREEN
- 2. RETAINING ANGLES SECURED TO WALL CASING AND DUCT.
- 3. DUCTWORK EXPOSED TO OUTDOORS TO BE STAINLESS STEEL.

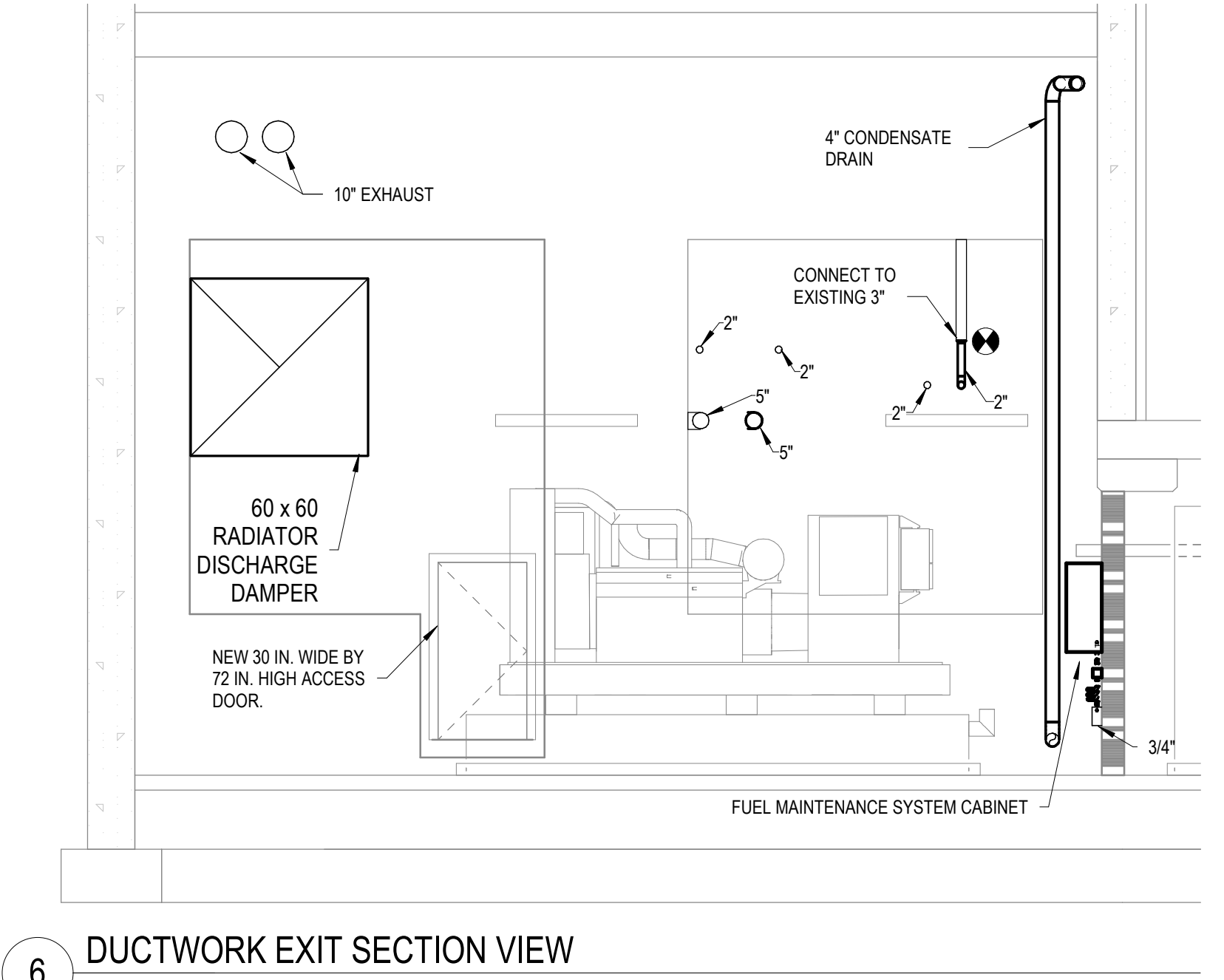
3 DUCT TERMINATION THROUGH WALL  
NOT TO SCALE



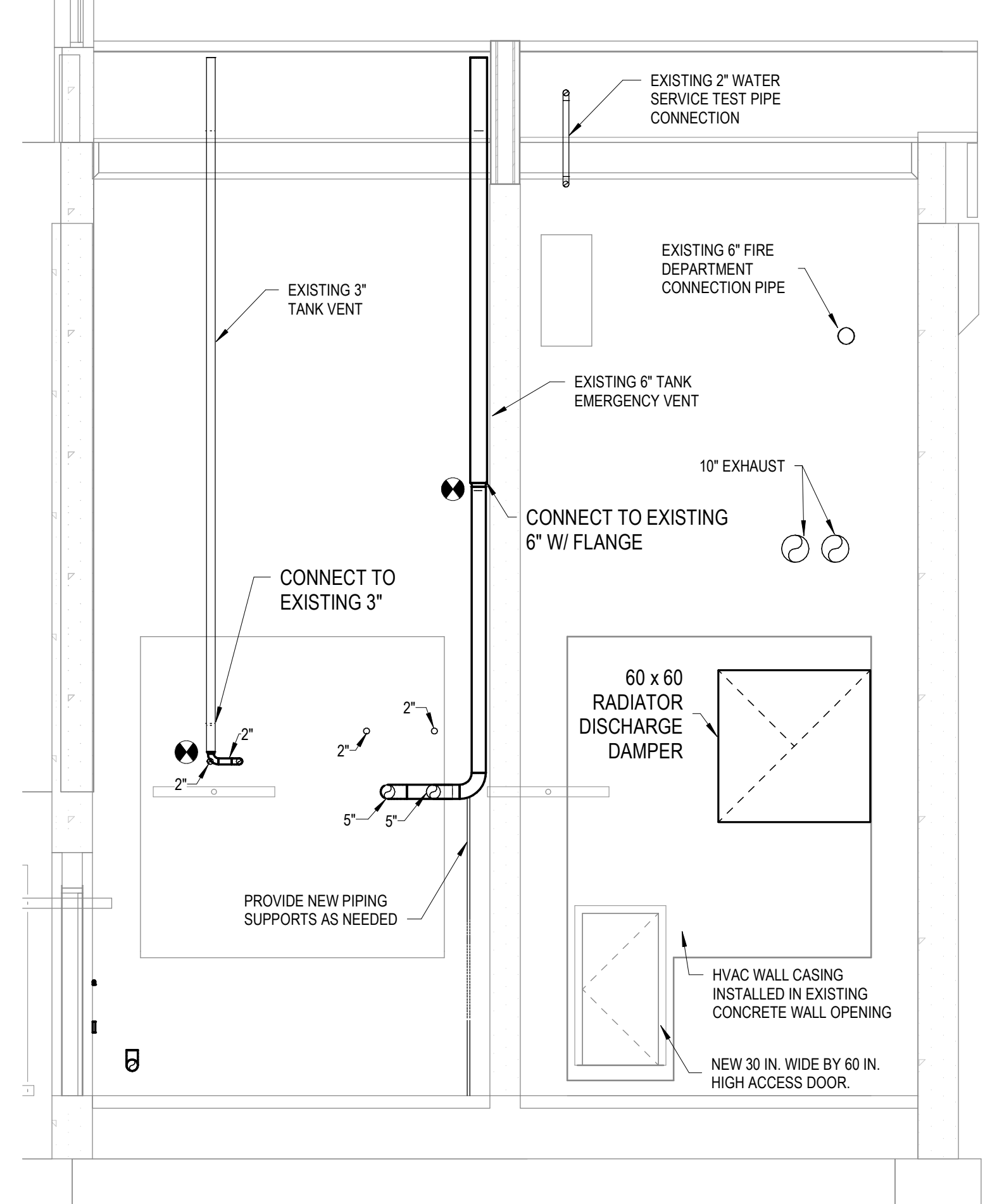
4 GENERATOR SECTION VIEW  
1/4" = 1'-0"



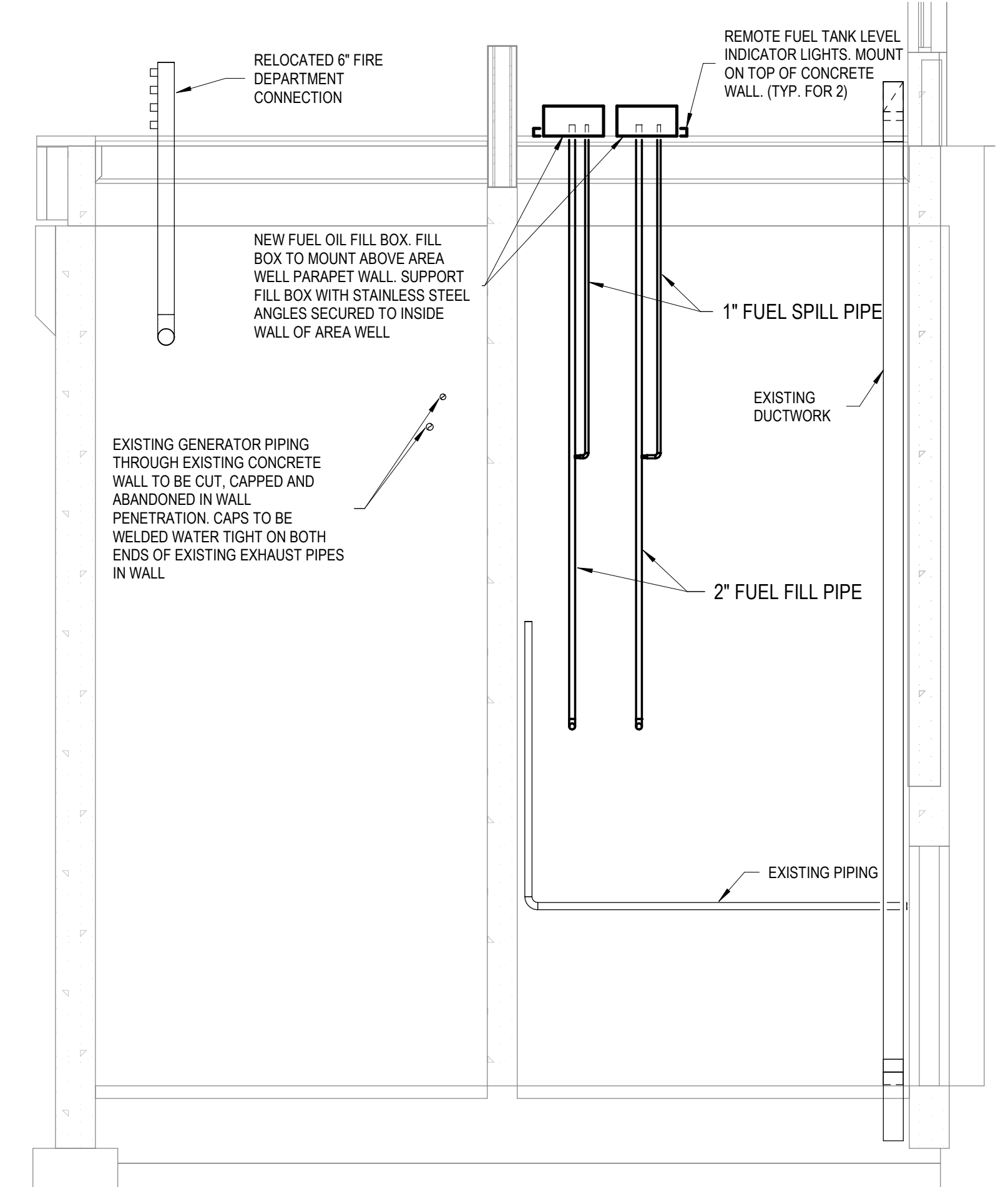
5 DUCTWORK SECTION VIEW  
1/4" = 1'-0"



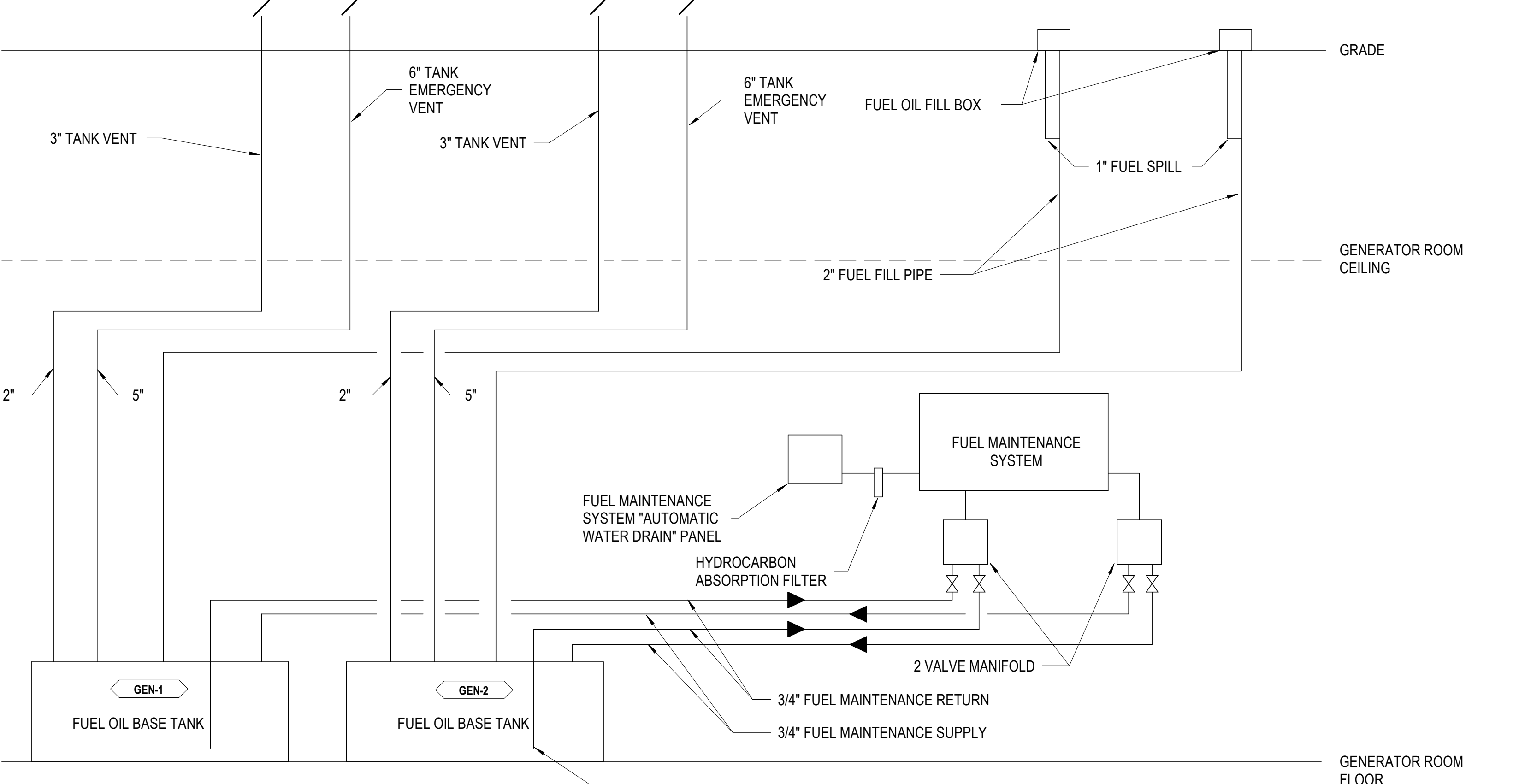
6 DUCTWORK EXIT SECTION VIEW  
1/4" = 1'-0"



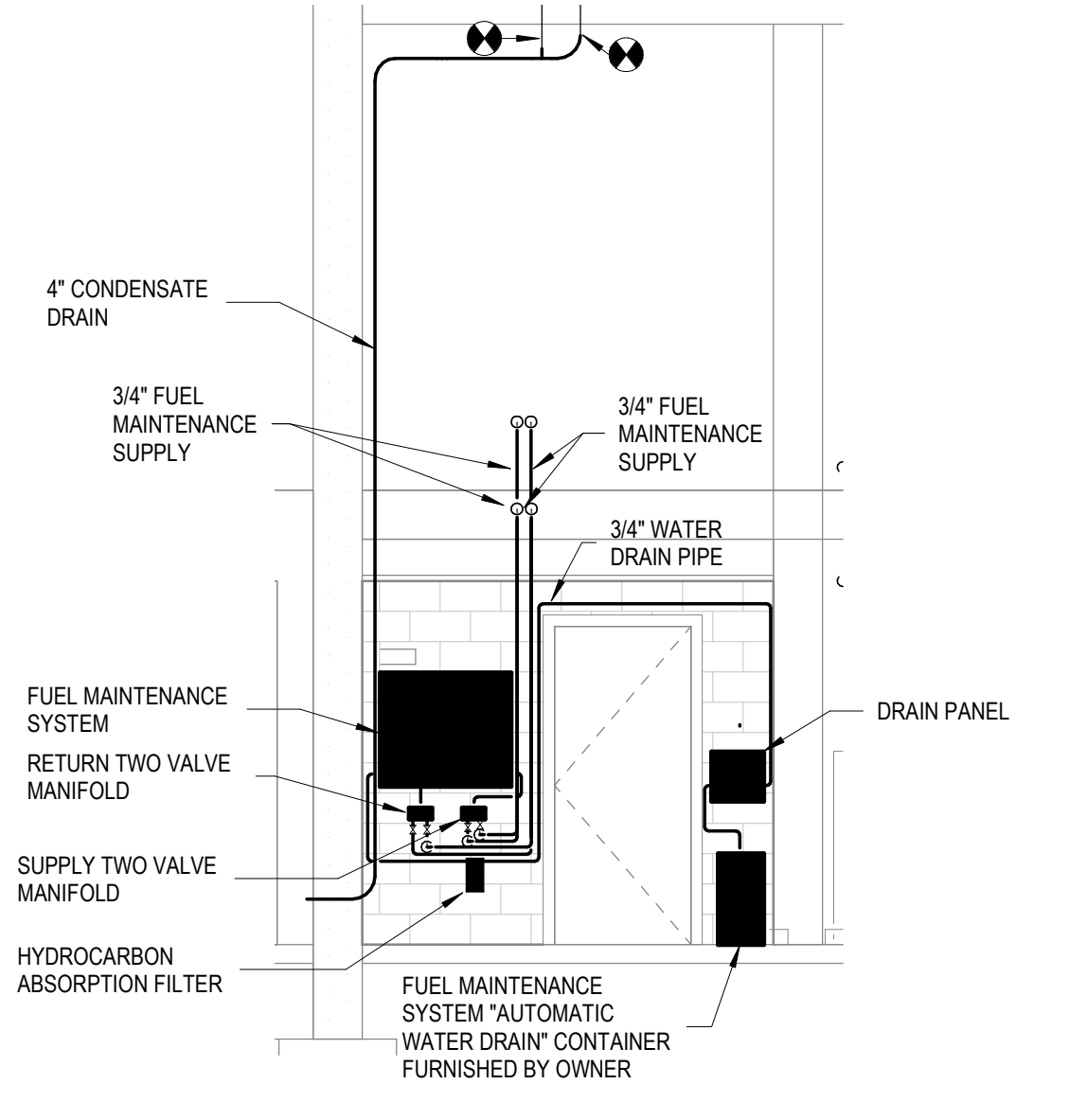
7 AREA WELL NORTH SIDE SECTION VIEW  
1/4" = 1'-0"



8 AREA WELL SOUTH SIDE SECTION VIEW  
1/4" = 1'-0"



9 FUEL OIL PIPING DIAGRAM  
NTS



10 FUEL MAINTENANCE SYSTEM  
1/4" = 1'-0"

HGA  
7475 Hubbard Avenue, Suite 201  
Middleton, WI 53562  
Telephone 608.554.5333

**DANE COUNTY  
PUBLIC WORKS**  
1919 ALLIANT ENERGY  
CENTER WAY  
MADISON, WI 53713

**DANE COUNTY  
GENERATOR  
REPLACEMENT  
PROJECT**  
CITY-COUNTY BUILDING  
210 MARTIN LUTHER  
KING JR BLVD  
MADISON, WI 53703

NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET

HGA NO: 2407-004-00

**MECHANICAL  
DETAILS AND  
SECTIONS**

DATE: January 18, 2022

BID DOCUMENTS

**M700**

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SYMBOL EXPLANATION table with 2 columns: Symbol, Description. Includes symbols for luminaire type, receptacles, circuit designations, and equipment identification.

FEEDER SCHEDULE table with columns: TAG, SETS, QTY, SIZE, GND, CONDUIT. Lists feeders for ALUMINUM and COPPER.

TRANSFER SWITCH SCHEDULE table with columns: PRIORITY, EQUIPMENT NAME, LOCATION, MAINS RATING, SCCR, TYPE, ATS CLEARANCE, MOUNTING, POLE, TRANSITION SWITCHING, BYPASS ISOLATION, EXISTING OR NEW, NOTES. Includes transfer switch schedule notes.

ELECTRICAL SYMBOLS table with columns: SYMBOL, DESCRIPTION, NOMINAL MOUNTING HEIGHT. Lists symbols for lighting, power distribution, communication, and fire alarm.

ABBREVIATIONS table with columns: Abbreviation, Full Name. Lists abbreviations for electrical components like AMP, AC, ACS, AFF, AIC, AL, etc.

GENERAL NOTES table with columns: Note Number, Description. Contains detailed instructions for installation, safety, and coordination.

ELECTRICAL SHEET INDEX table with columns: SYMBOL, DESCRIPTION, NOMINAL MOUNTING HEIGHT. Lists symbols for fire alarm, power, and miscellaneous devices.

NO DESCRIPTION DATE table for tracking changes and dates.

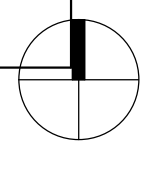
ISSUANCE HISTORY - THIS SHEET

HGA NO: 2407-004-00  
ELECTRICAL  
GENERAL  
NOTES AND  
SYMBOLS

DATE: January 18, 2022

BID DOCUMENTS

E000





NO	DESCRIPTION	DATE

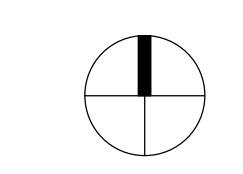
ISSUANCE HISTORY - THIS SHEET  
HGA NO: 2407-004-00

**ONE-LINE  
DIAGRAM  
COURTHOUSE**

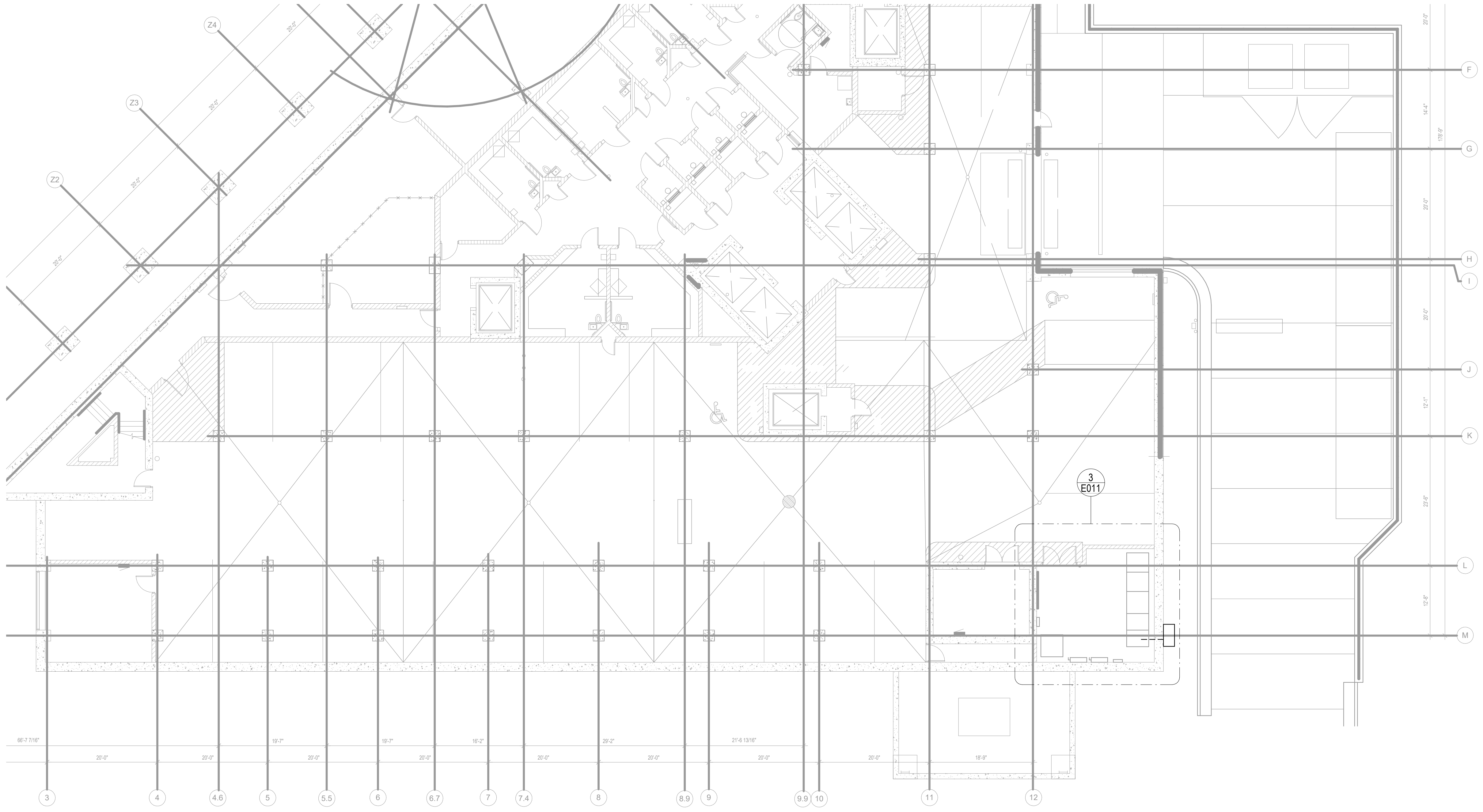
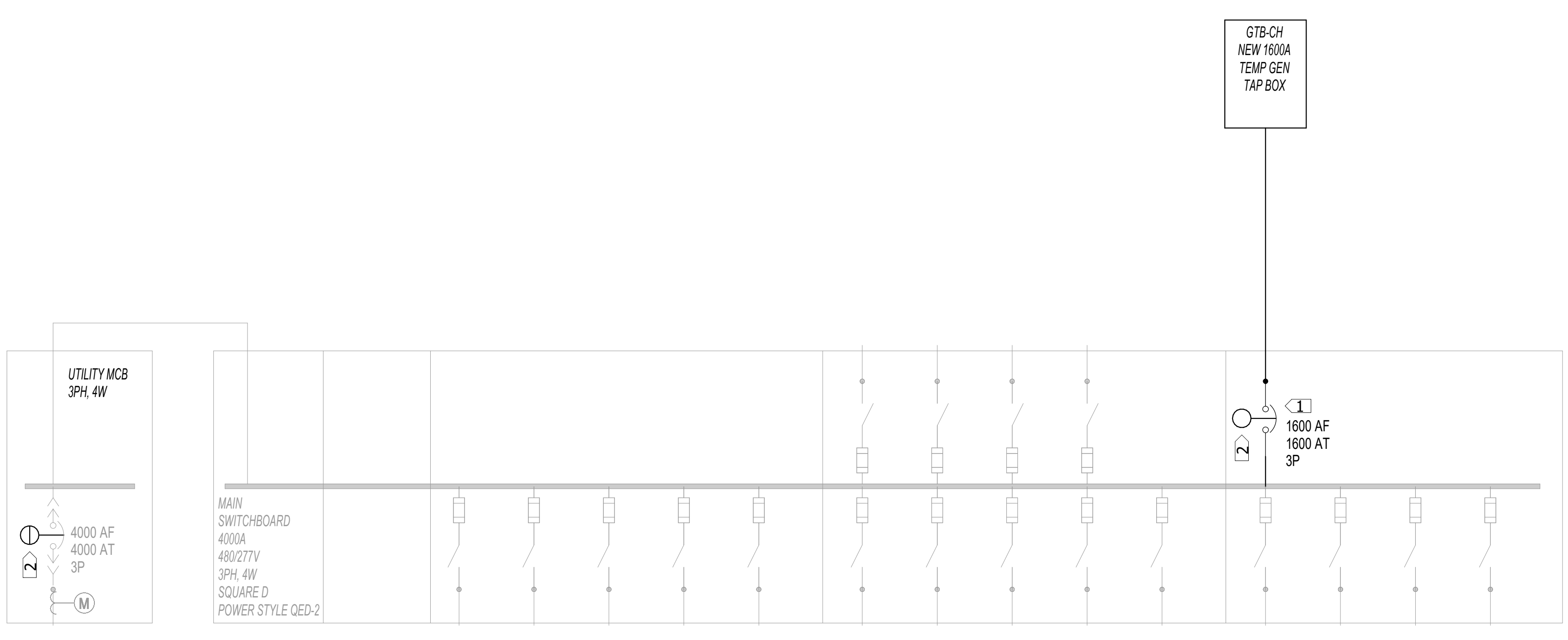
DATE: January 18, 2022

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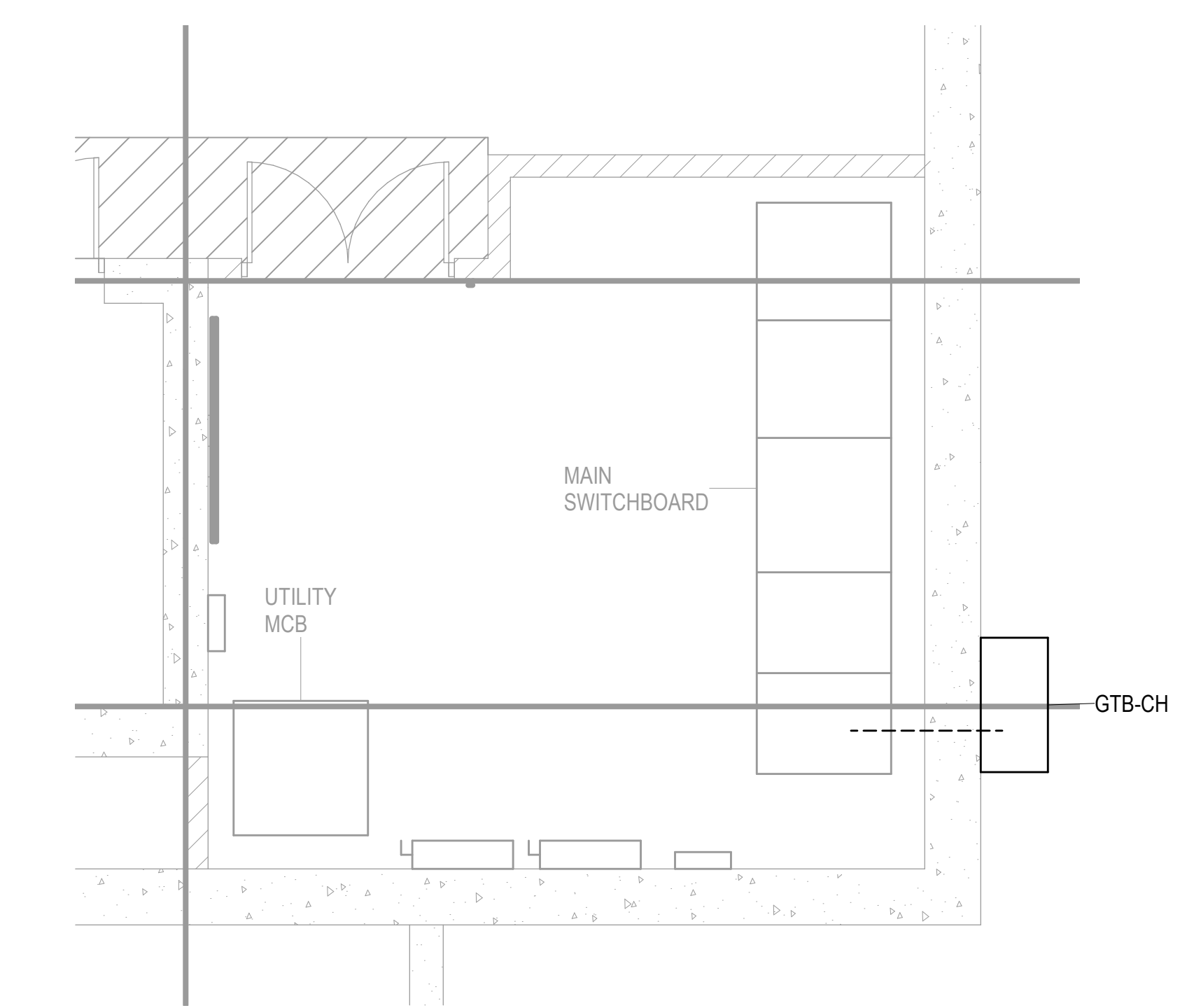
**E011**



- KEYNOTES:**
1. PROVIDE AND INSTALL ALL NECESSARY EQUIPMENT TO INSTALL THIS BREAKER IN THE EXISTING SQUARE D POWER STYLE QED-2 SWITCHBOARD INCLUDING NEW COVER PLATES.
  2. PROVIDE AND INSTALL KIRK KEY INTERLOCK THAT WILL ONLY ALLOW THE TAP BOX CIRCUIT BREAKER TO CLOSE WHEN THE UTILITY MCB IS OPEN.



**2 POWER PLAN - COURT HOUSE**  
3/32" = 1'-0"



**3 POWER PLAN - COURT HOUSE - MAIN ELECTRICAL ROOM**  
1/4" = 1'-0"

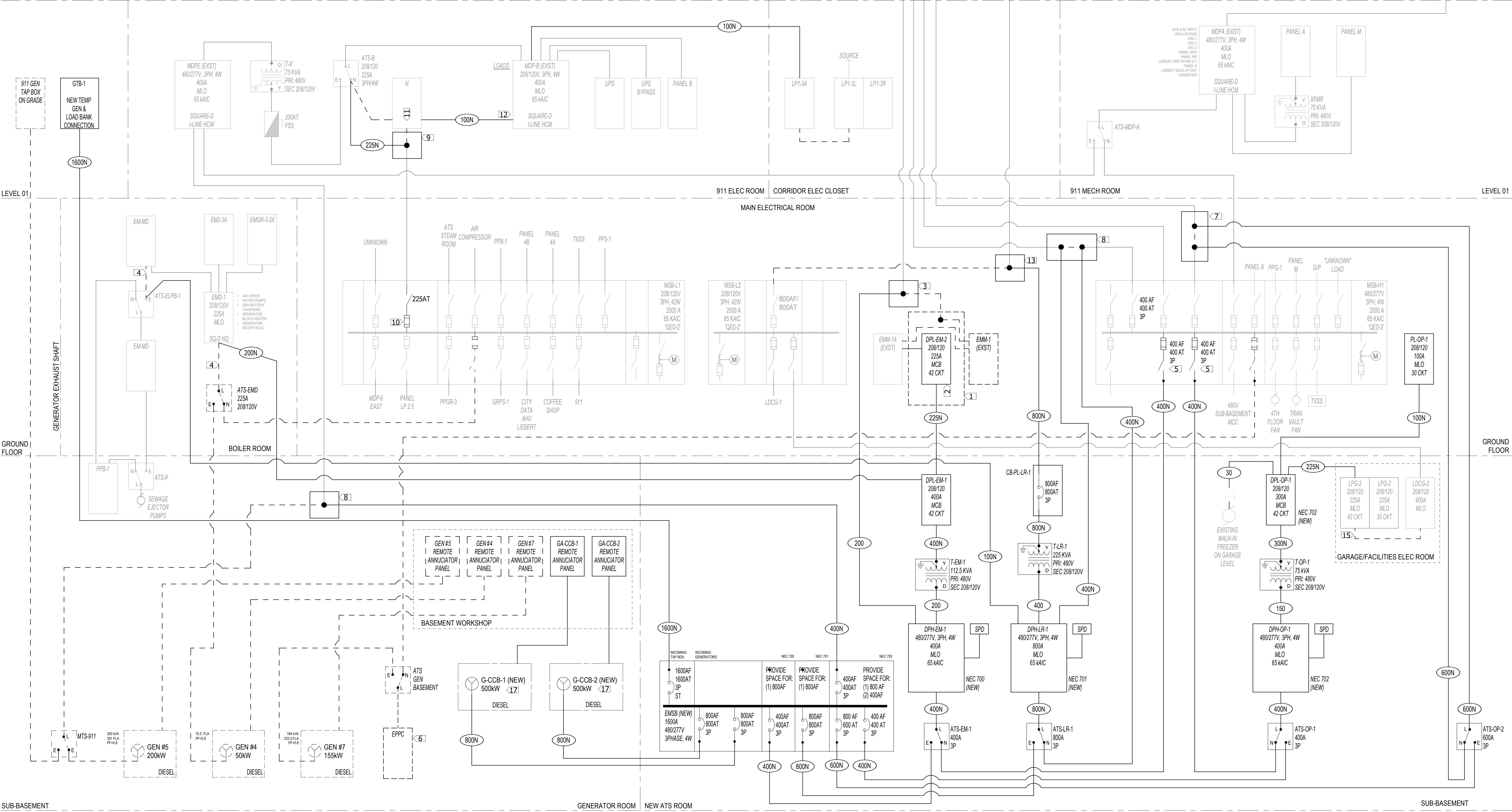
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Author

**KEYNOTES:**

1. ABANDONED DISTRIBUTION PANEL LABELED EMM-1, WHICH IS CURRENTLY SERVING AS A JUNCTION BOX SHALL BE REMOVED TO ALLOW THE NEW PANEL DPL-EM-2 TO BE INSTALLED IN ITS PLACE. ANY CIRCUITS THAT CURRENTLY PASS THROUGH THIS BOX WITHOUT GOING TO PANEL EMM-1 OR EMM-1A SHALL BE REROUTED AROUND THE NEW PANEL.
2. ALL EXISTING CIRCUITS THAT ARE CURRENTLY SERVED FROM PANELS EMM-1 AND EMM-1A SHALL BE REFEED FROM THE NEW PANEL DPL-EM-2.
3. PROVIDE AND INSTALL A JUNCTION BOX TO CAPTURE AND EXTEND THE EXISTING 200A VERTICAL FEEDER AS SHOWN.
4. DISCONNECT EXISTING WIRE FROM EQUIPMENT.
5. UTILIZE EXISTING SPARE FUSED SWITCH. PROVIDE A NEW FUSE AS INDICATED.
6. REFEED EXISTING TO REMAIN BRANCH CIRCUITS FROM NEW PANEL DPL-OP-1.
7. PROVIDE AND INSTALL A JUNCTION BOX TO CAPTURE AND EXTEND THE EXISTING 600A VERTICAL FEEDER AS SHOWN.
8. PROVIDE AND INSTALL A JUNCTION BOX TO CAPTURE AND EXTEND THE EXISTING 400A VERTICAL FEEDER AS SHOWN.
9. DISCONNECT AND REMOVE THE EXISTING NORMAL FEEDER FROM PANEL N TO ATS-B. DISCONNECT THE EXISTING PANEL N FEEDER AND EXTEND TO ATS-B NORMAL SOURCE CONNECTION POINT.
10. REPLACE THE EXISTING 400A FUSES WITH 225A FUSES.
11. REMOVE EXISTING 225A CIRCUIT BREAKER THAT CURRENTLY SERVES ATS-B.
12. PROVIDE AND INSTALL (2) 100A CIRCUIT BREAKERS IN PANEL MDP-B TO SERVE PANEL N AND PANEL LP1-3A.
13. PROVIDE AND INSTALL A JUNCTION BOX TO CAPTURE AND EXTEND THE EXISTING 800A VERTICAL FEEDER AS SHOWN.
14. EC TO HAVE THE OWNER'S ELEVATOR VENDOR REPROGRAM EXISTING ELEVATOR CONTROLS SO THAT DURING POWER OUTAGES, WHEN RUNNING ON GENERATOR POWER, ELEVATORS 4, 5 AND 7 CONTINUE TO OPERATE WHILE ELEVATORS 1, 2, 3, 6 AND 8 ARE PROGRAMMED FOR CONTROLLED DESCENT AND LOCKOUT.
15. DISCONNECT AND REMOVE EXISTING NORMAL POWER FEEDER TO THIS PANEL.
16. THIS EXISTING EQUIPMENT HAS NO EQUIPMENT LABEL. PROVIDE AND INSTALL A LABEL WITH THE NAME AS SHOWN ON THE ONE LINE DIAGRAM.
17. GENERATORS SHALL INCLUDE ONBOARD PARALLELLING.

WEST PENTHOUSE  
 LEVEL 07  
 LEVEL 06  
 LEVEL 05  
 LEVEL 04  
 LEVEL 03  
 LEVEL 02

EAST PENTHOUSE  
 LEVEL 07  
 LEVEL 06  
 LEVEL 05  
 LEVEL 04  
 LEVEL 03  
 LEVEL 02



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**DANE COUNTY PUBLIC WORKS**  
 1919 ALLIANT ENERGY CENTER WAY  
 MADISON, WI 53713



**DANE COUNTY GENERATOR REPLACEMENT PROJECT**  
 CITY-COUNTY BUILDING  
 210 MARTIN LUTHER KING JR BLVD  
 MADISON, WI 53703

NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET

HGA NO: 2407-004-00

**ONE-LINE DIAGRAM - CCB**

DATE: January 18, 2022

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**E012**



1 DEMOLITION PLAN - SUB-BASEMENT  
 1/4" = 1'-0"

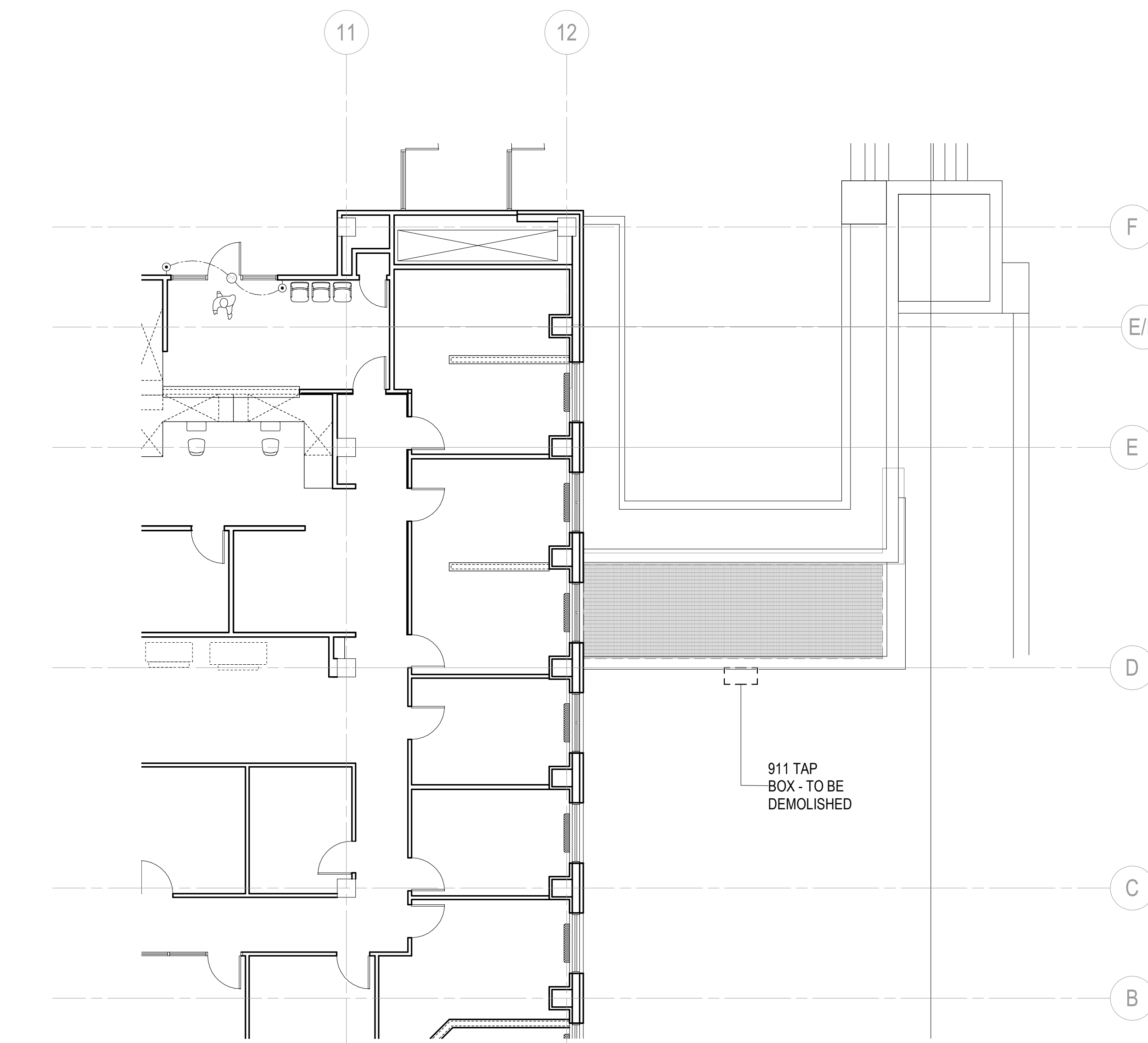
GENERAL NOTES

- EXISTING EQUIPMENT, DEVICES, AND LIGHTS INDICATED ON PLAN WERE TAKEN FROM EXISTING PLANS AND/OR FIELD OBSERVATION, AND SHALL NOT BE CONSIDERED COMPLETELY ACCURATE. THE ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFYING LOCATIONS OF EXISTING SYSTEMS PRIOR TO CONSTRUCTION AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES WHICH MAY AFFECT ANY WORK UNDER THIS CONTRACT.
- CONTRACTOR SHALL FIELD VERIFY EXACT CONDITIONS PRIOR TO ANY DEMOLITION. ELECTRICAL CONTRACTOR SHALL MAINTAIN CONTINUITY OF ADJACENT CIRCUITS TO DEVICES OR EQUIPMENT THAT ARE TO REMAIN DURING CONSTRUCTION. REROUTE CONDUIT AND WIRING AS NECESSARY.
- ELECTRICAL DEVICES AND EQUIPMENT SHOWN AS DASHED ARE TO BE DEMOLISHED AND IT IS THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR TO DISPOSE OF UNLESS NOTED OTHERWISE. ELECTRICAL DEVICES/EQUIPMENT SHOWN WITH LIGHT SOLID LINE TYPE ARE EXISTING TO REMAIN. ANY ITEMS TO BE TURNED OVER TO FACILITIES MANAGEMENT WILL BE NOTED.

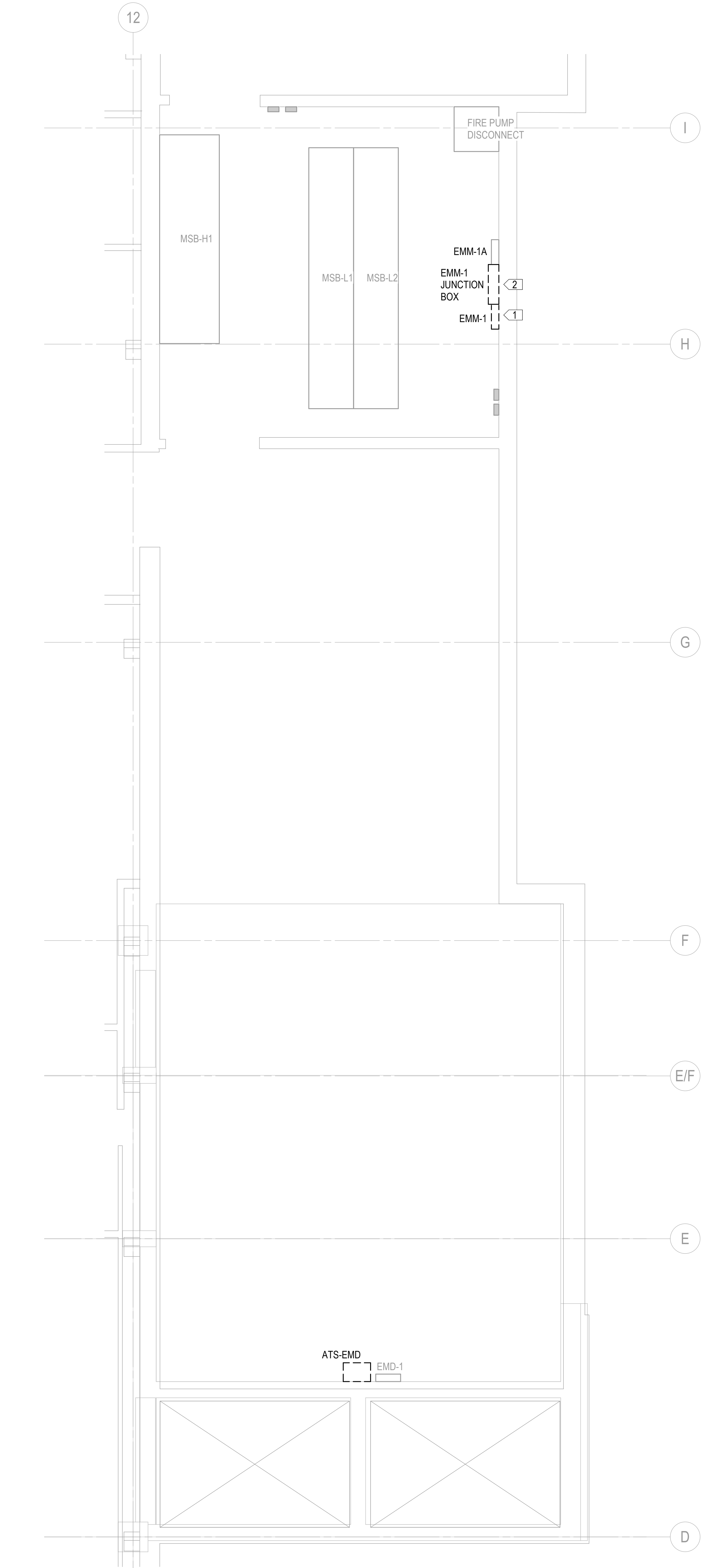
KEYNOTES - E100

- REFEED EXISTING CIRCUITS TO NEW PANEL DPL-EM-2.
- EXISTING DISTRIBUTION PANEL ENCLOSURE CURRENTLY SERVES AS A JUNCTION BOX AND SHALL BE DEMOLISHED. REROUTE ALL PASS THROUGH FEEDERS OUTSIDE OF THE NEW PANEL.

3 DEMOLITION PLAN - LEVEL 01  
 1/8" = 1'-0"



2 DEMOLITION PLAN - GROUND LEVEL - MAIN ELECTRICAL ROOM & BOILER ROOM  
 1/4" = 1'-0"



NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET

HGA NO: 2407-004-00

**DEMOLITION  
 PLAN**

DATE: January 18, 2022

BID DOCUMENTS

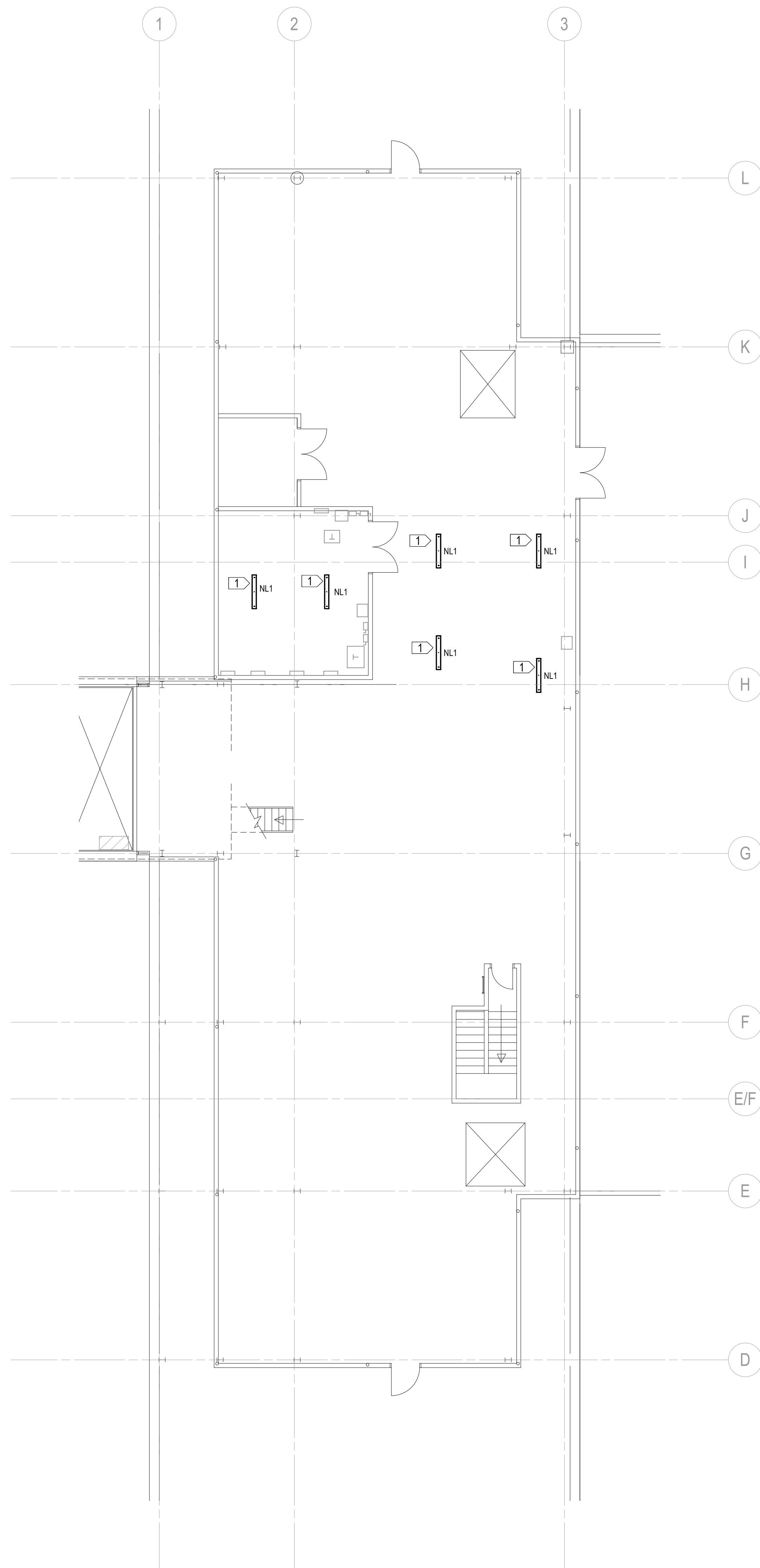
**E100**







- KEYNOTES - E208**
- 1 REPLACE EXISTING LIGHT FIXTURE WITH THE NEW FIXTURE "NL1".  
REUSE THE EXISTING WIRING, CIRCUITS, AND CONTROLS FROM THE  
PREVIOUS FIXTURE FOR THE NEW FIXTURE.



**1 LIGHTING PLAN - WEST PENTHOUSE**  
1/8" = 1'-0"

NO	DESCRIPTION	DATE

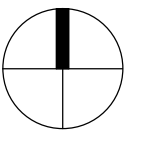
ISSUANCE HISTORY - THIS SHEET  
HGA NO: 2407-004-00

**LIGHTING PLAN -  
PENTHOUSE**

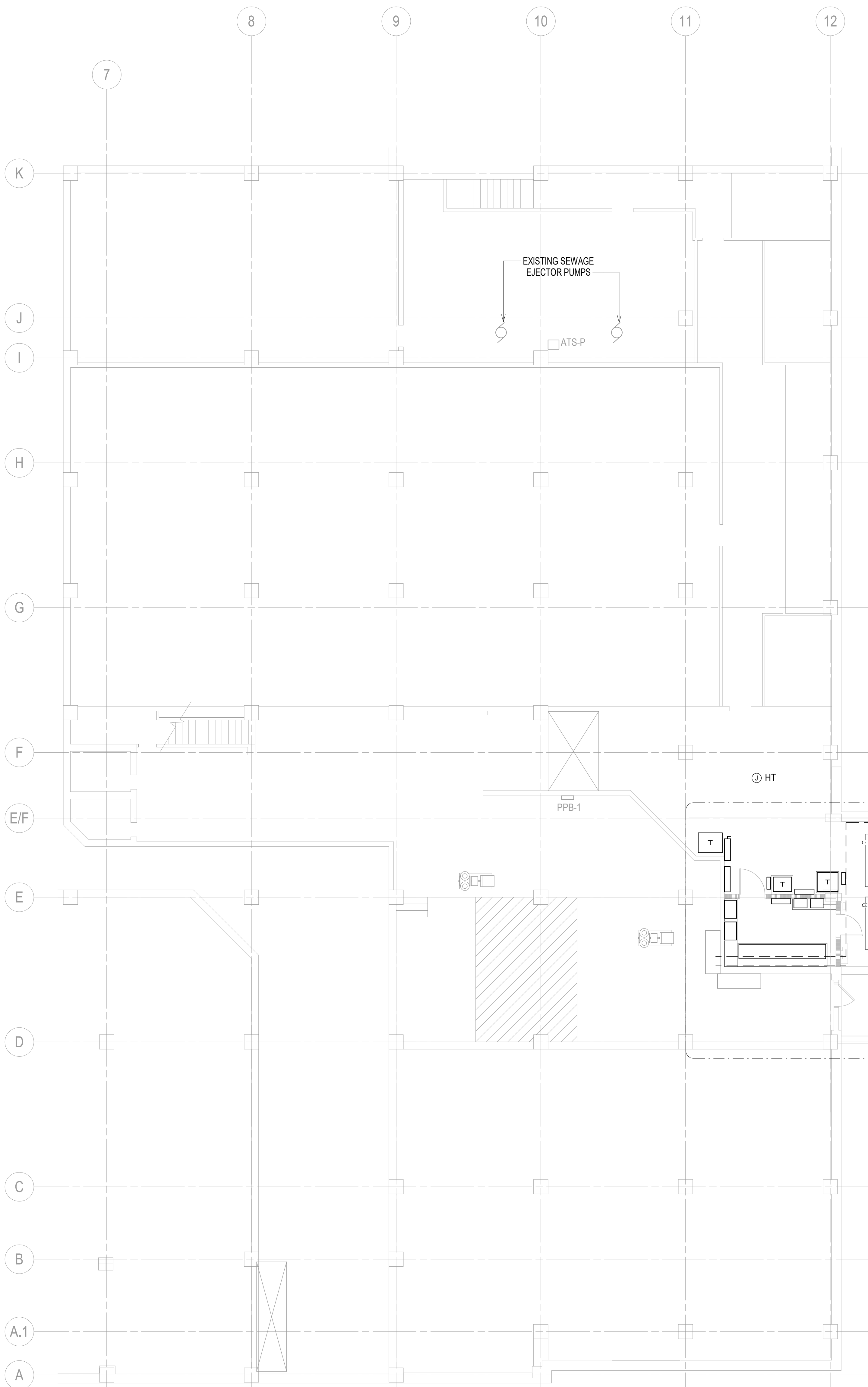
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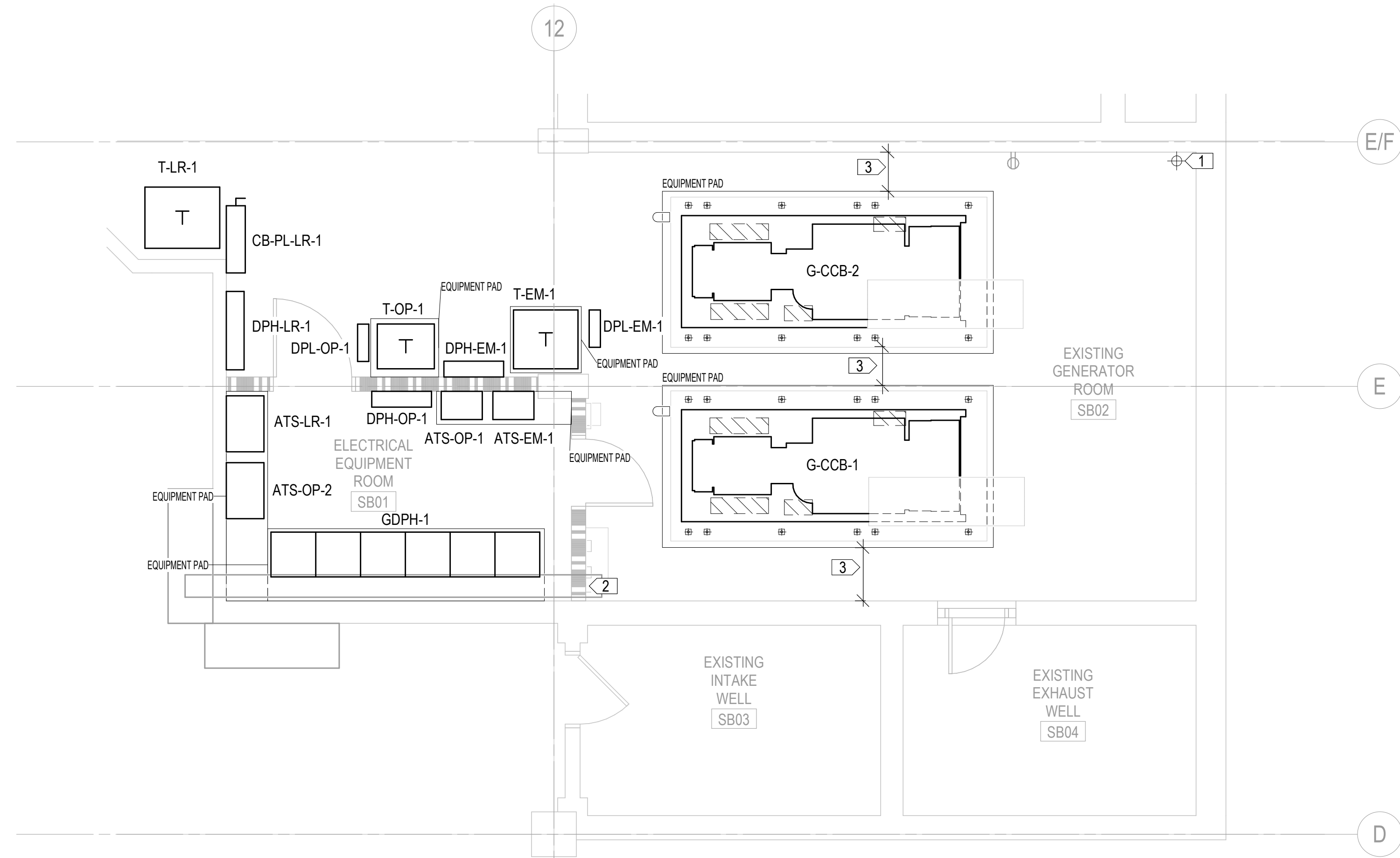
**E208**



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1 POWER PLAN - SUB-BASEMENT  
1/8" = 1'-0"



2 POWER PLAN - SUB-BASEMENT - CALLOUT  
1/4" = 1'-0"

TYPE	DESCRIPTION	VOLTAGE	POLES	MOCP	APPARANT LOAD	Panel	Circuit Number	FEEDER SIZE			DISCONNECT FURNISHED	DISCONNECT SIZE	NOTES
								SETS	QTY	SIZE			
HT	HEAT TRACE FOR SPRINKLER PIPING	208 V	2	20	800 VA	DPL-OP-1	19,21	1	2	#12 #12 3/4"	WEQUIP	N/A	

KEYNOTES - E300B

- 1 ABANDONED 4" MINIMUM CONDUIT THAT CONNECTS THE GENERATOR ROOM TO THE BOILER ROOM ABOVE. REUSE AS NEEDED FOR NEW CONSTRUCTION.
- 2 EXISTING BUS DUCT PASSING THROUGH ELECTRICAL ROOM TO MCCB IN CHILLER ROOM TO REMAIN.
- 3 PROVIDE AND MAINTAIN A MINIMUM OF 3 FEET OF WORKING CLEARANCE.

NO DESCRIPTION DATE

ISSUANCE HISTORY - THIS SHEET

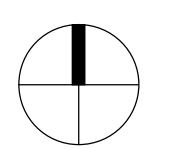
HGA NO: 2407-004-00

POWER PLAN -  
SUB-BASEMENT

DATE: January 18, 2022

BID DOCUMENTS

E300B



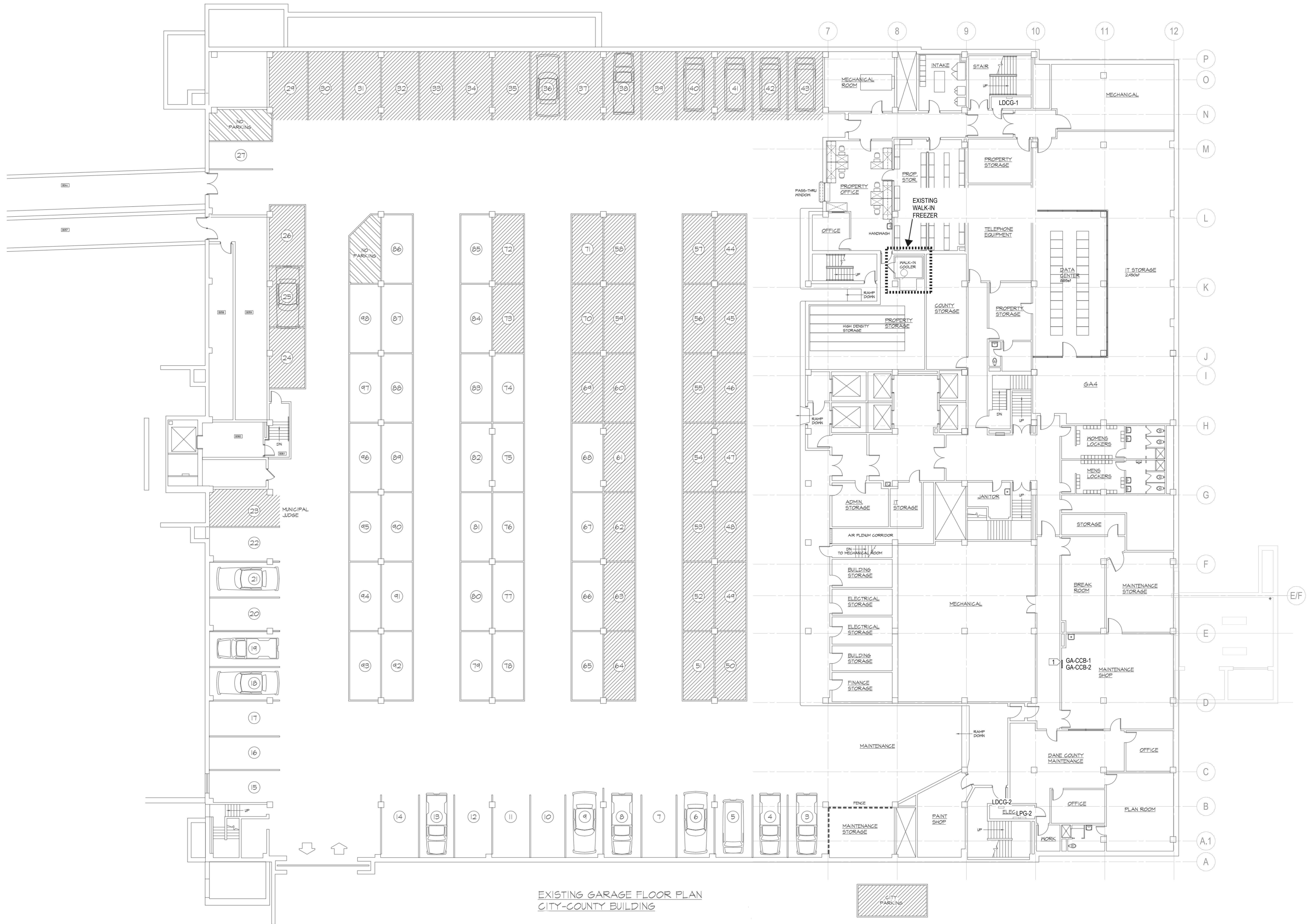


### DANE COUNTY GENERATOR REPLACEMENT PROJECT

CITY-COUNTY BUILDING  
210 MARTIN LUTHER  
KING JR BLVD  
MADISON, WI 53703

**KEYNOTES - E300B.1**

- 1 INSTALL NEW GENERATOR ANNUNCIATOR PANELS INTERFACED WITH THE NEW GENERATORS 1 & 2. COORDINATE FINAL PANEL LOCATION WITH BUILDING FACILITIES. DEMOLISH GENERATOR ANNUNCIATOR PANELS IN THE SPACE ASSOCIATED WITH THE DEMOLISHED GENERATORS.



EXISTING GARAGE FLOOR PLAN  
CITY-COUNTY BUILDING



NO	DESCRIPTION	DATE
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NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET

HGA NO: 2407-004-00

### POWER PLAN - BASEMENT

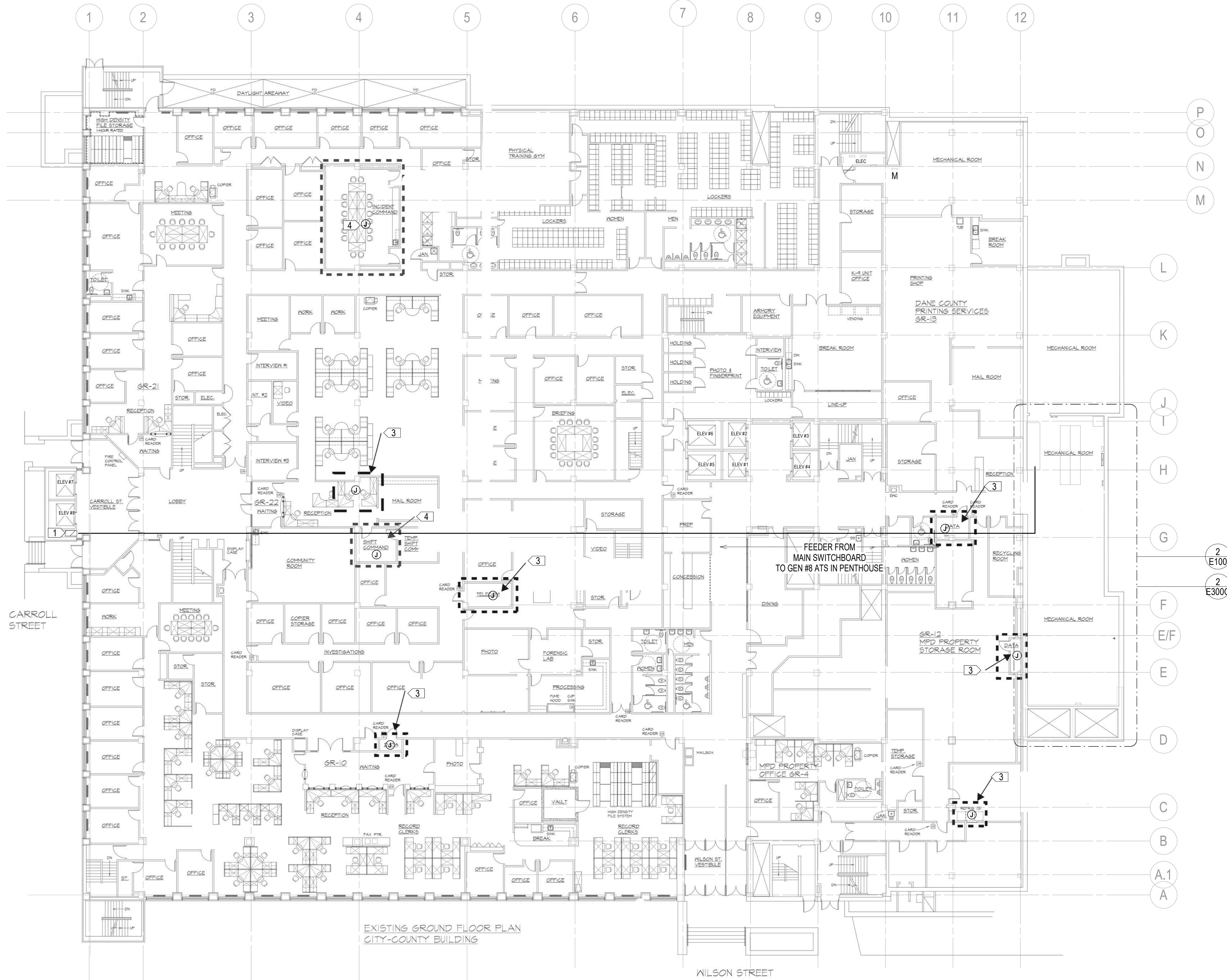
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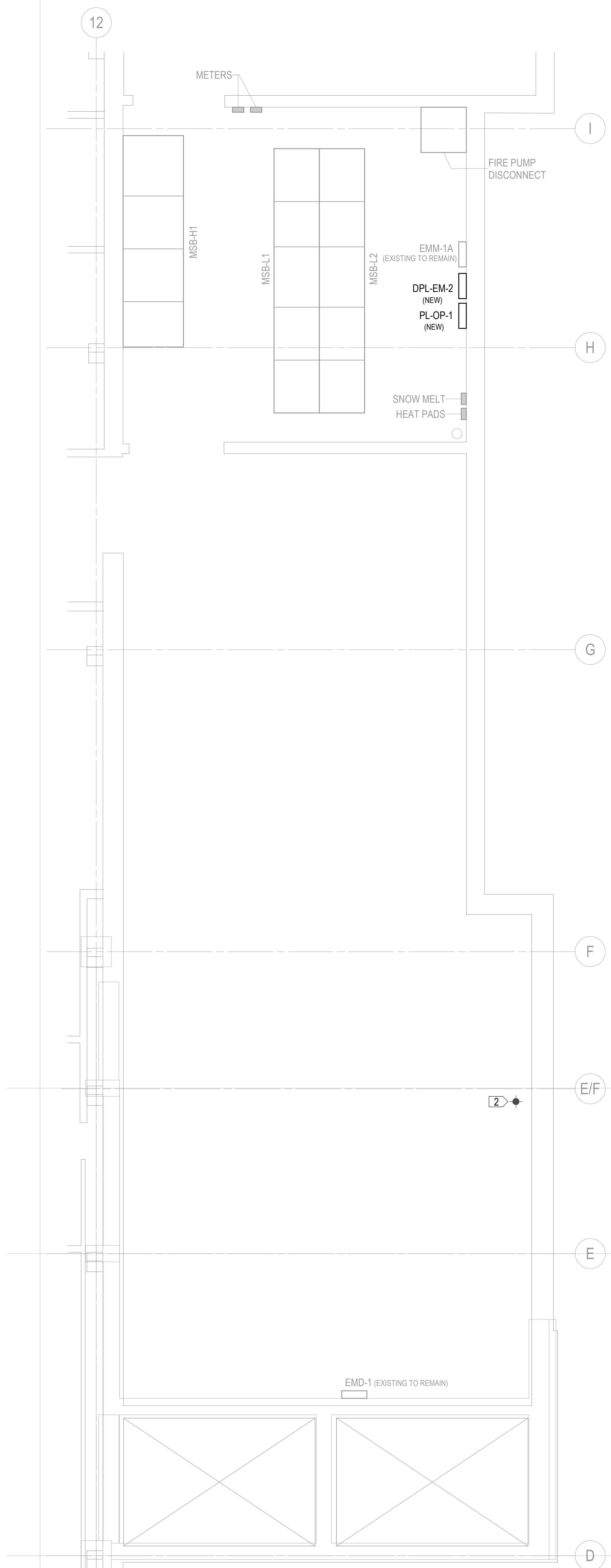
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**KEYNOTES - E300G**

- 1 EXISTING RISER SHAFT CONTAINING DP1 FEEDER AND GEN #8 ATS NORMAL SOURCE FEED TO PENTHOUSE.
- 2 ABANDONED 4" MINIMUM CONDUIT THAT CONNECTS THE GENERATOR ROOM TO THE BOILER ROOM ABOVE. REUSE AS NEEDED FOR NEW CONSTRUCTION.
- 3 CAPTURE AND EXTEND (3) 20A, 1 POLE RACK RECEPTACLE CIRCUITS FROM THIS ROOM TO NEW CIRCUIT BREAKERS IN PANEL PL-OP-1. IF THIS ROOM HAS FEWER THAN (3) RACK RECEPTACLE CIRCUITS TERMINATE EXTRA CIRCUITS IN A JUNCTION BOX IN THIS ROOM FOR FUTURE USE.
- 4 CAPTURE AND EXTEND (1) 20A, 1 POLE LIGHTING CIRCUIT AND (2) 20A, 1 POLE RECEPTACLE CIRCUITS FROM THIS ROOM TO NEW CIRCUIT BREAKERS IN PANEL PL-OP-1



**1 POWER PLAN - GROUND LEVEL**  
1/16" = 1'-0"



**2 POWER PLAN - GROUND LEVEL - BOILER AND ELECTRICAL ROOMS**  
1/4" = 1'-0"

**HGA**

7475 Hubbard Avenue, Suite 201  
Middleton, WI 53562  
Telephone 608.554.5333

**DANE COUNTY  
PUBLIC WORKS**  
1919 ALLIANT ENERGY  
CENTER WAY  
MADISON, WI 53713



**DANE COUNTY  
GENERATOR  
REPLACEMENT  
PROJECT**  
CITY-COUNTY BUILDING  
210 MARTIN LUTHER  
KING JR BLVD  
MADISON, WI 53703

NO	DESCRIPTION	DATE

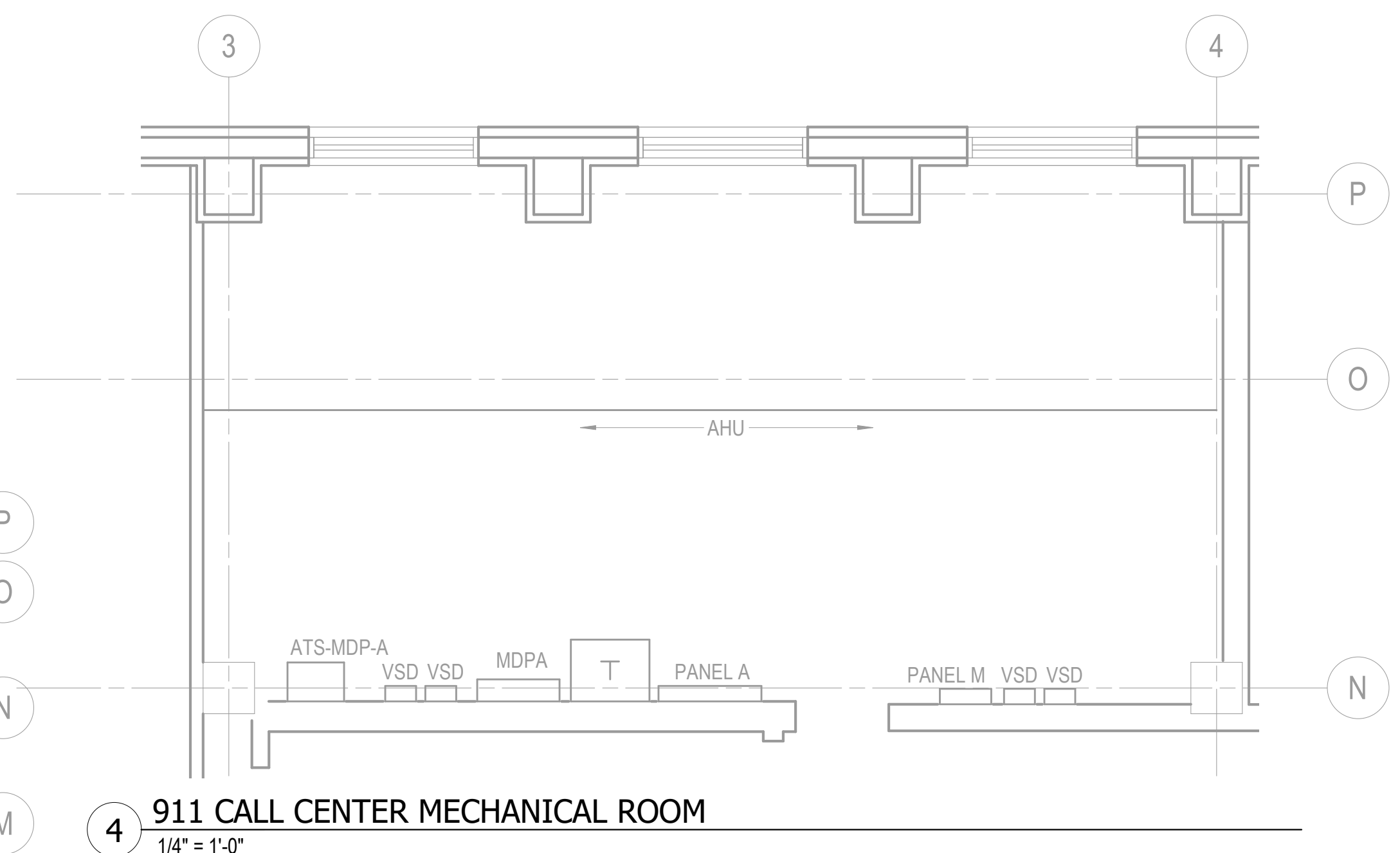
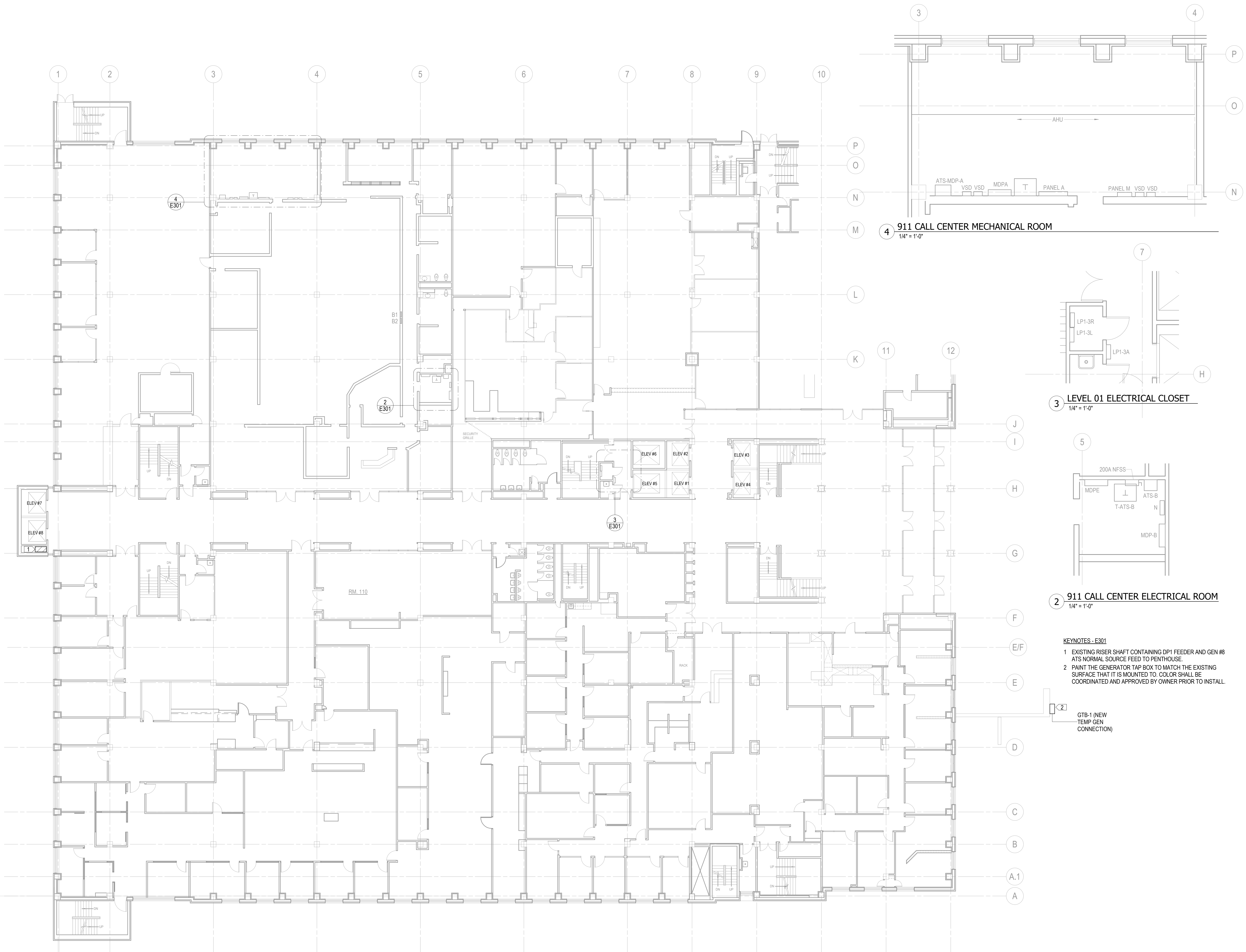
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**POWER PLAN -  
GROUND LEVEL**

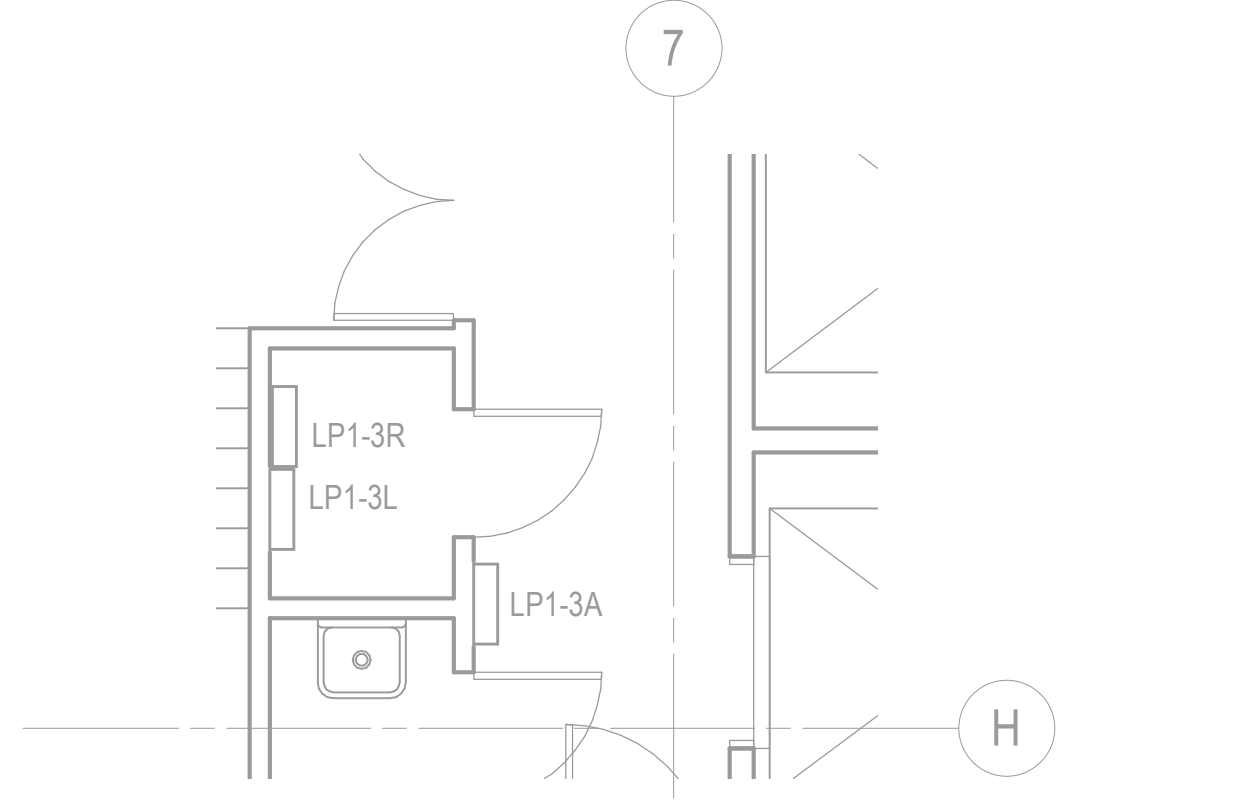
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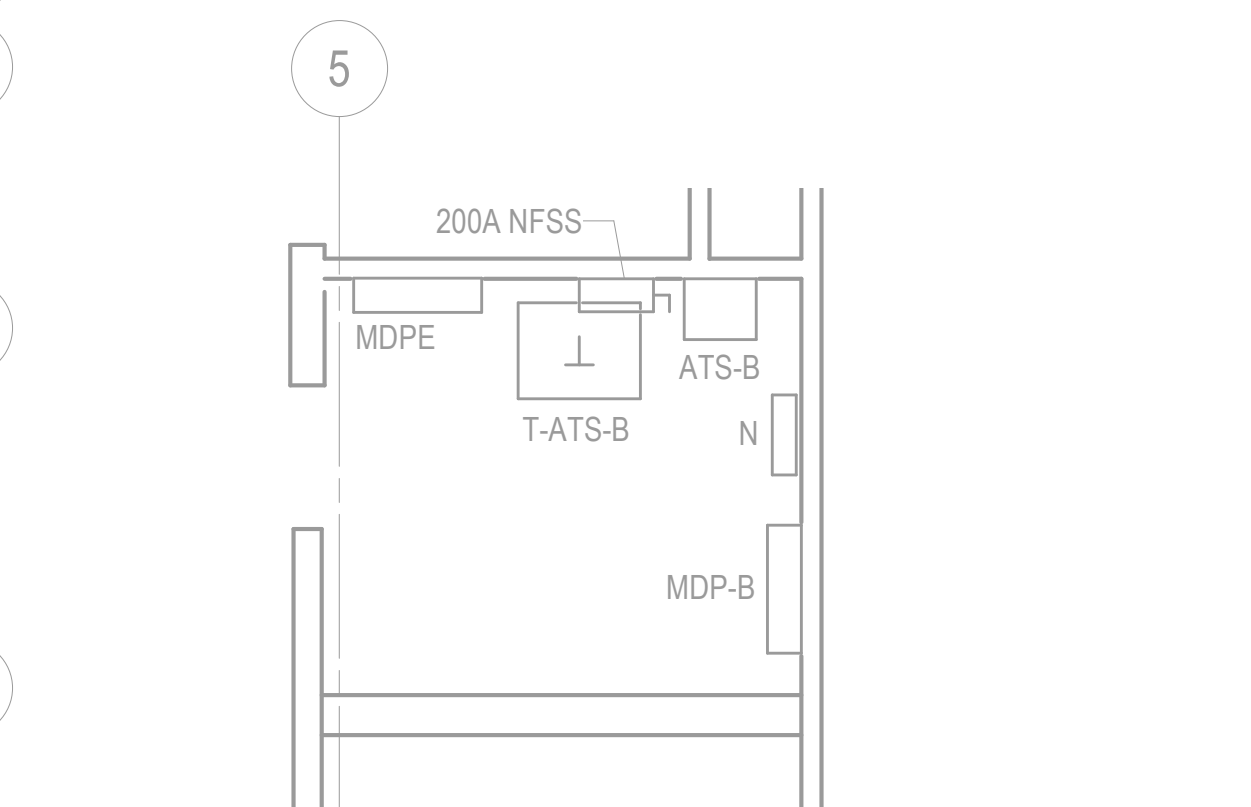
**E300G**



**4 911 CALL CENTER MECHANICAL ROOM**  
1/4" = 1'-0"



**3 LEVEL 01 ELECTRICAL CLOSET**  
1/4" = 1'-0"



**2 911 CALL CENTER ELECTRICAL ROOM**  
1/4" = 1'-0"

**KEYNOTES - E301**  
1 EXISTING RISER SHAFT CONTAINING DP1 FEEDER AND GEN #8  
ATS NORMAL SOURCE FEED TO PENTHOUSE.  
2 PAINT THE GENERATOR TAP BOX TO MATCH THE EXISTING  
SURFACE THAT IT IS MOUNTED TO. COLOR SHALL BE  
COORDINATED AND APPROVED BY OWNER PRIOR TO INSTALL.

GTB-1 (NEW  
TEMP GEN  
CONNECTION)

NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET  
HGA NO: 2407-004-00

**POWER PLAN -  
LEVEL 01**

DATE: January 18, 2022

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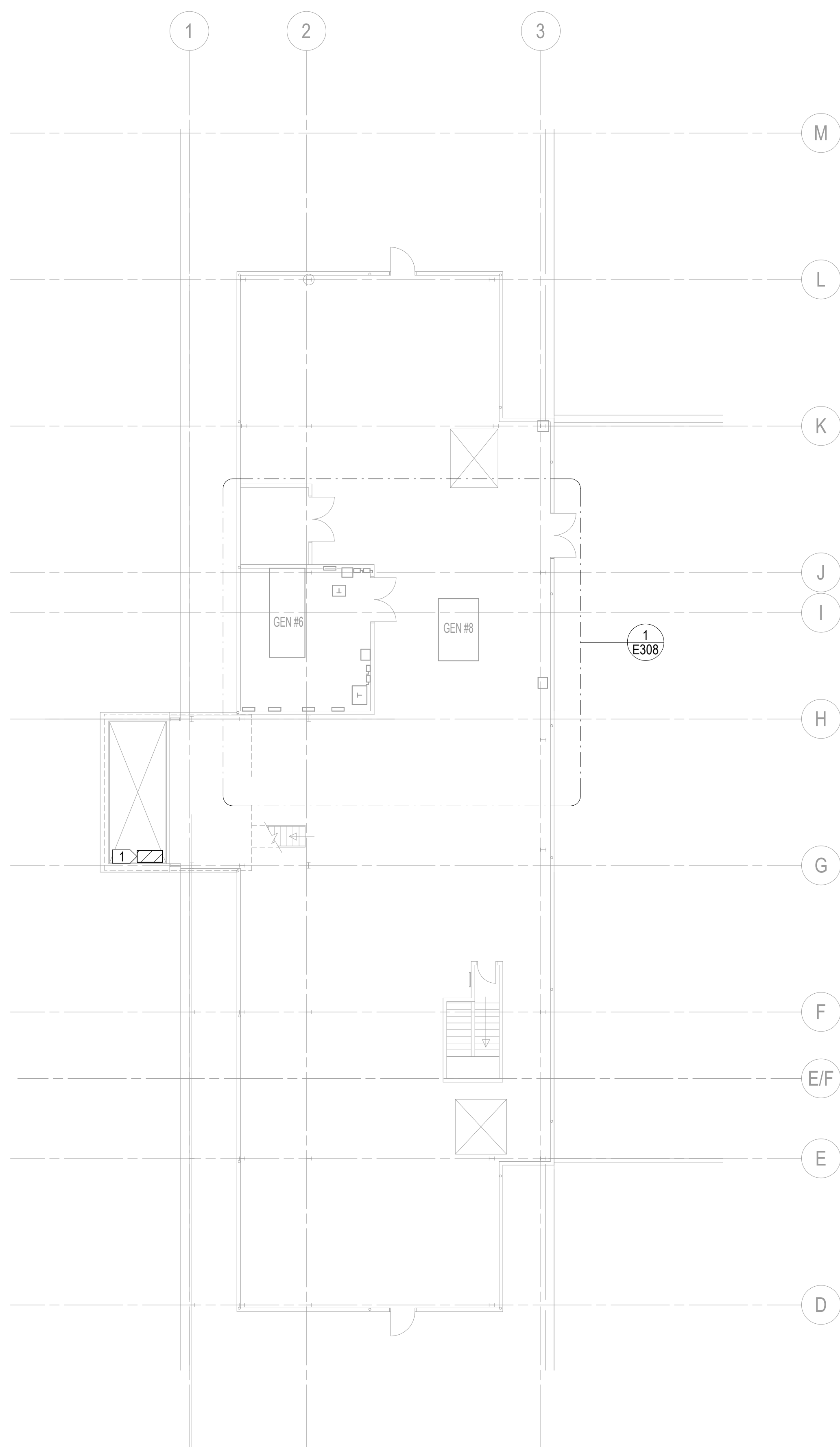
**E301**



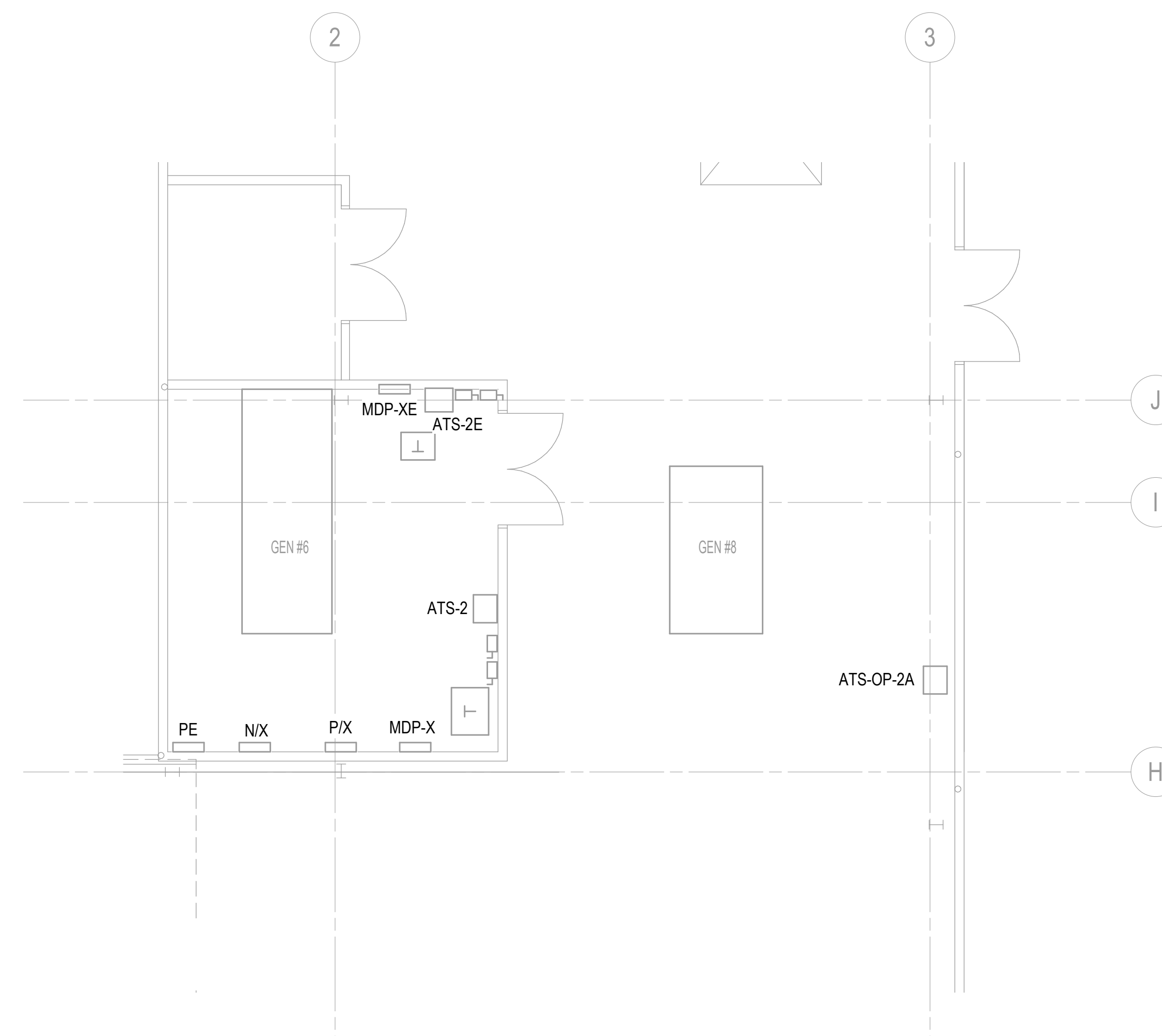


### KEYNOTES - E308

- 1 EXISTING RISER SHAFT CONTAINING DP1 FEEDER AND GEN #8 ATS  
NORMAL SOURCE FEED TO PENTHOUSE.



**2** POWER PLAN - WEST PENTHOUSE  
3/32" = 1'-0"



**1** POWER PLAN - WEST PENTHOUSE - CALLOUT  
3/16" = 1'-0"



**3** POWER PLAN - EAST PENTHOUSE  
3/32" = 1'-0"

NO	DESCRIPTION	DATE

ISSUANCE HISTORY - THIS SHEET  
HGA NO: 2407-004-00

**POWER PLAN -  
PENTHOUSE**

DATE: January 18, 2022

BID DOCUMENTS

# E308





DPH-OP-1 Location: BASEMENT Distribution System: 480/277V A.I.C Rating: 42,000 Mains Type: MCB Mains Rating: 400 A MCB Rating: N/A

Panel: DPL-EM-1 Location: BASEMENT Distribution System: 208/120V A.I.C Rating: 22,000 Mains Type: MCB Mains Rating: 400 A MCB Rating: 400 A

Panel: DPL-EM-2 Location: GROUND LEVEL MECH Distribution System: 208/120V A.I.C Rating: 22,000 Mains Type: MCB Mains Rating: 225 A MCB Rating: 225 A

Panel: DPL-OP-1 Location: BASEMENT Distribution System: 208/120V A.I.C Rating: 10,000 Mains Type: MCB Mains Rating: 400 A MCB Rating: 300 A

DPH-LR-1 Location: BASEMENT Distribution System: 480/277V A.I.C Rating: 42,000 Mains Type: MLO Mains Rating: 400 A MCB Rating: N/A

Panel: PL-OP-1 Location: MECHANICAL ROOM Distribution System: 208/120V A.I.C Rating: 10,000 Mains Type: MCB Mains Rating: 100 A MCB Rating: 100 A

DPH-EM-1 Location: BASEMENT Distribution System: 480/277V A.I.C Rating: 42,000 Mains Type: MLO Mains Rating: 400 A MCB Rating: N/A

LUMINAIRE SCHEDULE table with columns: TYPE, DESCRIPTION, MOUNTING, LENS/REFLECTOR, LAMP/LUMENS, BALLAST/POWER SUPPLY, WATTS, VOLTAGE, MANUFACTURER, CATALOG NUMBER, EQUAL MANUFACTURERS, NOTES, REVISION HISTORY

GENERAL NOTES:  
A. REFER TO DIVISION 26 SPECIFICATIONS FOR ADDITIONAL INFORMATION BEFORE ORDERING.  
B. ALL LED LUMINAIRES MUST COMPLY WITH LM-79 AND LM-80 TESTING STANDARDS. L70 LIFE SHALL HAVE A MINIMUM OF 50,000 HOURS.  
C. ANY PROPOSED SUBSTITUTIONS MUST BE SUBMITTED WITH PHOTOMETRIC CALCULATIONS AND CATALOG SHEETS WITH DATA TO PROVE EQUAL CHARACTERISTICS. PROVIDE PHYSICAL SAMPLES OF PROPOSED SUBSTITUTIONS UPON REQUEST.

NOTES:  
1. COORDINATE MOUNTING AND LOCATION WITH EQUIPMENT IN ROOM.  
2. TIE LIGHTING FIXTURES INTO EXISTING LIGHTING CIRCUIT.

Table with 3 columns: NO, DESCRIPTION, DATE

ISSUANCE HISTORY - THIS SHEET

HGA NO: 2407-004-00

ELECTRICAL SCHEDULES

DATE: January 18, 2022

BID DOCUMENTS

E500

